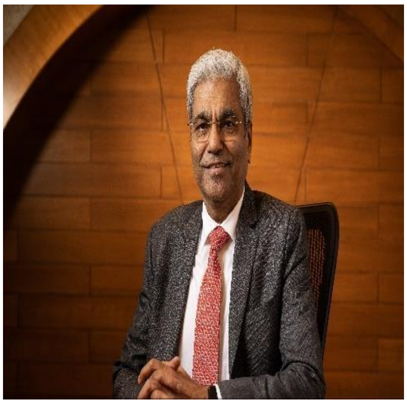
REVA UNIVERSITY
Bengaluru, India

SCHOOL OF APPLIED SCIENCES

B.Sc. – BIOTECHNOLOGY, BIOCHEMISTRY, GENETICS

HANDBOOK: 2025-26

Chancellor's Message



"Education is the most powerful weapon which you can use to change the world."

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. j

Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally, and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me, and I believe, it takes teamwork to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom, and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. Sanjay R Chitnis

Vice Chancellor, REVA University

Director Message

Biotechnology as interdisciplinary subject assimilates a number of disciplines and as such has grown rapidly. B.Sc. Biotechnology, Biochemistry, Genetics offered by REVA University aims to provide the required skills and knowledge necessary to pursue a successful career in Biotechnology, Genetics and Biochemistry. This program imparts need based, practical education in contemporary world to develop global competence among students. It strives to prepare students to become leaders in the field of Life Sciences in general and Biotechnology in particular by encouraging them to inculcate scientific thinking coupled with creative and innovative ideas.

The B.Sc. (BBG) degree program of REVA University is designed to prepare biotechnologist, biochemists, Microbiologist, genetics, scientists, teachers, professionals & administrators who are motivated, enthlasis & creative thinkers to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth. The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. Maximum number of courses are integrated with cross cutting issues, relevance to professional ethics, gender, human values, environment, and sustainability. The curriculum caters to and has relevance to local, national, regional, and global developmental needs.

By undergoing this program, you will develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge-based society.

This handbook provides you with an outline of regulations for master's degree, scheme of instruction, and detailed syllabus. I am sure the students choosing B.Sc. Biotechnology, Biochemistry and Genetics at REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teacher's involvement and guidance. We will strive to provide all the necessary comfort and congenial environment for their studies. I wish all students a pleasant stay at REVA and grand success in their career.

Prof. Shilpa BR
Director (I/C), SoAS

Contents

Sl. No.	Particulars	Page No.
1	Message from the Hon'ble Chancellor	1
2	Message from the Vice- Chancellor	2-3
3	Director's Message	4
4	Rukmini Educational Charitable Trust	6
5	About REVA University, Vision, Mission, Objectives	7-11
6	**About School of Applied Sciences** - Vision - Mission - BoS	12-15
7	**B.Sc. Biotechnology, Biochemistry, Genetics Program** - Program Overview - Program Educational Objectives - Program Outcomes - Program Specific Outcomes - Mapping of Course Outcomes with programme Outcomes - Mapping programme outcomes with Programme Educational - Objectives	16-43
8	Regulations Governing Applied Science Programme	……………….
9	Curriculum – B.Sc. Biotechnology, Biochemistry, Genetics	44-307
10	Career Development and Placement	308-309

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfil its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond Road Park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 15,000+ students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27th February, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempe Gowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and assisting students' placements.

REVA University recognizing the fact that research, development, and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology, and other areas of study. The interdisciplinary-multidisciplinary research is given the topmost priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries, and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and

Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor& Dean, and supported by well experienced Trainers, Counsellors, and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Oklahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitate students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration, and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing, and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists, and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K

Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class's every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

"To become a technologically advanced, sustainable global university dedicated to the wellbeing of all"

Mission

- Provide learner-centric education leveraged with cutting edge technologies.
- Foster stewardship by nurturing talent, leadership qualities, and entrepreneurial thinking in a safe and Secure environment.
- Promote liberal studies and foster the pursuit of performing arts, literature, sports, and other creative and intellectual disciplines.
- Promote a culture of collaboration and cooperation.
- Serve humanity and promote sustainability through higher education based on universal values.

Objectives

- Developing a sense of ethics in the University and community, making it conscious of its obligations to society and the nation.
- Performing all the functions of interest to its major constituents like faculty, staff, students, and the society to reach a leadership position.
- Smooth transition from teacher-centric focus to learner-centric processes and activities.
- To offer high-quality education in a competitive manner.
  Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines.

ABOUT THE SCHOOL OF APPLIED SCIENCES

The School of Applied Sciences offers graduate and post graduate programs in Biotechnology, Biochemistry, Chemistry, Physics and Mathematics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The School presently offers M.Sc. degree programs in Biochemistry, Biotechnology, Chemistry, Physics, Mathematics, Bioinformatics, Microbial Technology and B Sc with various combinations viz, Biotechnology, Biochemistry and Genetics, Bioinformatics, Statistics & Computer Science, Microbiology, Chemistry and Genetics. The school also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics, Microbiology and related areas of study.

The School of Applied Sciences is shouldered by well qualified, experienced, and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as models of innovative problems solving in the university environment to enrich their academic and professional careers.

Vision

To nurture intellect, creativity, character, professionalism, and research culture among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens with leadership qualities.

Mission

- To achieve excellence in studies and research through pedagogy and support interface between industry and academia
- To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure

- To establish state of the art laboratories to support research and innovation and promote mastery of science.
- To inculcate an ethical attitude and make students competitive to serve the society.

BoS Panel Members – 2025-26

Panel: Biotechnology and Genetics

Sl. No	Name, Designation &Affiliation	External/Internal member
1	**Prof. Shilpa B.R** Director (I/C) School of Applied Sciences Head of the Department - Biotechnology REVA University, Bengaluru, Karnataka, India.	Chairperson
2	**Dr. Pasupuleti Visweswara Rao** Associate Dean, School of Applied Sciences REVA University, Bengaluru, Karnataka, India.	Joint Chairperson
3	**Dr. Madhappa MB** Associate Professor Department of Biotechnology St. Joseph University Bangalore, Karnataka, India	External Academic Member Biotechnology Panel
4	**Dr. N G Raju** Professor and Chairman Department of Biotechnology Karnataka State Open University Mysore, Karnataka, India.	External Academic Member Genetics Panel
5	**Dr. Naveen Kumar M** Senior Research Scientist Natural Remedies Pvt. Ltd., Bangalore, Karnataka, India	External Industry Member
6	**Dr. Chaitali** Assistant Insectary Manager Tata Institute for Genetics and Society Bangalore, Karnataka, India	External Research Member
7	**Dr. Vijaya Shankar N** Senior Scientist, Aurigene, Bangalore, Karnataka India	External Industry Member

8	**Dr. Prabhakar Mishra** Associate Professor, Department of Biotechnology, School of Applied Sciences, REVA University, Bengaluru, Karnataka, India	Internal Member Biotechnology Panel

9	**Dr. Senthilkumar R** Associate Professor Department of Biotechnology School of Applied Sciences REVA University, Bengaluru, Karnataka, India	Internal Member `Biotechnology Panel
10	**Dr. Manjula. K.R** Professor Department of Biotechnology School of Applied Sciences REVA University, Bangalore, Karnataka, India	Internal Member Genetics Panel
11	**Dr. Ramya M** Associate Professor Department of Biotechnology School of Applied Sciences REVA University, Bengaluru, Karnataka, India	Internal Member Genetics Panel
12	**Dr.Kalicharan** Professor School of Legal Studies REVA University	Invited Member
12	**Dr. Nirmalya Ganguly** Scientist C National Institute of Animal Biotechnology Hyderabad, Telangana, India	Alumni Member
13	**Ms. Niroshini** 4th Semester B.Sc. BBG Department of Biotechnology, SoAS REVA University, Bengaluru	Current student

Panel Members: Biochemistry

Sl. No	Name, Designation &Affiliation	External/Internal member
1.	**Dr. Sikandar Mulla** Associate Professor & HOD (I/c) School of Allied Helath Sciences REVA University	Chairperson
2.	**Dr. Ananda Varthan H** Professor and Head Department of Life sciences Indian Academy Degree College, Bengaluru	External Member (Academic Expert)
3.	**Dr. K N Chdambara Murthy** Professor and Dean Neuberg Anand Academy of Lab Medicine Pvt. Ltd. Bengaluru	External Member (Industry Expert)
4	**Dr. Veer Raghvan** Professor, School of Allied Health Sciences REVA University, Bengaluru	Internal Member
5	**Dr. Vijay Kumar G** Associate Professor, School of Allied Health Sciences REVA University Bengaluru	Internal Member
6	**Ms. Ayswarya Devi R.S** 2^{nd} semester M.Sc. Biotechnology	Alumini and Current Student

B.Sc. Biotechnology, Genetics, Biochemistry as per NEP 2020
Program Overview

Biotechnology harnesses cellular and bio-molecular processes to develop technologies and products that help improve our lives and the health of our planet. The growing list of biotechnology products includes medicines, medical devices and diagnostics, more-resilient crops, biofuels, biomaterials, and pollution control. At present, there are more than 250 biotechnology health care products and vaccines available to patients, many for previously untreatable diseases. Millions of farmers around the world use agricultural biotechnology to increase yields, prevent damage from insects and pests and reduce farming impact on the environment. Hundreds of bio refineries are being built across the world to test and refine technologies to produce biofuels and chemicals from renewable biomass, which can help reduce greenhouse gas emissions.

Government of India, cognizant of the fact that Biotechnology is an ever-growing technological field benefitting the whole society, established Department of Biotechnology (DBT) in the year 1986 with a mandate to promote large scale use of Biotechnology. Recent times have seen a surge in research related to innovation, invention and product orientation. In fact, top experts have made it clear that innovation in biosciences can make it a bigger industry than information technology. The Indian biotech industry holds about 2 percent share of the global biotech industry. The biotechnology industry in India, comprising about 800 companies, is expected to be valued at US$ 11.6 billion in 2017. The government has to invest US$ 5 billion to develop human capital, infrastructure and research initiatives if it is to realize the dream of growing the sector into a US$100billionindustryby2025, asper Union Minister for Science and Technology. In the Union Budget 2017-18, the Department of Biotechnology (DBT) received Rs 2,222.11 crore (US$ 333.31 million), an increase of 22 per cent, to continue implementing the department's national biotech strategy and target increasing the turnover from the sector to $100 billion by 2025 from $7 billion in2016.

Biopharma is the largest sector, contributing about 62 percent of the total revenue followed by bio-services (18 per cent), Bio-Agri (15 per cent), bio-industry (4 per cent), and bioinformatics contributing (1 per cent). The high demand for different biotech products has also opened scope for the foreign companies to set up base in India. India has emerged as a leading destination for clinical trials, contract research and manufacturing activities owing to the growth in the bio-services sector. In this context, University Programmes at undergraduate and postgraduate level in Biotechnology across the Country have become relevant.

B.Sc. (B.B.G) at REVA UNIVERSITY has been designed to meet the human resources needs of existing and futuristic biotech industries, biotech research organizations and academic institutions. The programme is designed to produce graduates with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently to meet higher level expectations of biotech industries, research organization and academic institutions. The programme also provides sufficient skills and training on entrepreneurship development in Biotechnology. The programme deals with courses on cell biology, microbiology, genetic engineering, biochemistry; medical, animal, forensic and environmental biotechnology, biochemical techniques and processes, entrepreneurship and many other related courses.

Programme Educational Objectives (PEOs)

After 3 years of graduation, the graduate will:

PEO -1	Adopt strong foundation with skills, ethics, relevant training and education towards understanding life science.
PEO - 2	Apply appropriate tools and techniques for conducting scientific investigations to solve the problems in life science domain.
PEO – 3	Acquire higher degree of work in academics and research adapting to lifelong learning with continuous improvement.

Programme Outcomes (POs)

After the successful completion of the program, the graduate will be able to:

1. Science knowledge: Apply the knowledge of life science for the solution of complex problems in various domains including healthcare considering public health & safety and the cultural societal & environmental concerns.

2. Problem analysis: Identify, formulate & analyse problems related to various domains of life sciences relevant to biotechnology, genetics, and biochemistry.

3. **Conduct investigations of relevant problems**: Use basic knowledge including analysis and interpretation of data, and synthesis of the information to provide valid conclusions and to carry out the research procedures.
4. **Modern tool usage: To** Create, select and apply appropriate techniques, resources and modern technology which in turn benefit society.
5. **Environment and sustainability**: Understand and implement environmentally friendly approaches in life sciences to support sustainable development.
6. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms in Life Sciences.
7. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
8. **Communication**: Communicate effectively with the scientific community and with society at large. Be able to comprehend and document. Make effective presentations and deduce clear instructions.
9. **Project management and finance**: Demonstrate knowledge and understanding of life sciences and management principles and apply these to one's own work, as a member and leader in a team.
10. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
11. **Interdesciplinary Knowledge:** Integrate knowledge from Biological Sciences, Physical Sciences and Chemical Sciences to solve complex problems.

Program Specific Outcomes (PSO)

After successful completion of the program, the graduates shall be able to

1. Develop knowledge and understanding of various subjects in Biotechnology, Biochemistry and Genetics.
2. Explain, design, and analyse field related problems in the domains of Biotechnology, Biochemistry and Genetics.
3. Plan manufacturing process, handle instruments and test products in the field of Life Sciences.

Mapping of PEOS with Respect to Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO3
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√

CO PO MAPPING OF THE COURSES

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
B25AHK103	CO4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
B25AHH103	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	2	1	0	1	0	0	1	0	0	0	0	2	0	1
	CO2	1	0	1	1	0	1	1	2	1	1	0	2	1	1
	CO3	1	1	1	1	0	0	0	1	1	1	0	3	1	0
B25AHA101	CO4	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO5	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO6	1	0	0	0	0	0	1	2	1	2	0	2	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHE101	CO1	2	1	0	1	0	0	1	0	0	0	0	2	0	1

	CO2	1	0	1	1	0	1	1	2	1	1	0	2	1	1
	CO3	1	1	1	1	0	0	0	1	1	1	0	3	1	0
	CO4	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO5	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO6	1	0	0	0	0	0	1	2	1	2	0	2	1	0
Course code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0101	CO1	3	2	2	2	2	3	0	0	2	2	0	2	2	1
	CO2	3	2	2	2	3	0	0	0	1	2	0	2	0	1
	CO3	3	0	2	2	2	1	0	0	1	2	0	3	2	0
	CO4	3	2	2	2	2	1	0	0	2	2	0	3	2	0
	CO5	3	2	0	2	2	1	0	0	2	2	0	3	2	0
	CO6	3	2	2	2	3	1	0	0	2	2	1	3	2	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0101	CO1	3	3	0	1	0	0	1	2	2	1	1	3	3	3
	CO2	3	3	3	1	1	0	0	1	1	2	1	3	3	3
	CO3	2	3	3	1	1	0	0	2	2	2	1	2	3	3
	CO4	2	3	3	1	1	0	0	1	1	2	1	3	3	3
	CO5	3	3	3	2	3	0	0	1	1	2	1	3	3	3
	CO6	3	3	3	3	3	0	0	1	1	2	1	3	3	3
Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0101	CO1	3	2	3	3	3	3	1	0	1	1	3	3	2	2
	CO2	2	2	2	2	3	1	0	0	1	1	0	3	2	0
	CO3	3	3	2	0	2	2	0	1	1	1	0	2	2	0
	CO4	2	1	2	0	2	1	1	1	2	0	0	3	2	1
	CO5	3	3	2	2	3	1	1	1	2	1	0	2	0	0
	CO6	2	2	3	2	2	1	0	0	1	1	2	2	3	1
Course code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS111	CO1	2	2	1	2	1	0	0	0	0	0	0	2	1	1
	CO2	1	3	2	0	1	0	0	0	0	0	0	0	1	1
	CO3	2	2	2	1	2	0	0	0	0	0	0	0	2	2
	CO4	1	2	1	2	2	0	0	0	0	0	0	0	1	1
	CO5	2	3	2	2	2	0	0	0	0	0	0	0	1	2
	CO6	2	2	2	1	2	0	0	0	0	0	0	0	2	2
Course code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	2	2	1	2	1	2	0	0	1	0	0	2	1	1
	CO2	1	3	2	0	1	2	0	0	1	0	0	0	1	1

B25BTS112	CO3	2	2	2	1	2	2	0	0	1	0	0	0	2	2
	CO4	1	2	1	2	2	2	0	0	1	0	0	0	1	1
	CO5	2	3	2	2	2	2	0	0	1	0	0	0	1	2
	CO6	2	2	2	1	2	2	0	0	1	0	0	0	2	2
Course code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0102	CO1	3	2	2	2	2	1	0	0	2	2	0	3	2	2
	CO2	3	2	2	2	2	1	0	0	2	3	0	3	2	2
	CO3	3	2	2	2	3	1	0	0	2	3	1	3	2	2
	CO4	3	2	2	2	3	1	0	0	2	3	1	3	2	2
	CO5	3	2	3	2	3	1	0	0	2	3	1	3	2	2
	CO6	3	2	2	2	3	1	0	0	2	3	0	3	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0102	CO1	2	3	2	3	1	1	0	1	0	2	0	3	3	2
	CO2	2	3	3	1	1	1	0	1	2	1	0	2	3	2
	CO3	2	3	3	1	1	0	0	1	2	2	1	2	3	3
	CO4	2	3	3	1	1	1	0	2	2	2	0	3	3	3
	CO5	2	3	3	1	1	1	0	1	2	2	0	2	3	3
	CO6	2	3	3	1	1	1	3	1	2	2	1	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0102	CO1	3	2	1	2	3	2	0	0	2	1	0	3	3	2
	CO2	2	1	1	1	2	0	0	0	2	1	1	3	2	1
	CO3	2	2	2	2	2	1	0	0	0	1	0	2	2	1
	CO4	3	2	2	2	2	1	1	0	1	0	0	2	2	1
	CO5	3	2	0	2	2	3	0	1	2	3	0	3	2	3
	CO6	3	2	2	3	3	1	0	0	1	1	1	2	2	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0103	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHK203	CO1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0

	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHH203	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHA201	CO1	2	0	1	1	0	1	0	2	1	2	0	1	1	0
	CO2	0	1	0	1	0	0	1	0	0	1	0	1	0	1
	CO3	2	0	1	1	0	0	2	0	0	1	0	2	2	0
	CO4	1	0	1	1	1	0	1	0	1	1	0	3	1	0
	CO5	1	0	1	1	1	0	1	0	1	1	0	3	1	0
	CO6	1	0	1	1	1	0	1	0	1	1	0	3	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHE201	CO1	1	0	0	1	0	1	1	2	1	1	0	2	0	0
	CO2	1	1	0	0	0	0	2	2	1	1	0	2	1	0
	CO3	2	1	1	1	0	0	2	2	1	1	0	2	1	0
	CO4	1	0	0	2	0	0	3	2	1	1	0	1	0	0
	CO5	1	0	0	2	0	0	3	2	1	1	0	1	0	0
	CO6	1	0	0	2	0	0	3	2	1	1	0	1	0	0
Course Code	PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0201	CO1	3	2	2	3	3	2	0	0	1	1	0	1	1	1
	CO2	3	2	2	3	3	1	0	1	1	1	2	1	1	0
	CO3	3	3	2	3	3	0	0	1	1	0	2	1	2	1
	CO4	3	3	2	2	3	1	0	0	0	1	0	1	1	0
	CO5	2	3	3	3	3	2	0	2	1	1	2	2	2	0
	CO6	3	3	3	3	3	2	0	1	2	1	3	0	1	0
Course code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0201	CO1	2	2	3	2	0	3	0	2	2	2	1	0	2	1
	CO2	2		2	0	2	3	0	3	0	3	1	1	2	0
	CO3	3	3	0	2	2	0	3	2	3	0	1	2	0	2
	CO4	1	0	2	3	1	1	0	2	2	1	1	2	2	1
	CO5	2	0	2	0	3	2	0	1		2	0	0	1	0
	CO6	1	0	2	0	2	0	2	0	3	0	1	0	2	0
Course Code	POS /COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

B25GN0201	CO1	2	2	2	2	1	0	0	0	1	1	2	3	3	2
	CO2	3	2	1	2	3	1	0	0	1	2	2	2	2	0
	CO3	3	2	1	0	2	1	0	0	1	1	0	3	1	0
	CO4	2	3	3	3	2	1	1	1	2	2	0	3	3	2
	CO5	2	2	2	2	2	1	0	1	1	1	0	3	2	0
	CO6	2	2	3	0	2	1	0	0	2	1	0	3	2	1

Course Code	POS/ COs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO11	PO10	PSO1	PSO2
B25BT0202	CO1	2	2	3	3	3	0	2	2	1	2	2	2	2	2
	CO2	1	1	2	1	2	0	2	2	1	2	2	2	2	2
	CO3	3	2	2	2	2	0	1	1	1	2	0	3	3	3
	CO4	3	2	2	2	2	0	1	1	1	2	0	3	2	2
	CO5	3	2	2	2	2	0	1	1	1	2	0	3	2	2
	CO6	3	2	2	2	2	0	1	1	1	2	0	3	2	2

Course code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BC0202	CO1	1	2	1	2	0	0	1	1	0	3	0	2	1	0
	CO2	1	2	2	1	0	0	1	0	0	2	0	1	1	0
	CO3	1	2	1	2	0	0	1	0	0	2	1	1	1	0
	CO4	2	0	1	2	0	0	2	0	0	3	1	0	2	0
	CO5	2	0	2	2	0	2	0	2	0	2	2	2	0	2
	CO6	1	2	1	2	0	0	1	1	0	3	0	2	1	0

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0202	CO1	2	3	2	2	2	2	0	0	1	1	0	2	2	1
	CO2	3	3	2	0	2	0	0	0	2	1	0	1	1	1
	CO3	2	3	3	2	3	1	0	1	2	1	0	3	3	2
	CO4	2	2	2	3	3	1	1	0	1	0	2	1	2	1
	CO5	1	3	3	2	2	2	1	1	1	0	1	3	3	0
	CO6	2	2	2	1	1	0	0	0	1	1	0	3	3	1

Course Code	PO/CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PSO 1	PSO 2	PSO3
B25AS0213	CO1	1	0	1	1	0	0	0	1	0	1	0	1	1	1
	CO2	1	0	1	0	1	0	0	1	0	1	0	1	0	1
	CO3	1	1	0	1	1	0	1	1	1	0	0	1	1	1
	CO4	1	1	1	0	1	0	0	0	1	1	0	1	1	1
	CO5	1	1	1	1	1	0	1	0	1	0	0	1	1	1
	CO6	1	1	0	0	1	0	1	1	1	1	0	1	1	1

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO2	1	0	1	0	0	1	1	0	1	0	0	2	1	1

B25AHK303	CO3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHH303	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHA301	CO1	2	0	0	0	0	0	0	1	1	1	0	2	1	0
	CO2	2	0	0	2	0	0	0	0	1	0	0	1	0	0
	CO3	2	0	1	1	0	0	2	2	1	1	0	1	1	0
	CO4	2	0	0	1	0	0	2	1	1	1	0	2	1	1
	CO5	2	0	0	1	0	0	2	1	1	1	0	2	1	1
	CO6	2	0	0	1	0	0	2	1	1	1	0	2	1	1

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0301	CO1	2	3	3	1	2	2	0	3	0	0	3	3	2	3
	CO2	2	3	3	3	2	2	0	3	1	1	3	3	2	3
	CO3	2	3	3	1	2	2	0	3	1	1	3	3	2	3
	CO4	2	3	3	1	2	2	0	3	1	1	2	3	2	3
	CO5	2	1	1	2	2	0	0	1	1	1	3	1	0	1
	CO6	1	2	1	2	2	0	0	1	1	1	3	1	1	0

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0301	CO 1	2	3	2	2	2	2	1	1	2	2	2	3	3	3
	CO 2	2	3	1	2	3	1	2	1	2	1	2	3	3	1
	CO 3	2	3	2	3	2	1	1	1	2	1	3	3	3	1
	CO 4	2	3	2	1	2	3	2	3	2	1	2	3	3	1
	CO 5	3	3	1	1	2	1	2	2	2	1	1	1	3	1
	CO6	3	3	2	2	2	3	2	2	2	1	3	3	3	1

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0301	CO1	3	2	3	3	2	3	1	1	2	2	0	2	3	2
	CO2	3	3	3	3	2	2	0	1	2	2	0	3	3	1
	CO3	3	2	3	3	3	2	0	1	1	2	0	2	2	1
	CO4	3	3	3	2	2	1	1	1	1	2	0	2	3	2

	CO5	3	2	3	3	2	2	0	0	1	1	0	3	3	1
	CO6	2	2	3	3	3	1	0	0	1	0	0	1	2	1
Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PSO 1	PSO 2	PSO3
B25BT0302	CO1	2	3	3	1	2	2	0	3	0	0	0	3	2	3
	CO2	2	3	3	3	2	2	0	3	1	1	2	3	2	3
	CO3	2	3	3	1	2	2	0	3	1	1	0	3	2	3
	CO4	2	3	3	1	2	2	0	3	1	1	2	3	2	3
	CO5	2	1	1	2	2	0	0	1	1	1	2	1	0	1
	CO6	1	2	1	2	2	0	0	1	1	1	3	1	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0302	CO 1	2	3	2	2	2	2	1	1	2	2	0	3	3	3
	CO 2	2	3	1	2	3	1	2	1	2	1	0	3	3	1
	CO 3	2	3	2	3	2	1	1	1	2	1	0	3	3	1
	CO 4	2	3	2	1	2	3	2	3	2	1	0	3	3	1
	CO 5	3	3	1	1	2	1	2	2	2	1	1	1	3	1
	CO 6	3	3	2	2	2	3	2	2	2	1	1	3	3	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0302	CO1	2	2	3	2	2	0	0	0	1	1	0	3	3	1
	CO2	2	3	2	3	2	2	1	3	2	2	1	3	3	2
	CO3	2	3	1	2	2	1	0	0	1	1	1	2	3	1
	CO4	3	2	3	2	2	1	0	1	1	1	0	3	3	1
	CO5	2	2	3	2	2	1	0	1	0	1	0	3	3	2
	CO6	2	3	3	3	2	2	1	0	1	1	1	3	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BCS311	CO1	2	0	3	0	2	0	2	0	0	0	0	2	2	1
	CO2	1	0	0	3	0	2	0	3	0	3	0	2	3	0
	CO3	1	0	3	0	0	0	0	3	0	3	0	2	0	2
	CO4	2	3	0	3	0	2	0	3	2	2	0	0	1	0
	CO5	2	0	2	3	0	0	0	2	0	2	0	0	2	0
	CO6	2	0	2	2	0	3	0	2	0	2	1	0	2	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	2	1	1	0	1	0	1	1	0	0	0	2	1	1
B25BCS312	CO2	3	2	1	0	1	0	0	1	0	0	0	2	1	0
	CO3	2	2	2	0	1	0	0	1	0	0	0	1	1	0
	CO4	3	2	3	1	1	1	1	1	0	0	0	2	1	0
	CO5	3	2	2	1	1	0	0	1	0	0	0	2	1	0
	CO6	3	2	2	1	1	0	0	1	0	0	0	2	1	0

	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25BC0303	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25SB0301	CO1	3	0	0	1	2	1	0	0	1	1	0	2	2	0
	CO2	2	2	1	1	2	2	1	1	1	2	0	2	0	1
	CO3	2	2	1	1	1	1	1	0	1	0	0	1	0	0
	CO4	3	2	0	1	2	0	0	0	1	1	0	2	1	0
	CO5	2	1	1	0	0	0	0	0	2	1	0	2	1	0
	CO6	2	1	0	1	1	1	0	0	1	2	0	3	2	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0108	CO1	0	0	3	3	3	2	0	0	0	0	0	0	0	3
	CO2	0	0	2	3	3	2	0	0	0	0	0	0	0	3
	CO3	0	0	2	3	3	2	0	0	0	0	0	0	0	3
	CO4	0	0	2	2	3	1	0	0	0	0	0	0	0	3
	CO5	0	0	1	2	1	1	0	0	0	0	0	0	0	3
	CO6	0	0	1	2	1	1	0	0	0	0	0	0	0	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25NC0109	CO1	-	-	3	2	2	2	0	0	0	0	0	0	0	3
	CO2	-	-	2	3	3	2	0	0	0	0	0	0	0	3
	CO3	-	-	2	3	3	2	0	0	0	0	0	0	0	3
	CO4	-	-	2	3	3	1	0	0	0	0	0	0	0	3
	CO5	-	-	1	2	3	1	0	0	0	0	0	0	0	3
	CO6	-	-	1	2	3	1	0	0	0	0	0	0	0	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25NS0108	CO1	0	0	3	3	3	2	0	0	0	0	0	0	0	0
	CO2	0	0	2	3	3	2	0	0	0	0	0	0	0	0
	CO3	0	0	2	3	3	2	0	0	0	0	0	0	0	0
	CO4	0	0	2	2	3	1	0	0	0	0	0	0	0	0
	CO5	0	0	1	2	1	1	0	0	0	0	0	0	0	0
	CO6	0	0	1	2	1	1	0	0	0	0	0	0	0	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3

B25AHK403	CO1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25AHH403	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25AHA401	CO1	2	0	1	0	0	0	0	1	1	1	0	2	1	0
	CO2	1	0	1	1	0	0	0	2	1	1	0	1	1	0

	CO3	1	0	0	0	0	1	0	2	1	1	0	2	1	0
	CO4	1	1	2	0	0	0	1	3	1	1	0	3	1	0
	CO5	1	1	2	0	0	0	1	3	1	1	0	3	1	0
	CO6	1	1	2	0	0	0	1	3	1	1	0	3	1	0
Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PSO 1	PSO 2	PSO3
B25BT0401	CO 1	3	2	3	3	3	3	0	2	2	2	0	3	3	2
	CO 2	2	2	3	3	3	3	2	3	2	3	0	2	3	2
	CO 3	3	2	3	3	3	3	2	2	2	3	2	3	3	3
	CO 4	3	2	3	3	2	3	3	3	3	3	1	3	3	2
	CO 5	2	2	3	3	2	3	1	1	2	3	3	3	3	3
	CO 6	2	2	3	2	2	3	3	0	3	3	1	3	2	3
Course Code	POS /COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0401	CO 1	3	3	3	2	2	1	0	0	2	2	1	3	3	2
	CO 2	3	3	2	2	1	0	1	1	2	1	0	3	3	2
	CO 3	3	3	3	3	1	1	1	2	2	3	2	3	3	2
	CO 4	3	3	2	2	1	0	2	1	2	1	0	3	3	1
	CO 5	3	3	3	2	1	2	1	0	2	1	0	3	3	1
	CO 6	3	3	1	2	2	1	1	1	2	1	2	3	3	1
Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	1	1	1	1	2	1	1	2	0	3	2	1
	CO2	3	3	2	1	2	1	2	1	1	2	0	3	3	2

B25GN0401	CO3	3	3	3	2	2	1	2	2	2	3	0	3	3	3
	CO4	2	3	3	2	3	3	2	2	2	3	0	2	3	2
	CO5	3	2	2	2	3	2	2	2	2	3	0	3	3	2
	CO6	3	2	1	2	3	3	1	1	1	3	0	3	2	1
.Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PSO 1	PSO 2	PSO3
B25BT0402	CO 1	3	3	3	2	3	3	2	0	2	3	2	3	2	2
	CO 2	2	2	2	3	2	3	1	1	2	2	2	3	3	2
	CO 3	2	3	3	3	2	3	2	2	2	2	2	1	3	2
	CO 4	2	2	2	2	3	2	2	0	2	2	2	3	2	3
	CO 5	2	2	2	3	2	3	3	0	2	2	2	2	3	2
	CO 6	3	3	3	2	2	3	2	1	2	3	2	2	2	2
Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0402	CO 1	3	2	2	2	2	3	3	3	2	0	0	3	3	1
	CO 2	3	3	1	2	1	1	1	1	1	0	0	3	3	3
	CO 3	3	3	3	3	2	1	2	0	2	1	1	3	3	1
	CO 4	1	3	3	2	1	1	1	0	2	1	1	3	3	1
	CO 5	2	3	3	2	3	2	2	2	2	1	1	3	2	1

	CO 6	3	3	2	2	2	2	1	2	2	2	0	3	3	2
Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0402	CO1	2	1	1	0	2	1	0	0	0	1	0	2	1	0
	CO2	2	2	2	2	2	2	1	0	1	0	0	2	2	0
	CO3	2	2	1	1	1	2	0	0	1	0	0	2	2	0
	CO4	3	3	3	1	3	0	0	1	1	1	0	2	2	2
	CO5	2	2	1	0	2	1	0	2	2	0	0	2	2	1
	CO6	2	2	1	0	2	1	0	0	1	0	0	2	2	0
Course Code	PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0415	CO1	3	3	1	3	0	0	0	0	0	0	2	3	3	0
	CO2	1	3	2	3	0	2	1	2	1	1	3	3	3	1
	CO3	2	3	3	2	1	0	0	1	1	1	3	3	3	0
	CO4	3	3	2	2	0	0	1	1	1	0	3	2	3	2
	CO5	3	2	2	2	3	2	2	2	2	3	3	3	3	2
	CO6	3	2	1	2	3	3	1	1	1	3	3	3	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0412	CO1	2	1	1	2	3	1	0	0	1	1	1	1	1	0
	CO2	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO3	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO4	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO5	2	1	2	1	2	1	0	0	1	1	1	1	1	0

	CO6	2	1	2	1	2	1	0	0	1	1	1	1	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0501	CO 1	2	2	2	2	2	3	1	1	2	3	3	3	3	2
	CO 2	3	2	2	1	2	3	1	1	2	3	3	3	2	2
	CO 3	3	2	3	2	2	3	2	0	2	3	3	3	3	2
	CO 4	3	3	2	2	1	3	2	1	2	2	2	3	3	2
	CO 5	3	1	2	3	3	0	2	2	2	2	2	3	3	1
	CO 6	3	2	3	2	2	3	2	2	2	2	2	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0501	CO1	2	2	1	2	2	3	1	0	2	2	3	3	2	2
	CO2	2	2	2	2	1	2	1	1	1	3	2	2	2	1
	CO3	3	2	2	1	2	2	0	0	2	1	2	2	3	2
	CO4	2	2	1	1	2	1	1	0	0	1	2	2	2	1
	CO5	2	1	1	1	1	2	1	0	1	1	2	2	2	1
	CO6	1	0	1	2	1	1	0	0	1	1	2	2	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	2	2	3	0	0	0	0	0	0	0	2	2	2	0
B25GN0501	CO 2	3	3	3	0	0	0	0	0	0	0	2	3	3	0
	CO 3	3	3	3	2	0	0	0	0	0	0	1	3	3	0
	CO 4	3	3	0	3	0	0	0	3	0	0	2	3	3	0
	CO 5	3	3	0	3	0	3	0	0	0	0	3	3	3	0
	CO 6	3	3	0	3	0	0	0	0	0	0	1	3	3	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0502	CO 1	2	1	2	2	2	3	2	1	2	2	0	3	3	3
	CO 2	3	2	2	2	3	3	2	2	3	3	2	3	2	1
	CO 3	3	2	2	3	3	3	3	1	2	3	2	3	1	2
	CO 4	3	3	2	3	3	1	3	2	2	3	2	2	3	2
	CO 5	2	2	3	3	3	3	2	0	2	3	2	2	1	2
	CO 6	2	0	3	2	3	3	1	1	2	3	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0502	CO1	3	2	3	2	2	3	1	0	1	2	0	3	2	2
	CO2	2	1	1	2	1	3	1	0	1	1	1	2	1	1
	CO3	3	1	2	1	1	0	1	0	1	1	1	2	2	0
	CO4	1	1	1	1	1	1	0	0	1	1	0	2	2	1
	CO5	1	1	1	1	1	3	0	0	1	1	0	2	2	1
	CO6	1	1	1	0	1	3	0	0	1	1	0	2	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

B25GN0502	CO1	3	3	3	2	1	2	2	2	1	2	1	3	3	2
	CO2	2	2	2	2	1	1	2	2	1	2	1	2	2	2
	CO3	3	3	3	2	1	2	2	2	1	2	3	3	3	2
	CO4	2	3	3	2	1	1	2	2	1	2	1	2	3	2
	CO5	3	3	3	2	1	2	2	2	2	2	1	3	3	2
	CO6	3	2	2	2	1	1	2	2	2	2	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS511	CO 1	3	3	3	0	0	0	0	0	0	0	0	3	3	0
	CO 2	3	3	3	3	0	0	0	0	0	0	2	3	3	0
	CO 3	3	3	2	2	0	0	0	0	0	0	1	3	3	3
	CO 4	3	3	3	0	0	0	0	0	0	0	2	3	3	0
	CO 5	2	3	3	3	0	0	0	0	0	0	1	3	3	0
	CO 6	3	3	3	3	0	0	0	0	0	0	3	3	3	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS512	CO 1	3	3	0	3	3	3	0	0	0	0	0	3	3	3
	CO 2	3	3	0	0	0	0	0	0	0	0	0	3	3	0
	CO 3	3	3	0	0	0	3	0	3	0	0	0	3	3	0
	CO 4	3	3	3	3	3	0	0	0	0	0	2	3	3	3
	CO 5	3	3	0	3	3	3	0	0	0	0	2	3	3	3
	CO 6	3	3	0	0	3	3	0	0	0	0	2	3	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0501	CO1	3	3	3	3	1	0	1	0	1	2	2	3	3	2
	CO2	3	3	3	2	1	0	0	1	1	2	3	3	3	2
	CO3	3	3	3	3	1	0	1	1	1	2	2	3	3	2
	CO4	3	3	3	2	1	2	1	1	1	2	3	3	3	2
	CO5	3	3	2	3	1	1	0	2	1	2	2	3	3	2
	CO6	3	3	3	3	1	2	1	1	2	3	3	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25LS0501	CO1	2	1	0	1	1	1	0	0	0	1	0	2	2	1
	CO2	1	1	1	0	1	1	0	0	1	1	0	2	2	1
	CO3	2	2	2	1	1	1	1	0	1	1	0	2	2	1
	CO4	2	1	1	1	3	1	0	0	1	1	0	2	2	0
	CO5	2	2	0	1	2	1	0	0	1	1	0	2	2	0
	CO6	2	2	1	1	3	1	1	0	2	1	0	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	3	3	2	2	1	0	0	3	0	3	2	3
	CO2	2	2	3	3	3	2	0	0	2	2	0	3	2	3

B25BT0601	CO3	3	2	3	3	3	2	0	0	2	2	2	3	3	3
	CO4	3	2	3	3	3	2	0	0	1	2	2	2	2	3
	CO5	3	2	3	3	2	2	0	0	2	3	2	3	2	3
	CO6	3	2	3	3	3	3	0	0	2	2	3	3	2	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	1	2	1	3	0	0	1	1		2	2	2
	CO2	2	2	1	1	1	1	0	0	1	2		2	2	2
	CO3	3	2	1	1	2	2	0	0	2	1		3	3	2
B25BC0601	CO4	3	2	1	1	1	2	0	0	1	1		2	2	2
	CO5	1	1	1	1	1	2	0	0	1	1		3	3	1
	CO6	2	0	1	2	1	0	0	1	1	1		2	3	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	2	2	2	1	2	2	1	2	2	3	3	2
	CO2	3	3	2	2	2	2	1	2	1	2	2	3	3	2
	CO3	2	3	3	3	1	1	2	2	2	2	2	2	3	3
B25GN0601	CO4	2	3	3	3	1	2	2	2	2	3	2	2	3	3
	CO5	3	2	3	3	1	2	2	2	2	3	2	3	3	2
	CO6	3	2	3	3	1	2	2	2	2	3	2	3	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

	CO1	3	2	2	3	3	2	0	0	2	2	2	3	2	2
B25BT0602	CO2	3	2	2	3	3	2	0	0	2	2	2	3	2	2
	CO3	3	2	2	3	3	2	0	0	2	2	2	3	2	2
	CO4	3	2	2	3	3	2	0	0	2	2	2	2	2	3
	CO5	3	2	2	3	3	2	0	0	2	2	2	2	2	3
	CO6	3	2	3	3	3	2	0	0	2	2	2	2	2	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	1	3	2	3	1	0	2	2	2	3	2	2
	CO2	3	1	2	2	1	3	1	0	2	2	2	2	2	1
	CO3	3	1	2	2	2	3	1	1	2	1	1	2	2	1
B25BC0602	CO4	3	2	1	2	2	3	1	1	1	1	1	2	2	2
	CO5	3	2	2	2	1	3	1	1	2	2	2	2	2	1
	CO6	3	2	2	2	1	3	1	1	2	2	2	3	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	3	2	2	2	1	2	1	1	2	2	3	3	2
B25GN0602	CO2	3	2	2	3	1	1	2	2	1	2	2	3	2	2
	CO3	3	3	3	3	1	1	2	2	2	2	2	3	3	3
	CO4	3	3	3	3	1	1	2	2	2	2	2	3	3	2
	CO5	3	3	3	3	2	1	2	2	2	2	2	3	3	2

	CO6	3	3	3	3	2	1	2	2	2	2	2	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0601	CO1	3	3	2	2	2	1	2	1	1	2	2	3	3	2
	CO2	3	2	2	3	1	1	2	2	1	2	3	3	2	2
	CO3	3	3	3	3	1	1	2	2	2	2	2	3	3	3
	CO4	3	3	3	3	1	1	2	2	2	2	3	3	3	2
	CO5	3	3	3	3	2	1	2	2	2	2	2	3	3	2
	CO6	3	3	3	3	2	1	2	2	2	2	3	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25PT0601	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0604	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3

	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
B25BT070 1	CO1	1	3	1	2	0	0	0	0	1	1	2	1	1	1
	CO2	2	2	3	2	2	0	0	0	1	1	2	2	2	2
	CO3	3	2	2	2	2	2	1	0	0	0	2	2	2	2
	CO4	3	3	2	2	2	2	1	0	0	1	2	2	3	1
	CO5	2	1	2	2	3	2	2	0	1	1	2	2	1	1
	CO6	2	2	1	2	3	2	1	2	0	2	2	2	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
B25BT070 2	CO1	1	2	1	0	1	2	0	3	1	0	2	2	1	0
	CO2	3	2	0	3	2	0	0	0	2	1	2	2	1	0
	CO3	3	3	3	3	3	3	2	0	2	1	2	3	2	1
	CO4	3	2	2	3	3	2	2	2	2	3	2	3	2	2
	CO5	2	2	3	2	3	2	2	2	2	2	2	3	3	1
	CO6	3	2	3	0	0	0	1	2	2	0	2	2	1	0

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
B25BT0703	CO 1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO 2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO 3	3	2	0	2	3	3	3	1	2	2	2	3	1	1
	CO 4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO 5	3	2	0	2	1	0	1	0	2	1	2	3	2	0
	CO 6	2	0	0	2	3	2	0	0	1	0	2	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
B25B T0704	CO 1	3	2	3	3	3	2	3	2	2	3	2	3	2	3
	CO 2	3	0	2	2	2	0	0	3	2	0	2	3	1	2
	CO 3	3	3	3	3	3	3	2	3	3	3	2	2	3	3
	CO 4	1	1	0	0	2	1	0	0	2	0	2	3	2	1
	CO 5	3	2	3	3	2	0	0	1	2	3	2	3	2	3
	CO 6	3	2	3	2	1	0	2	2	2	1	2	3	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
B25BT0705	CO 1	3	2	3	3	3	2	3	2	2	3	2	3	2	3
	CO 2	3	0	2	2	2	0	0	3	2	0	2	3	1	2
	CO 3	3	3	3	3	3	3	2	3	3	3	2	2	3	3
	CO 4	1	1	0	0	2	1	0	0	2	0	2	3	2	1
	CO 5	3	2	3	3	2	0	0	1	2	3	2	3	2	3
	CO 6	3	2	3	2	1	0	2	2	2	1	2	3	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0706	CO 1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO 2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO 3	3	2	0	2	3	3	3	1	2	2	2	3	1	1
	CO 4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO 5	2	0	0	2	3	2	0	0	1	0	2	2	2	0
	CO 6	3	2	0	2	2	3	0	0	1	1	2	3	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS711	CO 1	3	2	3	3	3	2	0	0	2	3	2	2	2	2
	CO 2	2	2	3	3	3	2	0	0	2	3	2	3	2	2
	CO 3	3	2	3	3	3	2	0	0	2	3	2	2	2	2
	CO 4	3	2	2	3	3	2	0	0	2	3	2	3	2	2
	CO 5	3	2	2	3	3	2	0	0	2	3	2	3	2	3
	CO 6	3	2	2	3	3	3	0	0	2	3	2	3	2	2

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS712	CO 1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO 2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO 3	3	2	0	2	3	3	3	1	2	2	2	3	1	1
	CO 4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO 5	2	0	0	2	3	2	0	0	1	0	2	2	2	0
	CO 6	3	2	0	2	2	3	0	0	1	1	2	3	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS713	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS714	CO 1	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0701	CO 1	3	2	2	1	1	1	0	0	0	1	2	2	1	0
	CO 2	3	3	2	2	1	2	0	0	0	0	2	2	3	1
	CO 3	3	1	1	1	3	0	0	0	0	0	2	3	2	1
	CO 4	3	2	1	2	2	0	0	0	0	0	2	2	2	0
	CO 5	3	3	3	2	3	2	0	0	0	0	2	3	2	1
	CO 6	2	2	2	2	1	1	0	0	0	0	2	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN070 2	CO 1	3	2	2	2	1	1	0	0	0	0	2	3	2	0
	CO 2	3	2	2	2	1	1	0	0	0	0	2	2	2	0
	CO 3	3	3	2	3	1	0	0	0	0	0	2	3	0	0
	CO 4	3	2	2	2	1	0	0	0	0	0	2	2	2	0
	CO 5	3	2	3	1	1	0	0	0	0	0	2	2	1	0
	CO 6	3	2	3	2	2	1	0	0	0	0	2	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

B25GN0703	CO 1	3	2	1	2	1	1	0	0	0	0	**2**	3	2	0
	CO 2	3	3	3	2	1	1	1	0	0	0	2	2	2	0
	CO 3	3	2	2		1	1	0	0	0	0	2	3	3	0
	CO 4	3	2	2	2	1	1	0	0	0	0	2		2	0
	CO 5	3	3	3	2	1	1	0	0	0	0	2	1	1	0
	CO 6	3	2	3	3	3	1	0	0	0	0	2	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0704	CO 1	3	3	3	2	1	1	2	1	0	3	2	2	2	0
	CO 2	3	3	3	3	2	2	2	1	0	2	2	3	2	0
	CO 3	3	1	3	1	3	2	1	2	0	2	2	2	2	0
	CO 4	2	2	1	2	2	1	0	0	0	0	2	2	1	0
	CO 5	3	2	3	2	3	1	1	0	0	1	2	2	1	0
	CO 6	3	2	1	2	2	2	1	0	0	0	2	3	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0705	CO 1	3	3	3	2	1	1	2	1	0	3	2	2	2	0
	CO 2	3	3	3	3	2	2	2	1	0	0	2	3	2	0
	CO 3	3	1	3	1	3	2	1	2	0	2	2	2	2	0
	CO 4	2	2	1	2	2	1	0	0	0	0	2	2	1	0

	CO 5	2	2	3	2	1	1	1	0	0	2	2	2	1	0
	CO 6	3	2	1	2	2	2	1	0	0	0	2	3	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0706	CO 1	2	3	3	2	1	1	2	1	0	1	2	2	2	0
	CO 2	3	3	3	3	2	2	2	1	0	0	2	3	2	0
	CO 3	3	1	3	1	1	2	1	0	0	0	2	2	2	0
	CO 4	2	2	1	2	1	1	0	0	0	0	2	2	1	0
	CO 5	2	2	3	2	1	1	1	0	0	2	2	2	1	0
	CO 6	3	2	1	2	1	0	1	0	0	1	2	3	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS711	CO 1	3	2	3	1	1	0	0	0	0	0	2	2	2	0
	CO 2	3	2	2	2	0	1	0	0	0	0	2	2	2	0
	CO 3	3	2	3	1	1	1	0	0	0	0	2	1	2	0
	CO 4	3	2	2	1	1	0	0	0	0	0	2	2	2	0
	CO 5	3	2	3	2	1	2	0	0	0	0	2	2	0	0
	CO 6	3	2	3	2	1	2	0	0	0	0	2	3	2	1

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS71 2	CO 1	3	2	3	2	0	0	0	0	0	0	2	2	3	0
	CO 2	3	3	3	2	2	1	0	0	0	0	2	3	2	1
	CO 3	2	3	3	3	2	2	0	0	0	0	2	2	2	0
	CO 4	3	2	2	2	1	0	0	0	0	0	2	1	2	0
	CO 5	3	2	3	0	0	1	0	0	0	0	2	2	1	0
	CO 6	3	2	1	2	1	0	0	0	0	0	2	2	2	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS71 3	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS71 4	CO1	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1
B25BC0701	CO1	3	2	3	2	3	3	1	1	2	1	2	2	3	2
	CO2	3	0	1	2	3	2	0	1	2	1	2	2	3	2
	CO3	2	2	3	1	1	1	0	0	1	2	2	2	2	1
	CO4	2	2	3	2	2	1	1	0	1	2	2	1	2	1
	CO5	3	1	3	2	1	1	0	0	2	1	2	2	2	2
	CO6	3	1	3	2	1	1	1	0	2	2	2	2	2	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0702	CO 1	2	1	3	2	1	2	1	1	2	1	2	2	2	1
	CO 2	2	2	2	3	3	3	0	2	2	1	2	1	2	1
	CO 3	2	3	3	1	1	1	1	0	1	2	2	2	1	1
	CO 4	2	2	3	2	2	1	1	1	1	2	2	2	0	2
	CO 5	2	1	2	1	1	1	0	1	2	1	2	1	1	2
	CO 6	3	2	2	2	1	1	1	0	2	2	2	2	2	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	3	2	1	1	1	0	0	2	0	2	3	2	0

	CO 2	3	2	2	3	3	1	2	1	2	1	2	3	3	1
B25BC0703	CO 3	3	2	1	1	2	1	2	0	2	1	2	2	1	0
	CO 4	3	2	3	2	0	1	1	1	2	2	2	2	2	0
	CO 5	3	2	0	2	3	1	1	0	3	1	2	2	1	1
	CO 6	2	1	1	3	2	0	1	0	1	1	2	2	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	2	3	2	1	2	2	2	1	2	2	2	2	2	2
B25BC0704	CO 2	3	1	3	2	1	2	0	1	2	2	2	1	2	1
	CO 3	2	3	3	2	2	2	1	0	2	2	2	2	1	1
	CO 4	1	2	3	1	1	1	2	0	1	1	2	1	1	1
	CO 5	1	2	3	2	1	1	1	1	2	2	2	2	1	1
	CO 6	2	2	2	1	1	1	2	0	1	1	2	2	3	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	2	3	2	1	1	0	1	1	1	2	2	2	1
	CO 2	2	2	2	2	1	2	1	0	2	2	2	2	2	1
B25BC0705	CO 3	3	2	3	1	1	1	1	0	1	1	2	1	2	1
	CO 4	2	1	1	2	1	2	1	1	3	2	2	2	2	1
	CO 5	2	2	3	2	2	2	2	0	2	1	2	2	2	2
	CO 6	1	1	2	2	1	2	1	1	3	1	2	2	1	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	2	3	2	2	1	1	2	1	2	2	3	2	2

	CO 2	3	2	1	2	3	0	2	2	3	0	2	2	1	3
B25BC 0706	CO 3	1	0	1	2	3	2	0	0	1	0	2	1	0	2
	CO 4	2	2	2	0	1	0	3	1	2	1	2	2	3	2
	CO 5	1	2	1	2	3	2	1	2	2	1	2	2	1	1
	CO 6	3	2	0	2	2	0	2	0	2	1	2	2	2	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	2	3	3	2	1	1	1	1	2	2	2	3	3	2
B25BC S711	CO2	2	3	3	2	1	1	1	1	2	2	2	3	3	2
	CO3	2	2	3	2	1	1	1	1	2	2	2	3	3	2
	CO4	2	2	3	2	1	1	1	1	2	2	2	3	3	2
	CO5	2	3	3	2	1	1	2	1	2	2	2	3	3	2
	CO6	2	3	3	3	2	1	2	1	2	2	2	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	2	1	2	2	0	1	0	2	1	2	3	2	1
B25BC S712	CO 2	2	3	1	1	3	1	0	1	2	0	2	2	2	0
	CO 3	3	2	2	2	3	0	1	0	2	1	2	2	2	1

	CO 4	3	2	1	2	3	2	1	0	2	1	2	2	1	1
	CO 5	3	2	3	1	0	0	1	0	2	1	2	3	2	0
	CO 6	2	2	2	2	3	0	1	0	2	1	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS713	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS714	CO1	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0801	CO 1	3	2	3	1	1	3	0	2	2	0	2	3	2	2
	CO 2	1	1	2	1	1	0	0	2	2	2	2	3	3	3
	CO 3	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO 4	2	3	3	2	2	0	0	3	2	2	2	3	3	3

	CO 5	2	3	3	2	1	0	0	2	2	2	2	3	3	3
	CO 6	3	3	3	3	3	1	0	3	2	2	2	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0802	CO 1	3	2	3	1	1	3	0	2	2	0	2	3	2	2
	CO 2	1	1	2	1	1	0	0	2	2	2	2	3	3	3
	CO 3	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO 4	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO 5	2	3	3	2	1	0	0	2	2	2	2	3	3	3
	CO 6	3	3	3	3	3	1	0	3	2	2	2	3	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0803	CO 1	3	3	1	3	3	1	1	2	1	1	2	3	0	2
	CO 2	3	2	2	2	1	1	1	1	0	1	2	1	0	2
	CO 3	2	1	2	2	1	1	1	0	1	1	2	1	0	1
	CO 4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1
	CO 5	2	2	1	3	2	0	1	0	1	1	2	2	0	1

	CO 6	2	2	1	3	0	2	0	1	1	2	2	0	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	3	3	2	2	3	2	1	2	2	2	3	3	3
	CO 2	3	2	3	2	1	3	2	1	2	2	2	3	3	2
B25BT0804	CO 3	3	3	3	3	3	3	2	2	2	3	2	3	3	3
	CO 4	3	3	3	3	3	3	2	0	2	2	2	3	3	3
	CO 5	2	2	3	3	2	3	2	1	2	3	2	3	3	2
	CO 6	3	3	3	3	3	3	1	2	3	3	2	2	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	3	3	2	2	3	2	1	2	2	2	3	3	3
	CO 2	3	2	3	2	1	3	2	1	2	2	2	3	3	2
B25BT0805	CO 3	3	3	3	3	3	3	2	2	2	3	2	3	3	3
	CO 4	3	3	3	3	3	3	2	0	2	2	2	3	3	3
	CO 5	2	2	3	3	2	3	2	1	2	3	2	3	3	2
	CO 6	3	3	3	3	3	3	1	2	3	3	2	2	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	3	3	1	3	3	1	1	2	1	1	2	3	0	2
	CO 2	3	2	2	2	1	1	1	1	0	1	2	1	0	2
	CO 3	2	1	2	2	1	1	1	0	1	1	2	1	0	1
B25BT0806	CO 4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1
	CO 5	2	2	1	3	2	0	1	0	1	1	2	2	0	1
	CO 6	2	2	1	3	0	2	0	1	1	2	2	0	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

	CO 1	3	3	2	3	2	1	0	2	1	1	2	1	0	2
	CO 2	3	2	2	2	0	1	0	2	0	2	2	1	0	2
B25BTS811	CO 3	2	1	2	2	1	0	0	0	1	1	2	1	0	1
	CO 4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1
	CO 5	2	2	1	3	2	0	1	0	1	1	2	2	0	1
	CO 6	2	2	1	3	0	2	0	1	1	2	2	0	1	1
	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	CO 1	2	2	3	1	2	3	0	2	1	1	2	1	1	2
	CO 2	2	3	3	1	2	3	1	3	1	2	2	2	2	2
B25BTS812	CO 3	2	2	3	2	2	2	0	3	1	2	2	2	1	2
	CO 4	2	2	3	2	2	2	0	2	1	2	2	1	0	0
	CO 5	2	3	3	1	2	2	1	2	2	2	2	0	1	0
	CO 6	2	1	2	0	0	1	2	2	0	1	2	0	0	0
	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

Course Code B25BT0807	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0801	CO 1	3	3	3	3	2	2	2	3	2	2	2	2	1	3
	CO 2	3	3	2	2	3	2	2	2	2	2	2	3	3	2
	CO 3	3	2	1	2	3	2	2	2	2	2	2	3	2	3
	CO 4	1	2	2	2	2	2	2	2	3	2	2	3	3	2
	CO 5	3	2	1	2	2	3	1	1	1	1	2	3	3	2
	CO 6	1	3	2	3	2	2	1	1	1	2	2	2	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0802	CO 1	2	2	2	2	2	2	2	2	2	2	2	2	3	2
	CO 2	2	2	2	1	2	3	2	2	2	2	2	3	1	1
	CO 3	2	2	2	2	2	3	2	1	2	3	2	3	2	2
	CO 4	2	2	2	1	2	2	2	1	2	1	2	3	3	2
	CO 5	1	2	2	2	3	2	2	1	2	2	2	2	3	2
	CO 6	2	2	2	1	2	2	3	2	3	3	2	2	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	2	1	2	2	2	3	3	2	2	2	2	2	2	2
	CO 2	3	3	2	2	2	3	3	3	3	3	2	3	2	2
	CO 3	1	2	1	1	3	3	3	1	2	3	2	2	3	2
B25GN0803	CO 4	3	1	3	1	3	1	2	3	3	1	2	3	3	2
	CO 5	2	3	3	2	3	3	3	3	3	3	2	3	3	2
	CO 6	2	3	3	3	2	2	3	2	3	3	2	1	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0804	CO 1	2	2	2	2	2	2	1	2	1	1	2	2	3	2
	CO 2	1	2	2	2	3	2	1	2	2	2	2	3	1	1
	CO 3	3	2	1	2	3	2	2	2	2	2	2	3	2	2
	CO 4	1	2	1	2	2	2	1	2	2	2	2	3	3	2
	CO 5	2	2	2	2	3	2	2	2	2	1	2	2	3	2
	CO 6	3	3	2	3	2	2	1	2	2	2	2	2	3	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO 1	2	3	3	2	2	2	1	2	1	3	2	2	1	1
	CO 2	2	2	3	3	3	3	3	3	3	3	2	3	1	1

B25GN0805	CO 3	2	1	2	2	2	3	2	1	2	3	2	3	3	3
	CO 4	2	1	1	1	1	2	2	2	3	3	2	3	3	1
	CO 5	1	1	1	1	3	3	3	3	3	3	2	2	3	2
	CO 6	2	2	2	2	2	2	3	2	2	3	2	2	3	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0806	CO 1	2	1	3	1	3	3	3	2	3	2	2	3	2	2
	CO 2	2	2	2	2	3	2	1	2	2	2	2	3	2	2
	CO 3	3	2	1	2	3	2	2	2	2	2	2	3	1	1
	CO 4	1	2	1	2	2	2	1	2	2	2	2	2	3	1
	CO 5	2	2	1	2	2	3	2	2	2	1	2	2	3	2
	CO 6	3	3	2	3	2	2	1	2	2	2	2	2	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS811	CO 1	1	2	2	1	2	1	2	2	1	1	2	2	1	2
	CO 2	2	2	2	2	2	2	2	3	3	3	2	2	1	1
	CO 3	2	2	2	1	2	3	2	1	2	3	2	3	2	2
	CO 4	3	3	3	3	3	3	3	3	3	3	2	3	3	1
	CO 5	3	3	3	3	3	3	2	2	2	2	2	2	3	2
	CO 6	3	3	2	3	2	2	1	1	1	1	2	2	3	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN812	CO 1	2	1	2	1	2	2	1	1	1	2	2	2	1	1
	CO 2	2	3	3	1	3	2	2	2	1	1	2	3	1	1
	CO 3	1	2	2	1	2	3	2	1	2	3	2	3	2	2
	CO 4	2	2	2	2	2	2	2	2	2	2	2	3	3	1
	CO 5	1	1	2	1	2	3	1	2	1	1	2	3	3	2
	CO 6	3	3	2	3	2	2	1	1	2	2	2	2	3	2

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0807	CO 1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO 2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO 3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO 4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO 5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO 6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0801	CO1	2	3	2	1	1	1	0	1	1	1	2	3	2	0
	CO2	2	2	2	1	1	1	0	1	2	1	2	2	3	0
	CO3	2	2	3	1	1	1	0	1	2	1	2	2	2	1
	CO4	2	3	1	1	1	1	1	1	2	2	2	2	3	1

	CO5	3	3	1	2	1	1	0	1	2	2	2	2	2	0
	CO6	3	3	1	2	1	1	1	2	2	3	2	3	3	3
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0802	CO1	1	2	2	1	0	0	0	0	0	0	2	2	2	0
	CO 2	2	0	1	2	2	1	0	0	0	0	2	2	2	0
	CO 3	2	0	2	0	0	0	0	0	0	0	2	2	2	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	2	1	0
	CO 6	2	2	1	0	0	0	0	0	0	0	2	3	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0803	CO 1	3	2	3	1	0	0	0	0	1	1	2	3	2	1
	CO 2	3	3	2	1	2	0	0	2	1	0	2	2	2	0
	CO 3	3	1	3	2	3	0	2	1	2	1	2	2	1	0
	CO 4	3	3	2	3	3	0	2	2	2	2	2	1	1	3
	CO 5	3	1	3	0	1	0	0	1	2	1	2	2	2	0
	CO 6	3	1	2	0	0	1	0	0	2	2	2	2	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0804	CO1	2	2	1	0	1	1	0	0	2	2	2	2	3	1
	CO2	2	2	1	1	1	1	0	0	2	2	2	2	2	2
	CO3	2	1	1	1	1	1	0	0	2	2	2	2	1	0
	CO4	2	3	2	0	1	1	0	0	2	2	2	2	2	0
	CO5	2	2	2	2	1	1	0	0	2	2	2	2	1	1
	CO6	2	2	2	0	1	1	0	0	1	2	2	2	2	1
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0805	CO 1	2	2	2	1	1	0	0	0	0	0	2	2	2	0
	CO 2	2	1	1	2	2	1	0	0	0	0	2	2	2	0
	CO 3	2	1	2	0	0	0	0	0	0	0	2	2	1	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	2	1	0
	CO 6	2	2	1	1	0	0	0	0	0	0	2	2	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0806	CO1	3	2	1	1	2	0	1	0	2	1	2	2	3	3
	CO2	3	2	3	1	0	0	0	1	2	0	2	2	2	1
	CO3	2	2	2	0	3	0	0	1	2	0	2	0	2	3
	CO4	3	2	2	2	2	0	0	2	3	2	2	2	1	3
	CO5	2	2	2	2	3	2	1	2	3	2	2	3	3	3
	CO6	3	2	3	1	2	0	1	2	2	0	2	1	2	1

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BCS811	CO 1	3	1	2	2	1	1	0	0	0	0	2	2	1	0
	CO 2	2	2	3	1	2	1	0	0	0	0	2	2	1	0
	CO 3	1	1	3	1	1	1	0	0	0	0	2	1	1	0
	CO 4	1	1	3	1	1	1	0	0	0	0	2	2	2	0
	CO 5	1	2	3	1	1	0	0	0	0	0	2	1	1	0
	CO 6	2	1	1	1	1	0	0	0	0	0	2	1	1	0
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BCS812	CO 1	1	2	3	2	1	1	1	1	2	1	2	2	1	3
	CO 2	2	2	2	3	1	2	1	0	3	1	2	2	2	2
	CO 3	1	2	3	1	2	2	2	1	2	2	2	2	2	2
	CO 4	1	2	2	2	1	1	2	1	1	2	2	2	2	2
	CO 5	1	1	2	1	1	1	0	0	2	1	2	2	2	2
	CO 6	2	2	2	1	1	1	0	1	2	3	2	2	1	2
Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0807	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0808	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0808	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

B25BC0808	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

B. Sc. (Biotechnology, Biochemistry, Genetics)

Scheme of Instruction and Detailed Syllabus as per NEP 2020

(Effective from the Academic Year 2025-26)

Scheme of Instruction **Duration: 6+2 Semesters (3+1 Years)**

Sem	Course code	Title of the Course	DSC/DSE C/IDC/SE C/AEC/ VAC	Credit Pattern				
				L	T	P	Total	Hours
First	B25AHK103	Language II: Kannada I	AEC	3	0	0	3	3
	B25AHH103	Language II: Hindi I		3	0	0	3	3
	B25AHA101	Language II: Additional English I		3	0	0	3	3
	B25AHE101	Communicative English I	AEC	3	0	0	3	3
	B25BT0101	Cell Biology	DSC	3	0	0	3	4
	B25BC0101	General Biochemistry	DSC	3	0	0	3	4
	B25GN0101	Classical Genetics	DSC	3	0	0	3	4
	B25BTS111	Introduction to Good Laboratory Practices	DSE	2	0	0	2	2
	B25BTS112	Bioethics and Intellectual Property Rights (IPR)		2	0	0	2	2
	B25BT0102	Cell Biology Lab	DSC	0	0	2	2	3
	B25BC0102	Laboratory Course 1 (Biochemistry)	DSC	0	0	2	2	3
	B25GN0102	Classical Genetics Lab	DSC	0	0	2	2	3
	B25BT0103	Skill Enhancement Course-1 (Biotechnology)	SEC	0	0	3	3	3
	Total Credits			**17**	**0**	**09**	**26**	**32**
Second	B25AHK203	Language II: Kannada II	AEC	3	0	0	3	3
	B25AHH203	Language II: Hindi II		3	0	0	3	3
	B25AHA201	Language II: Additional English II		3	0	0	3	3
	B25AHE201	Communicative English II	AEC	3	0	0	3	3
	B25BT0201	General Microbiology	DSC	3	0	0	3	4
	B25BC0201	Biomolecules	DSC	3	0	0	3	4
	B25GN0201	Cytogenetics	DSC	3	0	0	3	4
	B25BT0202	General Microbiology Lab	DSC	0	0	2	2	3
	B25BC0202	Laboratory Course II (Biochemistry)	DSC	0	0	2	2	3
	B25GN0202	Cytogenetics Lab	DSC	0	0	2	2	3
	B25AS0213	Cyber Security	VAC	1	0	0	1	2
	Total Credits			**16**	**0**	**06**	**22**	**29**

	1st year credits			**33**	**0**	**15**	**48**	**61**
Students exiting the program after securing 48 Credits will be awarded UG Certificate in Science (BBG) provided they secure 4 credits in work-based vocational courses offered during summer term internship/apprenticeship in addition to 3 credits from skill-based courses earned during 1st and 2nd semesters.								
Third	B25AHK303	Language II: Kannada III	AEC	3	0	0	3	3
	B25AHH303	Language II: Hindi III		3	0	0	3	3
	B25AHA301	Language II: Additional English III		3	0	0	3	3
	B25BT0301	Environmental Biotechnology	DSC	3	0	0	3	4
	B25BC0301	Human Physiology	DSC	3	0	0	3	4
	B25GN0301	Molecular Genetics	DSC	3	0	0	3	4
	B25BT0302	Environmental Biotechnology LAB	DSC	0	0	2	2	3
	B25BC0302	Laboratory course III (Biochemistry)	DSC	0	0	2	2	3
	B25GN0302	Molecular Genetics LAB	DSC	0	0	2	2	3
	B25BCS311	Hormonal Biochemistry	DSE	2	0	0	2	2
	B25BCS312	Nutritional Biochemistry		2	0	0	2	2
	B25BC0303	Skill Enhancement course II-(Biochemistry)	SEC	0	0	3	3	3
	B25SB0301	Health and Wellness	VAC	1	0	0	1	1
	B25NC0109	NCC Activities						
	B25NS0108	NSS Activities						
		Total Credits		**15**	**00**	**09**	**24**	**30**
Fourth	B25AHK403	Language II: Kannada IV	AEC	3	0	0	3	3
	B25AHH403	Language II: Hindi IV	AEC	3	0	0	3	3
	B25AHA401	Language II: Additional English IV	AEC	3	0	0	3	3
	B25BT0401	Genetic Engineering	DSC	3	0	0	3	4
	B25BC0401	Biochemical Techniques	DSC	3	0	0	3	4
	B25GN0401	Developmental Genetics	DSC	3	0	0	3	4
	B25BT0402	Genetic Engineering Lab	DSC	0	0	2	2	3
	B25BC0402	Laboratory course IV (Biochemistry)	DSC	0	0	2	2	3
	B25GN0402	Developmental Genetics Lab	DSC	0	0	2	2	3
	B25AS0415	Introduction to AI in Life Sciences	IDC	2	0	0	2	2
	B25AS0412	Environmental Studies	AEC	2	0	0	2	2
	Total Credits			**16**	**0**	**06**	**22**	**28**
	2nd year credits			**31**	**00**	**15**	**46**	**58**
	2-year credits			**64**	**00**	**30**	**94**	**119**
	Students exiting the program after securing 94 Credits will be awarded UG Diploma in Science (BBG) provided they secure 4 credits in skill-based vocational courses offered during 1st year or 2nd year summer term.							
Fifth	B25BT0501	Immunology	DSC	3	0	0	3	4
	B25BC0501	Metabolism I	DSC	3	0	0	3	4
	B25GN0501	Human Genetics	DSC	3	0	0	3	4
	B25BT0502	Immunology Lab	DSC	0	0	2	2	3
	B25BC0502	Laboratory course V (Biochemistry)	DSC	0	0	2	2	3
	B25GN0502	Human Genetics Lab	DSC	0	0	2	2	3
	B25GNS511	Medical Genetics		2	0	0	2	2

	B25GNS512	Genotoxicity	DSE	2	0	0	2	2
	B25AS0501	"R" Programming	IDC	2	0	0	2	2
	B25LS0501	Constitution of India and Professional Ethics	AEC	2	0	0	2	2
		Total Credits		**15**	**0**	**06**	**21**	**27**
Sixth	B25BT0601	Plant Biotechnology	DSC	3	0	0	3	4
	B25BC0601	Metabolism II	DSC	3	0	0	3	4
	B25GN0601	Evolutionary and Biometrical Genetics	DSC	3	0	0	3	4
	B25BT0602	Plant Biotechnology Lab	DSC	0	0	2	2	3
	B25BC0602	Laboratory course VI (Biochemistry)	DSC	0	0	2	2	3
	B25GN0602	Evolutionary and Biometrical Genetics lab	DSC	0	0	2	2	3
	B25AS0601	Python Programming	IDC	2	0	0	2	2
	B25PT0601	Soft skill training	SEC	1	0	0	1	2
	B25AS0604	Internship/Project	DSE	0	0	3	3	4
		Total Credits		**12**	**0**	**9**	**21**	**29**
		3rd year credits		**27**	**0**	**15**	**42**	**56**
		3-year degree credits		**91**	**0**	**45**	**136**	**175**
	Exit Option with Bachelor of Science – B.Sc. in Biotechnology, Biochemistry, Genetics– BBG (with the completion of Courses equal to a minimum of 136 Credits) OR Continue studies to earn B.Sc. (Honors) / B.Sc. (Honors with Research) Degree.							
	Note: Students who secure 75% and above marks in the first SIX Semesters and wish to undertake Research at the Undergraduate level can choose a Research stream in the Fourth Year and such students are awarded B Sc. (Honors with Research) Degree							
Seventh		**B.Sc. (Hons.) in Biotechnology**						
	B25BT0701	Applied Microbiology	DSC	3	0	0	3	3
	B25BT0702	Bioprocessing Engineering	DSC	3	0	0	3	3
	B25BT0703	Medical Biotechnology	DSC	3	0	0	3	3
	B25BT0704	Applied Microbiology Lab	DSC	0	0	2	2	3
	B25BT0705	Bioprocessing Engineering Lab	DSC	0	0	2	2	3
	B25BT0706	Medical Biotechnology Lab	DSC	0	0	2	2	3
	B25BTS711	Aquatic Biotechnology	DSE	3	0	0	3	3
	B25BTS712	Animal Biotechnology						
	B25BTS713	AI Techniques in Biological Sciences	DSE	2	0	0	2	2
	B25BTS714	AI Literacy in Health care						
		Total Credits		**14**	**0**	**6**	**20**	**23**
		B.Sc. (Hons.) in Genetics						
	B25GN0701	Plant molecular genetics	DSC	3	0	0	3	3
	B25GN0702	Immunogenetics and immune technology	DSC	3	0	0	3	3
	B25GN0703	Genomics and proteomics	DSC	3	0	0	3	3
	B25 GN 0704	Plant molecular genetics lab	DSC	0	0	2	2	3
	B25GN0705	Immunogenetics and immune technology lab	DSC	0	0	2	2	3
	B25GN0706	Genomics and proteomics lab	DSC	0	0	2	2	3
	B25GNS711	Genetic of infertility and ART						3

	B25GNS712	Analytical Techniques in Genetics	DSE	3	0	0	3	
	B25BTS713	AI Techniques in Biological Sciences	DSE	2	0	0	2	2
	B25BTS714	AI Literacy in Health care						
		Total Credits		**14**	**0**	**6**	**20**	**23**
		B.Sc. (Hons.) in Biochemistry						
	B25BC0701	Clinical Biochemistry	DSC	3	0	0	3	3
	B25BC0702	Molecular Endocrinology	DSC	3	0	0	3	3
	B25BC0703	Plant Biochemistry	DSC	3	0	0	3	3
	B25BC0704	Laboratory course VII (Clinical Biochemistry Lab)	DSC	0	0	2	2	3
	B25BC0705	Laboratory course VIII (Molecular Endocrinology Lab)	DSC	0	0	2	2	3
	B25BC0706	Laboratory course IX (Plant Biochemistry Lab)	DSC	0	0	2	2	3
	B25BCS711	System biology	DSE	3	0	0	3	3
	B25BCS712	Phytochemistry of medicinal plants						
	B25BTS713	AI Techniques in Biological Sciences	DSE	2	0	0	2	2
	B25BTS714	AI Literacy in Health care						
		Total Credits of 7th Sem		**14**	**0**	**6**	**20**	**23**
		B.Sc. (Hons.) in Biochemistry						
	B25BT0801	Enzyme Technology	DSC	2	0	0	2	2
	B25BT0802	System Biology	DSC	2	0	0	2	2
	B25BT0803	Pharmacology and Toxicology	DSC	2	0	0	2	2
	B25BT0804	Enzyme Technology Lab	DSC	0	0	2	2	3
	B25BT0805	System Biology Lab	DSC	0	0	2	2	3
	B25BT0806	Pharmacology and Toxicology Lab	DSC	0	0	2	2	3
	B25BTS811	Nanobiotechnology	DSE	2	0	0	2	2
	B25BTS812	Clinical data Science						
	B25BT0807	Research Project / Internship	DSE	0	0	6	6	12
		Total Credits		**8**	**0**	**12**	**20**	**29**
		B.Sc. (Hons.) in Genetics						
Eighth	B25GN0801	Recombinant DNA technology	DSC	2	0	0	2	2
	B25GN0802	Expression of Eukaryotic genes	DSC	2	0	0	2	2
	B25GN0803	Cancer Genetics	DSC	2	0	0	2	2
	B25GN0804	Recombinant DNA technology Lab	DSC	0	0	2	2	3
	B25GN0805	Eukaryotic gene regulation Lab	DSC	0	0	2	2	3
	B25GN0806	Cancer Genetics Lab	DSC	0	0	2	2	3
	B25GNS811	Applied Microbial Genetics	DSE	2	0	0	2	2
	B25GNS812	Pharmacogenomics and nutrigenomics						
	B25GN0807	Research Project / Internship	DSE	0	0	6	6	12
		Total Credits		**8**	**0**	**12**	**20**	**29**
		B.Sc. (Hons.) in Biochemistry						
	B25BC0801	Cell and Membrane Biochemistry	DSC	2	0	0	2	2
	B25BC0802	Biochemistry of Diseases	DSC	2	0	0	2	2

	B25BC0803	Advance enzymology	DSC	2	0	0	2	2
	B25BC0804	Laboratory course X (Cell and Membrane Biochemistry Lab)	DSC	0	0	2	2	3
	B25BC0805	Laboratory course XI (Biochemistry of Diseases Lab)	DSC	0	0	2	2	3
	B25BC0806	Laboratory course XII (Advance enzymology Lab)	DSC	0	0	2	2	3
	B25BCS811	Biochemistry aspect of forensic Science	DSE	2	0	0	2	2
	B25BCS812	Cancer Biology						
	B25BC0807	Research Project / Internship	DSE	0	0	6	6	12
		Total Credits		**8**	**0**	**12**	**20**	**29**
		4th year credits		**22**	**0**	**18**	**40**	**52**
		4-year degree credits		**113**	**0**	**63**	**176**	**227**
Award of Bachelor of Science (Honors) Degree in Biotechnology/ Biochemistry/ Genetics (with the completion of Courses equal to a minimum of 176 Credits) OR Continue studies for Masters' Degree								
	B.Sc. (Honors with Research) Degree in Biotechnology							
	B25BT0801	Enzyme Technology	DSC	2	0	0	2	2
EI GHT	B25BT0802	System Biology	DSC	2	0	0	2	2
	B25BT0804	Enzyme Technology Lab	DSC	0	0	2	2	3
	B25BT0805	System Biology Lab	DSC	0	0	2	2	3
	B25BT0808	Research Project / Internship	DSE	0	0	12	12	24
	B.Sc. (Honors with Research) Degree in Biochemistry							
EI GHT	B25BC0801	Cell and Membrane Biochemistry	DSC	2	0	0	2	2
	B25BC0802	Biochemistry of Diseases	DSC	2	0	0	2	2
	B25BC0804	Laboratory course X (Cell and Membrane Biochemistry Lab)	DSC	0	0	2	2	3
	B25BC0805	Laboratory course XI (Biochemistry of Diseases Lab)	DSC	0	0	2	2	3
	B25BC0808	Research Project / Internship	DSE	**0**	**0**	12	12	24
	B.Sc. (Honors with Research) Degree in Genetics							
EI GHT	B25GN0801	Recombinant DNA technology	DSC	2	0	0	2	2
	B25GN0802	Expression of eukaryotic genes	DSC	2	0	0	2	2
	B25GN0804	Recombinant DNA technology Lab	DSC	0	0	2	2	3
	B25GN0805	Eukaryotic gene regulation Lab	DSC	0	0	2	2	3
	B25GN0808	Research Project / Internship	DSE	**0**	**0**	12	12	24
	Total Credits of 8th Sem (Honors with Research)			**4**	**0**	**16**	**20**	**34**
	Total Credits of 7th and 8th Sem			**18**	**0**	**22**	**40**	**57**
	Total Credits of 1st to 8th Sem			**109**	**0**	**67**	**176**	**232**
Award of Bachelor of Science (Honors with Research) Degree in Biotechnology/ Biochemistry/ Genetics (with the completion of Courses equal to a minimum of 176 Credits) OR Continue studies for Masters' Degree								

Semester wise summary of credit distribution (B.Sc. Hons.)

Semester	Credit Patterns				
	L	**T**	**P**	**Total**	**Hours**
First	**17**	**0**	**09**	**26**	**32**
Second	**16**	**0**	**06**	**22**	**29**
Third	**15**	**00**	**09**	**24**	**30**

Fourth	**16**	**0**	**06**	**22**	**28**
Fifth	**15**	**0**	**06**	**21**	**27**
Sixth	**12**	**0**	**09**	**21**	**29**
Seventh	**14**	**0**	**6**	**20**	**23**
Eighth	**8**	**0**	**12**	**20**	**29**
Total	**113**	**00**	**63**	**176**	**227**

Semester wise summary of credit distribution (Hons. By Research)

Semester	**Credit Patterns**				
	L	**T**	**P**	**Total**	**Hours**
First	**17**	**0**	**09**	**26**	**32**
Second	**16**	**0**	**06**	**22**	**29**
Third	**15**	**0**	**09**	**24**	**30**
Fourth	**16**	**0**	**06**	**22**	**28**
Fifth	**15**	**0**	**06**	**21**	**27**
Sixth	**12**	**0**	**09**	**21**	**29**
Seventh	**14**	**0**	**6**	**20**	**23**
Eighth	**4**	**0**	**16**	**20**	**34**
Total	**109**	**00**	**67**	**176**	**232**

Semester	**Ability Enhancement Course AEC**	**Discipline Specific Common Course DSC**	**Discipline Specific Elective Course DSE**	**Inter disciplinary Course IDC**	**Skill Enhancement course SEC**	**Value added Course VAC**	**Total Credits**
First	6	15	2	-	3	-	26
Second	6	15	-	-	-	1	22
Third	3	15	2	-	3	**1**	24
Fourth	5	15	-	2	-	-	22
Fifth	2	15	2	2	-	-	21
Sixth	-	15	**3**	2	1	-	21
Seventh	-	15	5	-	-	-	20
Eighth	-	12	8	-	-	-	20
Total	**22**	**117**	**22**	**6**	**7**	**2**	**176**

B.Sc. – Biotechnology, Biochemistry, Genetics
Detailed Syllabus
(Effective from Academic Year 2025-26)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHK103	**Language I: Kannada - I**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Overview

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯ ಪ್ರಕಾರವಾಗಿ ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Prerequisite / Pre reading for the course

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ.
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy:

- Direct method
- ICT and Digital support (Links attached)
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಒಳಗೊಂಡಂತೆ ವಿಷಯವಾರು ಪಠ್ಯಗಳನ್ನು ನೀಡಲಾಗಿದ್ದು, ಆ ಮೂಲಕ ಕನ್ನಡ ಭಾಷೆ, ಸಂಸ್ಕೃತಿಯ ಜೊತೆಗೆ ಮಾನವೀಯ ಗುಣಗಳನ್ನು ಪರಿಚಯಿಸುವ ಹಾಗೂ ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಪ್ರೇರೇಪಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಮೊದಲನೆಯ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ಕನ್ನಡ ನಾಡು-ನುಡಿ-ಚಿಂತನೆ, ಭೂಮಿ, ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂದಿಸಿದಂತೆ ವಿಷಯಗಳನ್ನು ನೀಡಿದ್ದು, ಅದಕ್ಕೆ ಪೂರಕವಾಗಿ ಸಾಹಿತ್ಯಿಕ ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ. ಈ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1) ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ. ಹಾಗೂ ವೈವಿಧ್ಯಮಯ ಭಾರತದ ಸಾಂಸ್ಕೃತಿಕ ನೆಲೆಗಳನ್ನು ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ

2) ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.

3) ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಬರಹ, ವೃತ್ತಿ ಪೂರ್ವಕ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ

4) ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

Course Outcomes:

ಕನ್ನಡ ನಾಡು-ನುಡಿ-ಚಿಂತನೆ, ಭೂಮಿ, ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಸಾಹಿತ್ಯ ಪಠ್ಯಗಳ ಕಲಿಕೆಯ ಮೂಲಕ ಅವುಗಳ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

1.ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ಸೂಕ್ಷ್ಮತೆಯ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಸುತ್ತದೆ

2.ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳನ್ನು ವಿವಿಧ ಆಯಾಮಗಳೊಂದಿಗೆ ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.
3.ಉತ್ತಮ ಭಾಷಾ ಕೌಶಲ್ಯವನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.
4.ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.
5.ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯದ ಶ್ರೀಮಂತಿಕೆಯ ಜೊತೆಗೆ ಮಾನವೀಯಮೌಲ್ಯಗಳನ್ನು ಮೂಡಿಸುತ್ತದೆ.
6.ಸದೃಢ ಬೌದ್ಧಿಕ ಮತ್ತು ಮಾನಸಿಕ ವ್ಯಕ್ತಿತ್ವವನ್ನು ವಿಕಾಸಿಸುತ್ತದೆ.

Mapping of Course Outcomes with programme Outcomes

COURS CODE	Course Outcomes	Program Outcomes													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHK103	CO 1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO 2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO 3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO 4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0

COURSE CONTENT/ SYLLABUS

ಪರಿವಿಡಿ		
ಘಟಕ 1 – ಕನ್ನಡ ನಾಡು ನುಡಿ ಚಿಂತನೆ 1.1 ಆರಂಕುಶಮಿಟ್ಟೊಡಂ ನೆನೆವುದೆನ್ನ ಮನಂ ಬನವಾಸಿ ದೇಶಮಂ **1.2 ಕನ್ನಡ ಕಟ್ಟುವ ಕೆಲಸ** **1.3 ಕನ್ನಡ ಸಂಸ್ಕೃತಿ ಮತ್ತು ಸ್ವಾಯತತೆ**	**ಪಂಪ** **ಹಾ.ಮ ನಾಯಕ** **ಬರಗೂರು ರಾಮಚಂದ್ರಪ್ಪ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 2 – ಭೂಮಿ **2.1 ಜನಪದ ಕಾವ್ಯ** **2.2 ಮರ ಗಿಡ ಬಳ್ಳಿ** **2.3 ರೈತನ ದೃಷ್ಟಿ**	**ಜನಪದ ತ್ರಿಪದಿಗಳು** **ವೈದೇಹಿ** **ಕುವೆಂಪು**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 3 – ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ **3.1 ಕನ್ನಡ ಸಾಫ್ಟ್‌ವೇರ್‌ಗಳ ಇತಿಹಾಸ** **3.2 ಮಹಿಳೆ ಮತ್ತು ವಿಜ್ಞಾನ** **3.3 ವೈಚಾರಿಕ ಪ್ರಜ್ಞೆಗೆ ಅಡೆತಡೆಗಳು**	**ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ** **ನೇಮಿಚಂದ್ರ** **ಹೆಚ್. ನರಸಿಂಹಯ್ಯ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 4 – ಸಂಕೀರ್ಣ **4.1 ಸಮಸ್ಯೆ ಮಗು** **4.2 ಕರಕುಶಲ ಕಲೆಗಳ ಮೇಲೆ ತಂತ್ರಜ್ಞಾನದ ಪ್ರಭಾವ** **4.3 ಎದೆಗೆ ಬಿದ್ದ ಅಕ್ಷರ (ಆಯ್ದ ಭಾಗ)**	**ಎ.ಎನ್. ತ್ರಿವೇಣಿ** ಡಾ. ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ ದೇವನೂರು ಮಹದೇವ	**9 ಗಂಟೆಗಳು**

TextBooks:
ಸಂಯೋಜಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ **'ವಿಜ್ಞಾನ ಸೌರಭ' – ಮೊದಲನೇ ಸೆಮಿಸ್ಟರ್ ಬಿಎಸ್ಸಿ (AS, AHS, SS)**

ಪರಾಮರ್ಶನ ಗ್ರಂಥಗಳು:
1.ಸಮಗ್ರಕಾವ್ಯ- ಗೋಪಾಲಕೃಷ್ಣ ಅಡಿಗ, ಕರ್ನಾಟಕ ಬುಕ್ ಏಜನ್ಸಿ, ಬೆಂಗಳೂರು,2015
2.ಪಂಪ ಮಹಾ ಕವಿ ವಿರಚಿತ ಪಂಪಭಾರತಂ – ಗದ್ಯಾನುವಾದ, ಅನಂತರಂಗಚಾರ್, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು, 2018
3.ಸಾಹಿತ್ಯ ವೈಜ್ಞಾನಿಕ ಮೀಮಾಂಸೆ-ಗಿರಿ, ಮನೋಹರ ಗ್ರಂಥಮಾಲ, ಧಾರವಾಡ,2016
4.ಸ್ಮೃತಿ- ವಿಸ್ಮೃತಿ ಭಾರತೀಯ ಸಂಸ್ಕೃತಿ- ರಾಜರಾಮ ಹೆಗಡೆ,ವಸಂತ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು2018
5.ಎದೆಗೆ ಬಿದ್ದ ಅಕ್ಷರ- ದೇವನೂರು ಮಹಾದೇವ, ಅಭಿನವ ಪ್ರಕಾಶನ ಬೆಂಗಳೂರು,2013
6.ಕುವೆಂಪು ದರ್ಶನ ವಿಚಾರ- ದೇಜಗೌ, ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು,2010
7.ದಕ್ಷಿಣ ಕರ್ನಾಟಕದ ಕಾವ್ಯ ಪ್ರಕಾರಗಳು- ಜಿ.ಶಂ.ಪ, ಅಭಿನವ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು.2016

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHH103	**Language I: Hindi - I**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Overview: पाठ्यक्रम का अवलोकन:

यह पाठ्यक्रम नवसिखुओं को अपनी भाषा की क्षमता के विकास हेतु तथा विभिन्न साहित्यिक गतिविधियों के माध्यम से समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिप्रेरित करता है।

Prerequisites/Pre reading for the course: पाठ्यक्रम हेतु पूर्व अपेक्षाएँ:

- विद्यार्थी ने पी.यू.सी. स्तर पर द्वितीय भाषा के रूप में हिंदी का अध्ययन किया होना चाहिए।
- हिंदी साहित्य के इतिहास का संक्षिप्त ज्ञान आवश्यक है।
- हिंदी व्याकरण की मूलभूत समझ आवश्यक है।
- अंग्रेज़ी-हिंदी अनुवाद से संबंधित जानकारी आवश्यक है।

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning

Objectives: पाठ्यक्रम के उद्देश्य:

- संदर्भानुसार उपयुक्त भाषा के प्रयोग की दक्षता का विकास करना।
- साहित्य के माध्यम से समाज और मानवीय मूल्यों की समझ विकसित कर उन मूल्यों की रक्षा के लिए प्रेरित करना।
- विद्यार्थियों में पुस्तक पठन एवं लेखन की स्वाभाविक प्रवृत्ति को प्रोत्साहित करना।
- साहित्य के माध्यम से प्रभावी एवं कुशल संप्रेषण कौशल का विकास करना।

Course Outcomes पाठ्यक्रम के अधिगम परिणाम

पाठ्यक्रम के समापन पर विद्यार्थी:

- सामाजिक मूल्यों और नैतिक उत्तरदायित्व को स्वीकार करने में सक्षम होगा।
- साहित्य की प्रासंगिकता को जीवन में समझने की क्षमता रखेगा।
- समाज में अंतर्निहित प्रवृत्तियों और विचारधाराओं का विश्लेषण कर सकेगा।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकेगा।

Mapping of Course Outcomes with programme Outcomes

Course code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHH103	CO1	0	0	1	0	1	1	1	1	1	2	0	2	2	1
	CO2	0	0	1	0	1	1	1	3	0	0	0	2	0	1
	CO3	0	0	0	1	0	1	1	3	0	0	0	3	2	0
	CO4	0	0	0	1	0	1	1	3	0	0	0	3	2	0
	CO5	0	0	0	1	0	1	1	3	0	0	0	3	2	0
	CO6	0	0	0	1	0	1	1	3	0	0	0	3	2	0

Course Content

इकाई – 1 : कहानी, भाषण रचना (10 घंटे)

1. **कहानी** – *पंच परमेश्वर* – प्रेमचंद
2. **कहानी** – *ढाई बीघा ज़मीन* – मृदुला सिन्हा
3. **भाषण रचना** – *एक दीवाना भाषण* – हरिशंकर परसाई

इकाई – 2 : कहानी, निबंध (10 घंटे)

4. **कहानी** – *अकाल मृत्यु* – जयप्रकाश
5. **कहानी** – *निवासित* – सूर्यबाला
6. **निबंध** – *अच्छी हिंदी* – रवीन्द्रनाथ त्यागी

इकाई – 3 : कहानी, संस्मरण (10 घंटे)

7. **कहानी** – *ज़हरबाद* – पांडेय बेचन शर्मा 'उग्र'
8. **कहानी** – *परदेसी* – ममता कालिया
9. **संस्मरण** – *शरद के साथ बिताया कुछ समय* – अमृतलाल नागर

इकाई – 4 : अनुवाद (09 घंटे)

- **शब्दों का अनुवाद** (अंग्रेज़ी से हिंदी)

- **अनुच्छेद अनुवाद** (अंग्रेज़ी से हिंदी)
- **संक्षेपण** – परिच्छेद के एक तिहाई भाग में

पाठ्यपुस्तक:

- **हिंदी पाठ्यपुस्तक** – रेवा विश्वविद्यालय द्वारा प्रकाशित

संदर्भ पुस्तकें:

1. **सुबोध व्यावहारिक हिंदी** – डॉ. कुलदीप गुप्त
2. **अभिनव व्यावहारिक हिंदी** – डॉ. परमानंद गुप्त
3. **हिंदी साहित्य का इतिहास** – डॉ. नागेंद्र
4. **आधुनिक हिंदी साहित्य का इतिहास** – डॉ. बैन सिंह
5. **हिंदी साहित्य का नवीन इतिहास** – डॉ. लाल साहब सिंह
6. **शुद्ध हिंदी कैसे बोलें, कैसे लिखें** – प्रेमनाथ पांडेय
7. **कार्यालय अनुवाद निर्देशिका**

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25AHA101	**Language I: Additional English – I**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Description:

This course introduces students to the rich intersections of literature, ethics, inclusivity, culture, and communication. Through critical engagement with literary texts, speeches, film excerpts, and contemporary media, learners will explore moral dilemmas, social justice, identity, cultural narratives, and human resilience. Alongside literary study, students will enhance essential language skills—speaking, writing, vocabulary development, and translation—while fostering empathy, analytical thinking, and cultural awareness.

Course Objectives:

1. To critically analyse a variety of literary texts to understand human values, ethical dilemmas, and cultural expressions.

2. To develop communication skills, including public speaking, listening, translation, and writing, relevant to academic and real-world contexts.

3. To demonstrate creativity in written expression through slogan writing, travelogues, and interpretive tasks.

4. To interpret literature as a reflection and critique of society, identity, and the human condition.

Course Outcomes:

On completion of the course, learners will be able to:

- Discuss key ethical and humanistic themes in literature from various cultures and historical contexts.
- Analyze characters, themes, and literary devices in prose, poetry, drama, and multimedia texts.
- Apply inclusive and culturally sensitive perspectives in discussions, presentations, and written work.
- Develop creative and reflective works such as travelogues, slogans, and captions while demonstrating linguistic and cultural competence.

Mapping of Course Outcomes with programme Outcomes

Course code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHA101	CO1	2	1	0	1	0	0	1	0	0	0	0	2	0	1
	CO2	1	0	1	1	0	1	1	2	1	1	0	2	1	1
	CO3	1	1	1	1	0	0	0	1	1	1	0	3	1	0
	CO4	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO5	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO6	1	0	0	0	0	0	1	2	1	2	0	2	1	0

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	**Humanities and Ethics**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Literature:** 1.“Letter to God” – G. L. Fuentes 2.“The Bet” – Anton Chekhov *3.The Merchant of Venice* (excerpts) – William Shakespeare 4.Language: Vocabulary building 5.Speaking Skills– Public Speaking	**11 Hours**
II		Fill in the blanks/		**11 Hours**

	Inclusivity and Diversity	MCQs/ Comprehension Tasks/ Descriptive Questions	.1. "Thank You Ma'am" – Langston Hughes 2."And Still I Rise" – Maya Angelou 3."The Lesson" – Toni Bambara 4. Language – Listening activities – English Songs 5.Writing – Slogan/Caption Writing	
III	**Cultural Narratives**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	1.Supermarket in California" – Allen Ginsberg 2. *The Danger of a Single Story* (Ted Talk, excerpt) – Chimamanda Ngozi Adichie 3. *Kanthara* (Film Text) 4. Language – Introduction to Translation Skills and Cultural diversity	**11 Hours**
IV	**Travel and Adventure**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	1. "The Road Not Taken" – Robert Frost 2. *The Art of Lying – Mark Twain* 3. Ulysses – Alfred Tennyson 4. Language – Travelogue writing	**11 Hours**

References:

1. **Fuentes, Gregorio López.** *Letter to God and Other Stories*. Translated ed., Bantam Classics, 1991.

2. **Chekhov, Anton.** *The Complete Short Stories*. Edited by Richard Peace, Library of America, 2009.

3. **Shakespeare, William.** *The Merchant of Venice*. Edited by Barbara A. Mowat and Paul Werstine, Folger Shakespeare Library, 2010.

4. **Behrens, Laurence, and Leonard J. Rosen.** *Writing and Reading Across the Curriculum*. 10th ed., Pearson, 2018. *(Vocabulary-building support.)*

5. **Lucas, Stephen E.** *The Art of Public Speaking*. 12th ed., McGraw-Hill, 2015.

6. **Hughes, Langston.** *The Collected Works of Langston Hughes*. Edited by Arnold Rampersad and David Roessel, Knopf, 2001.

7. **Angelou, Maya.** *And Still I Rise*. Random House, 1978.

8. **Bambara, Toni Cade.** *Gorilla, My Love*. Vintage, 1996. *(Includes "The Lesson.")*

9. **Patricia, Smith.** *Words on the Move: The Story of Slang*. Bloomsbury, 2014. *(For listening and language contexts.)*

10. **Reid, Sheryl, and Anne Margaret Daniel.** *Writing for Social Change: From Piggie to Protest*. Bloomsbury Academic, 2020. *(For slogan/caption writing.)*

11. **Ginsberg, Allen.** *Howl and Other Poems*. Edited by Barry Miles, Penguin Classics, 1993. *(Includes "Supermarket in California.")*

12. **Adichie, Chimamanda Ngozi.** *We Should All Be Feminists*. Anchor, 2014. *(Introduction and excerpts echo "Danger of a Single Story".)*

13. **Krings, Matthias, and Daniel (eds.).** *Reframing Multiculturalism: Cultural Hybridity and Translation*. Palgrave Macmillan, 2019.

14. **Shohat, Ella, and Robert Stam.** *Unthinking Eurocentrism: Multiculturalism and the Media*. 2nd ed., Routledge, 2014.

15. **Bordwell, David, and Kristin Thompson.** *Film Art: An Introduction*. 12th ed., McGraw-Hill, 2016. *(Useful for film interpretation like Kanthara.)*

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25AHE101	Communicative English – I	AEC	3	0	0	3	3

Course Description:

This course focuses on improving the spoken and written communication of the learners. The course develops personal, interpersonal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.

Pre-requisites:
The student must have knowledge of intermediate English Grammar and LSRW skills.

Pedagogy:
Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:
1. To enhance functional communication skills.
2. To develop functional use of language in professional contexts.
3. To utilize oral presentations in multiple contexts.
4. To apply effective written skills in formal communication.

Course Outcomes:
On completion of the course, learners will be able to:
1. Identify pressing issues relating to society, environment and media.
2. Develop a process-oriented approach to writing.
3. Apply the grammatical skills developed during the course aptly.
4. Demonstrate a good command over language usage and refined interpersonal skills.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHE101	CO1	2	1	0	1	0	0	1	0	0	0	0	2	0	1
	CO2	1	0	1	1	0	1	1	2	1	1	0	2	1	1
	CO3	1	1	1	1	0	0	0	1	1	1	0	3	1	0
	CO4	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO5	1	0	0	0	0	0	1	2	1	2	0	2	1	0
	CO6	1	0	0	0	0	0	1	2	1	2	0	2	1	0

Course Content:
Unit-I: Functional English **[11 Hours]**
Remedial Grammar: Sentence Structure - II
Kinds of Sentences
Tenses

Writing Skills: Official Letters
- Apology Letter
- Complaint Letter
- Letter of Enquiry: (Internship, Fellowship, Job Options)

Literature: Jyoti Lanjewar – "Mother"

Unit-II: Interpersonal Skills **[11 Hours]**

Remedial Grammar: Clause Analysis

Writing Skills: Essays:

- Descriptive Essay
- Narrative Essay
- Compare and contrast Essay
- Argumentative Essay
- Email Writing

Speaking: Debate

Literature: Nissim Ezekiel – Goodbye Party for Miss Pushpa T S

Unit-III: Multitasking Skills **[11 Hours]**

Remedial Grammar: Voices

Writing Skills:

- Note Taking
- Precis writing

Listening Skills: Listening Comprehension (Ted Talks/ Songs)

Literature: Abhijeet - On Screen Magic **-Tare Zameen Pe**

Unit-IV: Communication Skills **(11 Hours)**

Remedial Grammar:

- Prepositions of Place and Time
- Collocations
- Idioms and Phrases (Global)

Reading Skills: Comprehension with AI
(Unseen Passages followed by questions)

Literature: RK Narayan – An Astrologer's Day

References:

1. Green, David. Contemporary English Grammar Structures and Composition. MacMillan, 2010.
2. Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Longman, 2003.
4. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. Effective Technical Communication. Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

Course code	Cell Biology	Course type	L	T	P	C	CH
B25BT0101		DSC	3	0	0	3	4

Prerequisites/Pre reading for the course:

The student should be familiar with the basic concepts of biology.

Course Objectives:

The overall objectives of the course are to:

1. Provide students with the ability to recognize and identify the cell and its distinguishing feature.
2. Equip students with the understanding of the structure and organization of cell and related events of cell organelles
3. Provide students an understanding of cell cycle, cell division and cell death
4. Provide an understanding of cell signalling and signal transduction.

Course Outcomes:

After completing the course, the student should be able to:

1. Understand the structure and function of living cells
2. Outline the structure and function of cytoskeletal elements
3. Understand the concept of cell cycle and its regulation
4. Understand the concept of cell death and its regulation
5. Explore the concept of cell communication
6. Explore the concept of intracellular signal transductions

Mapping of Course Outcomes with programme Outcomes

Course code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0101	CO1	3	2	2	2	2	3	0	0	2	2	0	2	2	1
	CO2	3	2	2	2	3	0	0	0	1	2	0	2	0	1
	CO3	3	0	2	2	2	1	0	0	1	2	0	3	2	0
	CO4	3	2	2	2	2	1	0	0	2	2	0	3	2	0
	CO5	3	2	0	2	2	1	0	0	2	2	0	3	2	0
	CO6	3	2	2	2	3	1	0	0	2	2	1	3	2	0

Unit I: Cell Membrane and Cell Organelles 12 hrs

Historical perspectives of cell, cell theory, Prokaryotic and Eukaryotic cells; Ultrastructure of eukaryotic cells (Plant and animal), Plasma membrane -Ultrastructure and Functions (Active and Passive Transport, ion Channels and membrane pumps). Structure and functions of cell organelles: Nucleus, Mitochondria, Ribosomes, Golgi Complex, Endoplasmic reticulum, Lysosomes, peroxisomes.

Unit II: Cytoskeletal Systems and specialized cells 12hrs

Cytoskeleton - Nature of cytoskeleton, Actin filaments, actin-binding proteins-Molecular basis of muscle contraction, Intermediate filaments, Microtubules, MAPs, MTOC (Centrioles and Basal Body), Structure and functions of cilia and flagella. Cell Motility (Pseudopodial movement), Specialized cells: Muscle Cells (Types, Structure and function), Blood Cells (Types, Structure and function), Nerve cells (Types, Structure and function), Cancer cells

Unit III: Cell Cycle and Cell Death **12 hrs**

Cell cycle, regulation of cell cycle- Cyclins and Cyclin dependent kinases, Cell Cycle checkpoints. Cell division – (a) Mitosis (Process and stages of mitosis and significance of mitosis), (b) Meiosis (Process of meiosis, structure, and functions of synaptonemal complex, significance of meiosis), achromatic apparatus, Apoptosis- Mechanism and types, and necrosis, physiological relevance of cell death.

Unit IV: Extracellular Matrix and Cell Signaling **12 hrs**

Extracellular matrix and Cell-cell interactions, Cell adhesion-integrins, selectins, cadherins. Cell Junction- Tight and gap junctions, Desmosomes, plasmodesmata. Cell Signaling: General principles of cell signaling, signaling via G-protein coupled receptors, kinase receptors, Role of secondary messengers. Mechanism of nerve transmission- Resting and action potential, electrical and chemical transmission, Neurotransmitters, and their receptors.

Reference Books

1. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter (2014). 6th Edition. Molecular Biology of the Cell, Garland Science publisher.
2. Geoffrey M. Cooper and, Robert E. Hausman (2016). The Cell: A molecular approach.7th edition. Publisher: Sinauer Associates, USA.
3. Gerald Karp (2013). Cell and Molecular Biology: Concepts and Experiments.7th edition. John Wiley and Sons Inc. NY
4. Pollard TD, Earnshaw WC, Lippincott-Schwartz J, Johnson G (2022). Cell biology E-book. Elsevier Health Sciences.
5.

Course code	General Biochemistry	Course type	L	T	P	C	CH
B25BC0101		DSC	3	0	0	3	4

Course Objectives:

1. To study the structure and reactions of Chemical bonding.
2. To understand the properties of Liquids

3. To provide the basic characteristics of Chemical equilibrium
4. To make the students to recollect the basic chemistry concepts required for biochemical reactions.
5. To gain knowledge about anomalous propertis of water.
6. To understand the importance of buffer systems and buffer capacity.

Course Outcomes: After completing the course, the student shall be able to:

1. Analyse the properties of fluids.
2. Apply knowledge on preparation of buffers solutions.
3. Understand the relationship between kinetics and equilibrium.
4. Apply knowledge on understanding of catalysis.
5. Analyse the toxic levels of in organic substances and the biochemical mechanism of toxicity.
6. Understand the biological importance of metal ions

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0101	CO1	3	3	0	1	0	0	1	2	2	1	1	3	3	3
	CO2	3	3	3	1	1	0	0	1	1	2	1	3	3	3
	CO3	2	3	3	1	1	0	0	2	2	2	1	2	3	3
	CO4	2	3	3	1	1	0	0	1	1	2	1	3	3	3
	CO5	3	3	3	2	3	0	0	1	1	2	1	3	3	3
	CO6	3	3	3	3	3	0	0	1	1	2	1	3	3	3

UNIT-I **12hrs**

Chemical bonding: Nature and types of chemical bonding: Ionic bonding; Born-Haber cycle. Characteristics of ionic bonding, covalent bonding and its types, Hybridization in Boron, Carbon, Nitrogen and oxygen containing compounds. Electron affinity or electronegativity, polar and non-polar covalent bonds, Coordinate bond; Ligands, Noncovalent interactions; Hydrogen bonds; types, Hydrophobic, non-polar interactions. Vander Waals interactions. Water: Physical and chemical properties of water, Structure of water, Hydrogen bonding between water molecules, Role of non-covalent interactions in water**.**

UNIT II **12hrs**

Liquids: Properties of liquids – vapor pressure, viscosity and surface tension. Relationship between vapor pressure and boiling point, freezing point-heat of fusion. Viscosity- Definition, units, experimental determination using Ostwald's viscometer. Surface tension: - Definition, units, experimental determination using stalagmometer. Surfactants – effect of surfactants on surface tension. pH and Buffers: Lewis's concept of acids and bases. Ionic product of water, pH scale, weak acids and bases, Ionization of weak acids, Titration of a weak acid by a strong base. Henderson-Hassel balch equation and its applications, types of buffers, Buffer action. Biological buffer systems: Mechanism of action of Phosphate, Bicarbonate and protein buffer systems in human body.

UNIT III **12 hrs**

Chemical Equilibrium: Definition and example of Reversible reactions. Law of mass action, Chemical equilibrium–definition and characteristics. Relationship between Kp and Kc. Homogeneous and heterogeneous systems with an example of each. Le Chatelier's principle. Equilibrium constant and free energy change. Structure and biological applications of ATP and its role as energy currency of the cell. Binding of oxygen by hemoglobin. **Reaction Kinetics & Catalysis:** Definition of Molecularity, Order, and rate of reactions. Rate law or Rate equation, rate constant and half-life period. Expression for zero and first order reactions, Pseudo unimolecular reactions. Theories of reaction rates –Arrhenius equation, transition state theory. Characteristics of catalysts, Types of catalysis–with an example of biological and non-biological reactions.

UNIT IV **12 hrs**

Bio-inorganic and Environmental Chemistry: Metal ions in biological systems. Types of ligands with examples; Role of iron in Myoglobin and cytochromes, Magnesium in chlorophyll, Cobalt in vitamin12. Metal activated enzymes. Toxicology-toxicity and detoxification of Pb, Hg, Cd. LD-50 and ED-50 values of major toxicants (Bisphenol). Water pollution: Treatment of sewage and industrial effluents (tanning and electroplating); Pesticides hazards – Malathion, Cypermethrin. Brief Introduction to Bioremediation with applications in natural resources.

Reference Books:

1. Atkins' physical chemistry Atkins, 2014) by Peter Atkins, Julio De Paula, and James Keeler ,12 th edition; Oxford university press.
2. Physical Chemistry (2014) by David W. Ball 2 nd edition, W published by Thomson Press.
3. Text book of Biochemistry (2023) by Dr Prasad R Manjeshwar., 6 th edition, -Prasad Book house.
4. Sharma, L.R., Pathania, M.S. and Puri, B.R., (2010.) Principles of physical chemistry, 46 th edition-publisher- VISHAL Publishing Co
5. Fundamentals of Biochemistry (2004) by Dr J.L Jain., et al. 7 th edition, S. Chand publication.

<table>
<tr><th>Course Code</th><th rowspan="2">Classical Genetics</th><th>Course Type</th><th>L</th><th>T</th><th>P</th><th>C</th><th>CH</th></tr>
<tr><td>B25GN0101</td><td>DSC</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
</table>

Prerequisites/Pre reading for the course:

1. Students should have a knowledge of the cell types.
2. They should have prior idea about the classification of organisms.

Course Objectives:

The objective of this Course is to:

1. To explore the world of research using model organisms.
2. To understand the inheritance pattern as conveyed by Mendel.
3. To analyze the different gene interactions and inheritance
4. To discuss the involvement of chromosomes in sex determination.

Course Outcomes:

By the end of the course the student will be able to:

1. Compare the different model organisms used for research and its significance.
2. List out the milestones in the evolution of the field of genetics.
3. Outline the inheritance patterns of traits and the interaction of genes.
4. Illustrate the involvement of chromosomes in sex determination and the mechanisms involved in sex differentiation.
5. Deduce the inter and intra-allelic interaction of genes.
6. Comprehend the significance of microscopy in genetics.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0101	CO1	3	2	3	3	3	3	1	0	1	1	3	3	2	2
	CO2	2	2	2	2	3	1	0	0	1	1	0	3	2	0
	CO3	3	3	2	0	2	2	0	1	1	1	0	2	2	0
	CO4	2	1	2	0	2	1	1	1	2	0	0	3	2	1

	CO5	3	3	2	2	3	1	1	1	2	1	0	2	0	0
	CO6	2	2	3	2	2	1	0	0	1	1	2	2	3	1

Course contents:

Course contents:

UNIT I Scope of Genetics **12 hrs**

History of Genetics – Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory.

Model organisms - Structure, life cycle, genetic and industrial applications: Prokaryotes – Bacteriophage, TMV, *Escherichia coli*, Eukaryotes – *Coenorhabditis elegans*, *Drosophila melanogaster*, *Arabidopsis thaliana*, Zebrafish, Rattus species, *Saccharomyces cerevisiae*, *Pichia pastoris*.

UNIT II Mendelian Genetics and Microscopy **12 hrs**

Microscopy: Magnification, Resolving power, Principles and Applications of Simple, Compound, Stereo-zoom. Biography of Mendel and his experiments on pea plants. Principle of dominance. Law of Segregation: Monohybrid cross, back cross and Test cross, Problems related. Law of Independent Assortment: Dihybrid cross in pea plant, back cross and Test cross. Deviations from Mendelism: Incomplete inheritance and Co-dominance. Related problems.

UNIT III Multiple alleles & gene interactions **12hrs**

Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Gene Interactions: Inter allelic: - Complementary gene interaction (9:7) Ex: *Lathyrus odoratus*, Supplementary gene interaction (9:3:4) Ex: Grain color in Maize. Epistasis - Dominant Ex.: Fruit color in Cucurbita pepo, Recessive - Ex.: Coat color in Mice. Non- Epistasis - Ex.: Comb pattern in Poultry. Related problems. Allelic Variation & Gene function – Atavism/Reversion, Penetrance (complete &incomplete), Expressivity, Modifier/Modifying genes.

UNIT IV

Sex Determination **12 hrs**

Chromosome theory of Sex determination: XX- XY, XX-XO, ZZ-ZW; Genic Balance theory of Bridges, Intersexes and Super sexes in Drosophila, Y chromosome in sex determination of *Melandrium*. Environment and sex determination; Hormonal control of

Sex determination (Free martins). Gynandromorphs. Sex differentiation. Dosage compensation. Related problems.

Reference Books:

1. Peter J. Russell, Paul E. Hertz. BeverlyMcMillon. (2012). *Biology: The Dynamic Science*, 2nd Edition,Brooks/Cole Pub Co.
2. P.K. Gupta. (2014). *Cell and Molecular Biology*, 4th Edition, Rastogi Publications.
3. P.K. Gupta, (2013). *Cytogenetics*,1st Edition, Rastogi Publications.
4. P.D. Sharma. (2012). *Microbiology*, 3rd Edition, Rastogi Publications.
5. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th edition, Wiley Publishers.

Course Code	**Cell Biology Lab**	**Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0102		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course.

The student should have knowledge of basic biology, basic microscopy techniques and cellular Structures

Course Objectives:

The overall objectives of the course are to:

1. Explore the different stages of mitosis and meiosis.
2. Provide information about the different staining techniques.
3. Study the usage of microscope and the calibration to analyse the size of cells.
4. Illustrate different cell organelles and their enzyme activity.

Course Outcomes:

After completing the course, the student should be able to:

1. Understand the concept of cell division of eukaryotes.
2. Understand the concept of cell types
3. Outline the qualitative examination of cells.
4. Outline quantitative examination of cells.
5. Understand the basics of cell organelle extraction and its staining
6. Assessing the cell viability through cellular experimentation.

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25BT0102	CO1	3	2	2	2	2	1	0	0	2	2	0	3	2	2
	CO2	3	2	2	2	2	1	0	0	2	3	0	3	2	2
	CO3	3	2	2	2	3	1	0	0	2	3	1	3	2	2
	CO4	3	2	2	2	3	1	0	0	2	3	1	3	2	2
	CO5	3	2	3	2	3	1	0	0	2	3	1	3	2	2
	CO6	3	2	2	2	3	1	0	0	2	3	0	3	2	2

Course Contents:

1. Structural analysis of prokaryotic and eukaryotic cells
2. Temporary preparation of Stained samples for Mitosis (Onion root tips)
3. Temporary preparation of Stained samples for Meiosis (Onion flower bud)
4. Isolation of mitochondria and nucleus from animal cell using density centrifugation method.
5. Isolation of chloroplast and chlorophyll pigment study
6. Differential staining of Leucocytes
7. Estimation of Cell Count using haemocytometer
8. Estimation of cell size by micrometry method

References

1. Russell, D., Sambrook, J., & Russell, D. W. (2006). *The Condensed Protocols from Molecular Cloning: A Laboratory Manual*. http://ci.nii.ac.jp/ncid/BA77594444
2. Rastogi, S.C., 2006. Cell and molecular biology. New Age International.
3. Verma PS, Agarwal VK. Genetics, (Multicolour Edition). S. Chand Publishing; 2009. Cell Biology,
4. Gupta, P.K., 2005. Cell and molecular biology. Rastogi Publications.

Course Code	Laboratory Course 1 (Biochemistry)	Type	L	T	P	C	Hrs/Week
B25BC0102		DSC	0	0	2	2	3

Prerequisites:

Requires knowledge of pre-university chemistry, physics and biology

Course Objectives

The objective of this Course is to:

1. To understand the preparation of various chemical components.
2. To know the analysis and quantification of chemical compositions.

3. To anlyze the viscosity and surface tention.

4. To understand the biological importance of buffers

5. To know the buffer capacity in the biological importance.

6. To know the concept of pH metric titrations.

Course Outcomes

After completing the course, the student shall be able to:

1. Prepare standard solutions and solvents
2. Determine the physical parameters of the solvents
3. Determine the concentration of various compounds using titrimetric.

4.Determine the preparation of organic compounds

5. Determine the normality of organic solutions

6.Prepare the various types of biological buffers.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC 0102	CO1	2	3	2	3	1	1	0	1	0	2	0	3	3	2
	CO2	2	3	3	1	1	1	0	1	2	1	0	2	3	2
	CO3	2	3	3	1	1	0	0	1	2	2	1	2	3	3
	CO4	2	3	3	1	1	1	0	2	2	2	0	3	3	3
	CO5	2	3	3	1	1	1	0	1	2	2	0	2	3	3
	CO6	2	3	3	1	1	1	3	1	2	2	1	2	3	3

Course Contents

1. Estimation of NaOH using Potassium hydrogen phthalate.
2. Estimation of potassium permanganate using standard sodium oxalate solution.
3. Estimation of hardness of water using EDTA (Standard EDTA to be provided)
4. Preparation of m-nitrobenzene from Nitrobenzene
5. Preparation of p-nitro acetanilide from Acetanilide
6. Determination of density and viscosity of the given organic liquid using Ostwald's viscometer
7. Determination of density and surface tension of the given liquid using Stalagmometer.
8. Preparation of Acetate, Phosphate and Citrate Buffers.
9. pH metric titration of amino acid against NaOH.

10. pH metric titration of amino acid against HCL.

Reference Books:

1.An Introduction to Practical Biochemistry- by Plummer D.T, (2017),3 r rd edition., Publisher-McGraw-Hill

2.Quantitaive chemical analysis, by Daniel C. Harris and Charles A Lucy (2019),10 th edition, Publisher-Payal Enterprises

3.Fundamentals of Calculations by Krish Moorthy, (2007) 2nd Edition., Publisher-CRC Press

4.Cooper, G. M., & Adams, K. W. (2022). Fundamentals of Molecular Biology. In

5.*Oxford University Press, eBooks*. https://doi.org/10.1093/hesc/9780197583746.003.0004

6.Whalley, N. A., Walters, S., & Hammond, K. (2018). Molecular Cell Biology. In *Wits University Press eBooks* (pp. 37–49). https://doi.org/10.18772/22008014655.9.

7.Thomas D. Pollard, William C. Earnshaw, Jennifer (2007), Cell Biology: Cell Biology E-Book, Elsevier

Course Code	Classical Genetics Lab	Type	L	T	P	C	Hrs/Week
B25GN0102		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

Requires theoretical knowledge of cell biology

Course Objectives:

The objective of this Course is to

1. To study the different model organisms used for genetic research and their significance.
2. To illustrate Gram staining technique.
3. To understand the ultra-structure and functions of cell organelles

Course Outcomes:

After completing the course, the student shall be able to:

1. Demonstrate proficiency in handling and operating different types of microscopes.
2. Perform and interpret agglutination results to determine human blood types.
3. Apply staining techniques to visualize cellular components.
4. Develop skills in culturing and maintaining Drosophila melanogaster.
5. Identify and differentiate wild-type and mutant Drosophila.
6. Design and perform basic genetic crosses in Drosophila, analyse and explain the inheritance patterns

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0102	CO1	3	2	1	2	3	2	0	0	2	1	0	3	3	2
	CO2	2	1	1	1	2	0	0	0	2	1	1	3	2	1
	CO3	2	2	2	2	2	1	0	0	0	1	0	2	2	1
	CO4	3	2	2	2	2	1	1	0	1	0	0	2	2	1
	CO5	3	2	0	2	2	3	0	1	2	3	0	3	2	3
	CO6	3	2	2	3	3	1	0	0	1	1	1	2	2	1

Course Content

1. Handling of microscopes –dissection, stereo and compound microscopes.
2. Blood grouping.
3. Staining of plant nucleus.
4. Vital staining of mitochondria using Janus green.
5. Culturing and Handling of *Drosophila*:
   a) Culture media Preparation
   b) Cleaning and Sterilization of bottles
   c) Handling of *Drosophila*
6. Morphology and Sexual dimorphism of wild type and mutant *Drosophila*.
7. Breeding experiments in *Drosophila* (monohybrid/Law of Segregation).
8. Breeding experiments in *Drosophila* (dihybrid crosses/Law of Independent Assortment).

Reference Books:

1. Peter J. Russell, Paul E. Hertz. Beverly McMillon. (2012). *Biology: The Dynamic Science*, 2nd Edition, Brooks/Cole Pub Co.
2. P.K. Gupta. (2014). *Cell and Molecular Biology*, 4th Edition, Rastogi Publications.
3. P.K. Gupta, (2013). *Cytogenetics*,1st Edition, Rastogi Publications.
4. P.D. Sharma. (2012). *Microbiology*, 3rd Edition, Rastogi Publications.
5. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th edition, Wiley Publishers.

Course code	**Introduction to Good Laboratory Practices**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BTS111		**DSE**	**2**	**0**	**0**	**2**	**2**

Pre-requisites

The student should have a knowledge of biology, chemistry and physics.

Course Description

This course aims to provide foundational and practical understanding of Good Laboratory Practices (GLP) within academic laboratory settings. It covers principles, protocols, safety, ethics, and documentation standards that are crucial for ensuring data integrity, safety, and regulatory compliance in laboratory work.

Course Objectives:

1. Understand the concept, evolution, and importance of GLP in academic research and teaching laboratories.
2. Identify and describe international GLP standards and their relevance to laboratory operations.
3. Explain the core principles of GLP including organization, equipment management, and study protocols.
4. Apply GLP principles to laboratory safety, ethical conduct, and quality assurance.

Course Outcomes:

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

1. Define and explain the origin, principles, and importance of GLP in academic laboratory settings.
2. Demonstrate understanding of international GLP standards (OECD, WHO) and their application in academic contexts.
3. Describe and apply organizational roles, equipment handling, maintenance, and SOPs in lab operations.
4. Practice safe, ethical, and responsible conduct in laboratory settings using proper PPE and emergency protocols.
5. Maintain accurate laboratory records and reports according to GLP documentation standards.
6. Analyze quality assurance practices, ethical issues, and regulatory compliance using relevant case studies.

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS111	CO1	2	2	1	2	1	0	0	0	2	2	0	2	1	1
	CO2	1	3	2	0	1	0	0	0	3	3	0	0	1	1
	CO3	2	2	2	1	2	0	0	0	2	2	0	0	2	2
	CO4	1	2	1	2	2	0	0	0	2	2	0	0	1	1
	CO5	2	3	2	2	2	0	0	0	3	3	0	0	1	2
	CO6	2	2	2	1	2	0	0	0	2	2	0	0	2	2

Unit I: Foundations of Good Laboratory Practices (GLP) 12 Hrs

Introduction to GLP with focus on its origin, evolution, and significance in academic research.

Overview of national and international guidelines (NGCMA, ICMR, CDSCO, BIS, FSSAI, OECD and WHO) and core GLP principles including roles and responsibilities of personnel, laboratory infrastructure, equipment maintenance, and validation. Emphasis on study protocols, Standard operating procedure development, data integrity, documentation practices, and quality assurance systems. Safety practices covering PPE, Basic Waste Segregation and Disposal Methods,chemical and biological hazard management, emergency procedures, and ethical conduct in laboratories.

Unit II: GLP Applications in Life Science Laboratories 12 Hrs

Basic Laboratory Conduct and Etiquette -Understanding do's and don'ts in academic laboratories. Labelling and Handling of Biological Samples. Safe Storage of Chemicals and Biological Reagents, Introduction to color-coded storage and compatible materials. Understanding Laboratory Signs and Symbols, Familiarity with biosafety, hazard, and emergency signage. Proper Use and Maintenance of Common Lab Equipment. Introduction to Laboratory Log-books and Record-Keeping, Introduction to Laboratory Emergency Equipment.

Textbooks and Reference Materials:

- Elzagheid, M. (2023). Chemical Technicians: Good Laboratory Practice and Laboratory Information Management Systems. Walter de Gruyter GmbH & Co KG.
- Spivak, S. M., & Brenner, F. C. (2018). Standardization essentials: Principles and practice. CRC Press.
- Taylor, J. K. (2018). Quality assurance of chemical measurements. Routledge.

Recommended Reading:

- Laboratory Quality Management System (WHO Guidelines)
- ISO 15189 (for clinical laboratories) – optional extension

Course code	Bioethics and Intellectual Property rights	Course type	L	T	P	C	CH
B25BTS112		DSE	2	0	0	2	2

Prerequisites

The student should have prior knowledge of Civics and Biological Sciences

Course Objective

- To introduce basic concepts of ethics and safety that are essential for various branches of science involving technical procedures and protection of intellectual property and related rights.
- To understand balanced integration of scientific and social knowledge in sustainable

development

Course Outcomes

After the completion of the course, the student will be able to

1. Interpret basics of bioethics and its impact on all the biological sciences and the quality of human life
2. Recognize importance of biosafety practices and guidelines in research
3. Comprehend benefits of GM technology and related issues
4. Recognize importance of protection of new knowledge and innovations
5. Understand the current laws and regulations related to biodiversity and biotechnology
6. Understand about IPRs related to biotechnological research

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS112	CO1	2	2	1	2	1	2	0	0	1	0	3	2	1	1
	CO2	1	3	2	0	1	2	0	0	1	0	3	0	1	1
	CO3	2	2	2	1	2	2	0	0	1	0	3	0	2	2
	CO4	1	2	1	2	2	2	0	0	1	0	0	0	1	1
	CO5	2	3	2	2	2	2	0	0	1	0	0	0	1	2
	CO6	2	2	2	1	2	2	0	0	1	0	0	0	2	2

Course Contents

UNIT-I **12 hrs**

Introduction to Bioethics

Bioethics and its relationship with other branches. Biosafety guideline in India. Biosafety protocol. Ethical, Legal & Social impacts of Biotechnology. Release of GMOs in environment, Human embryonic cloning & stem cell research, transgenic plants and animals.

UNIT-II **12 hrs**

Introduction to IPR

Concept of Intellectual Property, Types of Intellectual Property, Patents, Copyrights, Designs, Trademarks, Geographical Indication, Trade Secrets. Agreements and Organisations; GATT, TRIPS, WIPO. Concept of traditional knowledge, Biopiracy and Bioprospecting. Protection of plant varieties-Farmers Rights and Plant breeders' rights, Patenting biotechnological inventions.

Reference Books:

1. Sateesh,M.K.,Bioethics and Biosafety, IK International Publishers (2008)
2. Singh I.and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).

3. Jose Cibelli, Robert P lanza, Keith HS. (2013). Principles of cloning, Campbell, Michael D.West, Academic Press.
4. Sateesh MK. (2010). Bioethics and Biosafety, IK International Publishing House Pvt.Ltd.
5. Sreekrishna V. (2007). Bioethics and Biosafety in Biotechnology, New Age International Pub.
6. Singh K. (2010). Intellectual Property Rights on Biotechnology, BCIL, New Delhi.
7. WIPO Intellectual Property Handbook. (2008). www.wipo.int

Course Code	Skill Enhancement Course-1	Course Type	L	T	P	C	CH
B25BT0103		**SEC**	**0**	**0**	**2**	**2**	**4**

Course Objective: To carry out the academic training towards enhancing co-curricular knowledge research-based skills.

Course Outcomes
After completion of the course, the students will be able to
1. Understand the basic research skills.
2. Upgrade their knowledge about the analytical instrumentation.
3. Implement the subject specific practical knowledge into research studies.
4. Correlate the theoretical and practical understanding of research-based knowledge.
5. Develop critical thinking skills necessary to evaluate information, make decisions, and innovate within the field.
6. Analyze problems within the scope of the course and apply appropriate solutions.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0103	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. – Biotechnology, Biochemistry, Genetics
Detailed Syllabus

SECOND SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHK203	Language II: Kannada-II	AEC	3	0	0	3	3

Course Overview

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯ ಪ್ರಕಾರವಾಗಿ ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Prerequisite / Pre reading for the course

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ.
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy:

- Direct method
- ICT and Digital support (Links attached)
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಒಳಗೊಂಡಂತೆ ವಿಷಯವಾರು ಪಠ್ಯಗಳನ್ನು ನೀಡಲಾಗಿದ್ದು, ಆ ಮೂಲಕ ಕನ್ನಡ ಭಾಷೆ, ಸಂಸ್ಕೃತಿಯ ಜೊತೆಗೆ ಮಾನವೀಯ ಗುಣಗಳನ್ನು ಪರಿಚಯಿಸುವ ಹಾಗೂ ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಪ್ರೇರೇಪಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಎರಡನೇ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ಜೀವನ ಕಲೆ, ಕನಸು, ದಾಂಪತ್ಯ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂದಿಸಿದಂತೆ ವಿಷಯಗಳನ್ನು ನೀಡಿದ್ದು, ಅದಕ್ಕೆ ಪೂರಕವಾಗಿ ಸಾಹಿತ್ಯಕ ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ. ಈ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ. ಹಾಗೂ ವೈವಿಧ್ಯಮಯ ಭಾರತದ ಸಾಂಸ್ಕೃತಿಕ ನೆಲೆಗಳನ್ನು ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ
2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.
3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಬರಹ, ವೃತ್ತಿ ಪೂರ್ವಕ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ
4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

Course Outcomes:

ಜೀವನ ಕಲೆ, ಕನಸು, ದಾಂಪತ್ಯ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಸಾಹಿತ್ಯ ಪಠ್ಯಗಳ ಕಲಿಕೆಯ ಮೂಲಕ ಅವುಗಳ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

1. ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ಸೂಕ್ಷ್ಮತೆಯ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಸುತ್ತದೆ

2. ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳನ್ನು ವಿವಿಧ ಆಯಾಮಗಳೊಂದಿಗೆ ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.
3. ಉತ್ತಮ ಭಾಷಾ ಕೌಶಲ್ಯವನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.
4. ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.
5. ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯದ ಶ್ರೀಮಂತಿಕೆಯ ಜೊತೆಗೆ ಮಾನವೀಯಮೌಲ್ಯಗಳನ್ನು ಮೂಡಿಸುತ್ತದೆ.
6. ಸದೃಢ ಬೌದ್ಧಿಕ ಮತ್ತು ಮಾನಸಿಕ ವ್ಯಕ್ತಿತ್ವವನ್ನು ವಿಕಾಸಿಸುತ್ತದೆ.

Mapping of Course Outcomes with programme Outcomes

COURSE CODE	Course Outcomes		Program Outcomes												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHK203	CO 1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO 2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO 3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO 4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0

COURSE CONTENT/ SYLLABUS

ಪರಿವಿಡಿ		
ಘಟಕ 1 – ಜೀವನ ಕಲೆ **1.1 ಬುದ್ಧ** **1.2 ಜಾಗತೀಕರಣದ ಜಾಲದಲ್ಲಿ ಇಂದಿನ ಮಹಿಳೆ** **1.3 ಸಂಸ್ಕೃತಿಯ ಪರಿಚಿತಿಗೆ**	**ದ ರಾ ಬೇಂದ್ರೆ** **ಡಾ. ಇಂದಿರಾ** **ಶಿವರಾಮ ಕಾರಂತ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 2 – ಕನಸು **2.1 ಒಂದಿರಳು ಕನಸಿನಲಿ** **2.2 ತಿರುಕಣ್ಣನ ಮತದಾನ** **2.3 ನನಗೊಂದು ಕನಸಿದೆ**	**ಕೆ.ಎಸ್.ನರಸಿಂಹಸ್ವಾಮಿ** **ನಿರಂಜನ** **ಮಾರ್ಟಿನ್ ಲೂಥರ್ ಕಿಂಗ್(ಜ್ಯೂ)**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 3 – ದಾಂಪತ್ಯ **3.1 ಧಾರವಾಹಿಗಳು** **3.2 ಅಕ್ಕು** **3.3 ಸರಳ ಮದುವೆಗಾಗಿ**	**ಡಾ. ಜಿ. ಪ್ರಶಾಂತ್ ನಾಯಕ** **ವೈದೇಹಿ** **ಕಡಿದಾಳು ಶಾಮಣ್ಣ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 4 – ಸಂಕೀರ್ಣ	**ನಾಗೇಶ ಹೆಗಡೆ**	**9 ಗಂಟೆಗಳು**

4.1 ಮಾನವ ನಿರ್ಮಿತ ಮಹಾಸಮಸ್ಯೆಗಳು **4.2 ಆನ್ಲೈನ್ ಮಾರುಕಟ್ಟೆಯ ಕಷ್ಟ-ಸುಖ** **4.3 ದೇಶಪ್ರೇಮ ಮತ್ತು ಸರ್ಕಾರ**	**ಯಶವಂತ ಡೊಂಗ್ರೇ** **ಕೆ.ಮರುಳ ಸಿದ್ದಪ್ಪ**	

TextBooks:
ಸಂಯೋಜಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ **'ವಿಜ್ಞಾನ ಸೌರಭ' – ಎರಡನೇ ಸೆಮಿಸ್ಟರ್ ಬಿಎಸ್ಸಿ (AS,AHS,SS)**

ಪರಾಮರ್ಶನ ಗ್ರಂಥಗಳು:

1. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಕತನ-ಡಾ ಕರಿಗೌಡ ಬೀಚನಹಳ್ಳಿ, ಪ್ರಸಾರಾಂಗ ಕನ್ನಡ ವಿ ವಿ ಹಂಪಿ, 2017
2. ಪರಿಸರ ಅಧ್ಯಯನ- ಪ್ರೊ. ಕೆ ಬೈರಪ್ಪ, ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು, 2006
3. ಕುವೆಂಪು ಸಂಚಯ- ಸಂ. ಡಾ. ದೇಜಗೌ, ಕುವೆಂಪು ಭಾಷಾ ಭಾರತಿ ಪ್ರಾದಿಕಾರ, ಬೆಂಗಳೂರು, 2009
4. ಸಾಹಿತ್ಯ ಸಂಸ್ಕೃತಿ ಮತ್ತು ದಲಿತ ಪ್ರಜ್ಞೆ - ಡಾ ಅರವಿಂದ ಮಾಲಗತ್ತಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು, 2014
5. ಎದೆಗೆ ಬಿದ್ದ ಅಕ್ಷರ- ದೇವನೂರು ಮಹಾದೇವ, ಅಭಿನವ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು, 2013
6. ನಮ್ಮ ಸಂಸ್ಕೃತಿ ಪರಂಪರೆ - ಬೆಟಗೇರಿ ಕೃಷ್ಣಶರ್ಮ, ಕನ್ನಡ ಸಂಸ್ಕೃತಿ ಇಲಾಖೆ, ಬೆಂಗಳೂರು, 2011
7. ಲೋಹಿಯಾ ವ್ಯಕ್ತಿ ಮತ್ತು ವಿಚಾರ- ಬಾಪೂ ಹೆದ್ದೂರ ಶೆಟ್ಟಿ, ಲಡಾಯಿ ಪ್ರಕಾಶನ ಗದಗ, 2012

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**C**	**Hr/ Wk**
B25AHH203	**Language – II: Hindi - II**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Overview: पाठ्यक्रम अवलोकन:
यह पाठ्यक्रम नवशिक्षुओं को अपनी भाषा-प्रयोग क्षमता के विकास हेतु तथा विभिन्न साहित्यिक गतिविधियों के माध्यम से समाज, संस्कृति और जीवन के मूल्यों को समझने के लिए अभिप्रेरित करता है।

Prerequisites/Pre reading for the course: पूर्वापेक्षित ज्ञान

- विद्यार्थियों ने पी.यू.सी. स्तर पर द्वितीय भाषा के रूप में हिंदी का अध्ययन किया होना चाहिए।
- हिंदी साहित्य के इतिहास का संक्षिप्त ज्ञान आवश्यक है।
- हिंदी व्याकरण की मूलभूत समझ होनी चाहिए।
- अंग्रेज़ी से हिंदी अनुवाद से संबंधित जानकारी आवश्यक है।

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning
Objectives: पा□□म उ□े□:

• संदर्भ के अनुसार उपयुक्त भाषा प्रयोग करने की दक्षता का विकास करना।

• साहित्य के माध्यम से समाज एवं मानवीय मूल्यों की समझ विकसित कर, उनके संरक्षण हेतु प्रेरित करना।

• विद्यार्थियों में स्वाभाविक पठन एवं लेखन की प्रवृत्ति को प्रोत्साहित करना।

• साहित्य के माध्यम से प्रभावी एवं कुशल संचार कौशल का विकास करना।

Course Outcomes

पाठ्यक्रम की समाप्ति पर विद्यार्थी:

- सामाजिक मूल्यों एवं नैतिक उत्तरदायित्व को स्वीकार कर सकेगा।
- साहित्य की प्रासंगिकता को जीवन में समझने की योग्यता रखेगा।
- समाज में अंतर्निहित प्रवृत्तियों एवं विचारधाराओं का विश्लेषण करने में सक्षम होगा।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार कौशल विकसित कर सकेगा।

Mapping of Course Outcomes with programme Outcomes

Course Code	**Course Outcome**	**Program Outcomes**													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHH203	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0

Course Content : पाठ्यक्रम विषय सूची / पाठ्यक्रम सामग्री

इकाई – 1: कविता – प्राचीन एवं आधुनिक *(10 घंटे)*

1. कबीर के दोहे
2. कविता – *सखी, वे मुझसे कहकर जाते* – मैथिलीशरण गुप्त
3. कविता – *प्रेत का बयान* – नागार्जुन

इकाई – 2: कविता – प्राचीन एवं आधुनिक *(10 घंटे)*

4. सूरदास के पद
5. कविता – *संभ्रांत सुंदरी* – सूर्यकांत त्रिपाठी 'निराला'
6. कविता – *छिप-छिप अश्रु बहाने वालों* – गोपालदास नीरज

इकाई – 3: कविता – प्राचीन एवं आधुनिक *(10 घंटे)*

7. रहीम के दोहे

8. कविता – *क्या कहीं संवेदना लेकर तुम्हारी* – हरिवंशराय बच्चन
9. कविता – *माँ के लिए ससुराल जाने से पहले* – निर्मला पुतुल

इकाई – 4: अनुवाद और तकनीकी अभ्यास *(9 घंटे)*
- शब्दों का अनुवाद (हिंदी से अंग्रेज़ी)
- अनुच्छेद अनुवाद (हिंदी से अंग्रेज़ी)
- यूनिकोड विविध अभ्यास

Text book/s: पाठ्यपुस्तक:
1. हिंदी पाठ्यपुस्तक – रेवा विश्वविद्यालय द्वारा प्रकाशित

References: संदर्भ ग्रंथ
1. सुबोध व्यावहारिक हिंदी – डॉ. कुलदीप गुप्त
2. अभिनव व्यावहारिक हिंदी – डॉ. परमानंद गुप्त
3. हिंदी साहित्य का इतिहास – डॉ. नागेन्द्र
4. आधुनिक हिंदी साहित्य का इतिहास – डॉ. बैजनाथ सिंह
5. हिंदी साहित्य का नवीन इतिहास – डॉ. लाल साहब सिंह
6. शुद्ध हिंदी कैसे बोलें, कैसे लिखें – प्रेमनाथ पांडेय

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Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25AHA201	**Language II: Additional English – II**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Description:
This is a 3-credit course designed to enhance English language skills through socially relevant themes like inclusivity, cultural identity, and human values. Exploring disability, local food traditions, value-based education, and indigenous narratives, learners develop empathy, critical thinking, and effective communication. It fosters cultural awareness and ethical reflection through reading, writing, and interactive classroom activities.

Course Objectives:

- To develop language proficiency through exposure to socially relevant themes and diverse literary genres.
- To enhance cultural literacy by exploring local food traditions and their narrative significance.
- To instil values of empathy, respect, and unity through literary reflections on social harmony.
- To critically examine indigenous voices and the representation of marginalized communities in literature.
- To improve speaking, reading, writing, and critical thinking skills through interpretative and creative responses.

Course Outcomes:
On completion of the course, learners will be able to:

- Analyze and interpret a variety of texts that promote awareness of disability and inclusivity in society, demonstrating comprehension and critical engagement.

• Evaluate the cultural significance of regional food traditions through analytical and descriptive writing, emphasizing their social and historical contexts.
• Examine and appreciate indigenous literature and critically reflect on voices from the margins to develop sensitivity toward cultural diversity and representation.
• Apply effective English communication strategies to present, discuss, and defend ideas related to inclusion, identity, and ethical living.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHA201	CO1	2	0	1	1	0	1	0	2	1	2	0	1	1	0
	CO2	0	1	0	1	0	0	1	0	0	1	0	1	0	1
	CO3	2	0	1	1	0	0	2	0	0	1	0	2	2	0
	CO4	1	0	1	1	1	0	1	0	1	1	0	3	1	0
	CO5	1	0	1	1	1	0	1	0	1	1	0	3	1	0
	CO6	1	0	1	1	1	0	1	0	1	1	0	3	1	0

Course Contents

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	**Ecology& Environment**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Literature:** William Wordsworth – Lines Written in Early Spring Toru Dutt – Our Casuarina Tree Rachel Louise Carson- And No Birds Sing **Writing Skills:** Paragraph Writing	**11 Hours**
II	**Voices from the Margin**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Literature:** Namdeo Dhasal- "Hunger" Pavel Friedmann – The Butterfly Premchand – The Thakur's Well **Writing Skills:** **2.4** Book / Movie Review	**11 Hours**
III	**Women &**	Fill in the blanks/	**Literature**:	**11 Hours**

	Society	MCQs/ Comprehension Tasks/ Descriptive Questions	Malala- I am Malala Banu Mushtaq- Stone Slabs for Shahista Mahal Amrita Pritam: The Weed **Writing Skills:** Writing for Media	
IV	**Popular Culture**	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Literature**: Rudyard Kipling –"If" Susan Sontag -A Woman's Beauty: Put-Down or Power Source Alvin Toffler – *Future Shock* (Temporary Needs, Technological Backlash) **Media-ready Skills**: Script for Podcast and Presence on Camera	**11 Hours**

References:

- **Lunsford, Andrea A., and John J. Ruszkiewicz.** *Everything's an Argument with Readings*. 9th ed., Bedford/St. Martin's, 2022. *(Great for persuasive paragraph/composition skills.)*
- **Strunk Jr., William, and E. B. White.** *The Elements of Style*. 4th ed., Longman, 2000.
- **Merrill, John C., and Harold A. Fisher.** *The World's Great Media*. 5th ed., Oxford UP, 2017. *(For writing for media.)*
- **McKee, Robert.** *Story: Substance, Structure, Style and the Principles of Screenwriting*. Methuen, 1997. *(Useful for scriptwriting skills.)*
- **Kipling, Rudyard.** *"If—." Rewards and Fairies*, Macmillan, 1910.
  Sontag, Susan. *"A Woman's Beauty: Put-Down or Power Source?" New York Times Magazine*, 23 Nov. 1972, pp. 34–38.
  Toffler, Alvin. *Future Shock*. Bantam, 1970. *(Particularly chapters on "Temporary Needs" and "Technological Backlash" as part of writing for media.)*
- **Mushtaq, Banu.** *"Stone Slabs for Shahista Mahal."* In *The Friday Island*, Penguin Books India, 1998.
  Pritam, Amrita. *"The Weed."* First published in Punjabi, translated by Surjit Athwal, in *Amrita Pritam: Selected Poems*, Sahitya Akademi, 1999.
- **Yousafzai, Malala, and Christina Lamb.** *I Am Malala: The Girl Who Stood Up for Education and Was Shot by the Taliban*. Little, Brown, 2013.
- **Wordsworth, William.** *Lines Written in Early Spring.* 1798.
- **Dutt, Toru.** *"Our Casuarina Tree."* First published in *A Sheaf Gleaned in French Fields*, 1876.

- **Carson, Rachel Louise.** *“And No Birds Sing.”* From *Under the Sea-Wind*, Simon & Schuster, 1941.
- **Dhasal, Namdeo Laxman.** *“Hunger.”* Translated by Dilip Chitre, in *Namdeo Dhasal: Poet of the Underworld, Poems 1972–2006*, Navayana, 2006.
- **Friedmann, Pavel.** *“The Butterfly.”* 4 June 1942. *I Never Saw Another Butterfly: Children’s Drawings and Poems from Terezin Concentration Camp, 1942–1944*, edited by Hana Volavková and Jiří Weil, Schocken Books, 1994.
- **Premchand, Munshi.** *“The Thakur’s Well.”* 1926. In *Selected Stories of Premchand*, translated by Gordon C. Roadarmel, Indiana University Press, 1980.

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHE201	**Communicative English – II**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Description

This course is designed to enhance students’ proficiency in English with a focus on effective communication in academic, professional, and social contexts. It integrates essential language skills—reading, writing, speaking, and listening—while reinforcing grammatical accuracy and developing cognitive, persuasive, and employability-related competencies. Through exposure to literary texts, students gain critical thinking skills and cultural insights. The course also emphasizes official communication formats, creative expression, and job-readiness tools such as report writing, CVs, and cover letters.

Pre-requisites: The student must possess functional knowledge of LSRW skills.

Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:

1. To develop professional and academic writing skills suitable for diverse communication contexts.
2. To improve reading comprehension and critical analysis through literary texts.
3. To build cognitive and persuasive skills essential for effective decision-making and expression.
4. To compose and present professional documents like reports, CVs, and cover letters with clarity and precision.

Course Outcomes:

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

1. Analyse and apply grammatical rules such as clause analysis, sentence structures, and speech conversion.
2. Compose coherent and contextually appropriate texts including blogs, notices, and formal

letters.
3. Develop job application documents and engage in professional dialogue writing.
4. Utilize persuasive and cognitive strategies in both written and spoken communication.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHE201	CO1	1	0	0	1	0	1	1	2	1	1	0	2	0	0
	CO2	1	1	0	0	0	0	2	2	1	1	0	2	1	0
	CO3	2	1	1	1	0	0	2	2	1	1	0	2	1	0
	CO4	1	0	0	2	0	0	3	2	1	1	0	1	0	0
	CO5	1	0	0	2	0	0	3	2	1	1	0	1	0	0
	CO6	1	0	0	2	0	0	3	2	1	1	0	1	0	0

Course Content:

Unit-I: Language Acquisition **[11 Hours]**
Remedial Grammar: Correction of Sentences
Writing Skills: Official Communication

- Blog writing
- Letters to the News Papers, Public Notices
- Circulars, Minutes of the meeting

Reading Skills: Reading Comprehension (unseen passages)
Literature: Temsula Ao – "The Jungle Major."
Unit-II: Persuasive Skills **[11 Hours]**
Remedial Grammar: Sentence Structure - I

- Simple
- Compound
- Complex
- Compound- Complex

Writing Skills: Creative writing

- Story writing
- Digital Narratives & Introduction to AI powered Tools

Literature: Martin Luther King – I Have A Dream
Unit-III: Cognitive Skills **[11 Hours]**
Remedial Grammar:

- Direct and Indirect speech
- Conditional sentences

Writing Skills: Report writing

- Survey report
- Feasibility report
- **Listening Skills:** Listening Comprehension (Motivational Speech)

Literature: Morgan Housel - Man in the car Paradox (Extract from Psychology of Money)

Unit-IV: Employability Skills **[11 Hours]**
Remedial Grammar:
- Degrees of Comparison
- Modals
- Prefix and Suffix
- Homonyms and Homophones

Writing Skills: Cover letter and Curriculum Vitae writing
Speaking Skills: Dialogue Writing

Literature: The Paradox of Life – Dalai Lama
References:

1. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. Objective English. Pearson Education, 2013.
4. Dixson, Robert J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd., 1988.
5. Turton, Nigel D. ABC of Common Errors. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.
7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). Effective English. Pearson Education, 2009.

Course code	General Microbiology	Course type	L	T	P	C	CH
B25BT0201		DSC	3	0	0	3	4

Prerequisites/Pre reading for the course:

The student should be familiar with the basic concepts of Cell biology and Microscopy.

Course Objectives:

The overall objectives of the course are to:

1. To understand the origin and concepts of microorganisms as science
2. To explore the various types of micro-organism and their significance
3. To familiarize the students in cultural methods involved in microbiology
4. To exploit the microbial physiology for the benefit of society

Course Outcomes:

By the end of the course the students will be able to:

1. Understand the scope and importance of microbiology in biotechnology
2. Handle microorganisms and utilize for other purpose
3. Exploit various methodologies involved in microbiology
4. Illustrate the microbial metabolism
5. Understand microbial enumeration and staining techniques.
6. Understand the microbial application in versatile fields.

Mapping of Course Outcomes with programme Outcomes

Course Code	PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25BT 0201	CO1	3	2	2	3	3	2	0	0	1	1	0	1	1	1
	CO2	3	2	2	3	3	1	0	1	1	1	2	1	1	0
	CO3	3	3	2	3	3	0	0	1	1	0	2	1	2	1
	CO4	3	3	2	2	3	1	0	0	0	1	0	1	1	0
	CO5	2	3	3	3	3	2	0	2	1	1	2	2	2	0
	CO6	3	3	3	3	3	2	0	1	2	1	3	0	1	0

Unit I: Introduction to Microbiology **12 Hr**

Origin and historical development of MB, Biogenesis & abiogenesis theory, Contribution of microbiologist- Leeuwenhoek, Robert Hook, Koch, Pasteur, Lister & Fleming; Bergey's' classification & phylogenetic analysis, Binomial nomenclature, classification systems in different microbial classes; Prokaryotic Microbial cell: Ultrastructure and Classification of Bacterial cell; Eukaryotic Cells: Ultrastructure and Classification of Fungi, Protozoans, Algae; Ultrastructure and Classification of Virus

Unit II: Microbial physiology **12 Hr**

Metabolism, anabolism & catabolism, Aerobic and anaerobic respiration-fermentation process, glycolysis, TCA cycle, Entner Duodruffs pathway, pentose phosphate pathway, electron transport chain and its significance. Bacterial photosynthesis (green and purple bacteria)-oxygenic & anoxygenic photosynthesis, role of photosystem and accessory pigments in the photosynthesis, biochemical nitrogen fixation–non symbiotic and symbiotic bacteria. Quorum Sensing.

Unit III: Microbial Techniques **12 Hr**

Isolation-pour, streak & spread plating, and enumeration of microbes-indirect & direct methods. Sterilization Techniques: - Physical and Chemical based sterilization techniques; Staining techniques in microbiology-simple, differential & structural; Microbial medium- Defined Media; Complex Media, based on constituency; Based on Functional Use: General purpose media, Enriched media, Selective Media, Growth curve-phases & its importance. Molecular characterization of microbes- PCR based study.

Unit IV: Applied Microbiology **12 Hr**

Microbiology as Interdisciplinary science: Agricultural Microbiology- Microbe-plant associations. Microbial fertilizers and pesticides Environmental Microbiology: Role of microbes in the biodegradation of organic and inorganic waste; Industrial Microbiology- Role of microbes in fermentation and bioprocess engineering; Food Microbiology; Use of microbes as source of food. Single cell protein, Microbial polysaccharides and polyhydroxyalkanoates. Medical microbiology: Concept of antibiotics, Vaccines

Reference Books

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2014). *Prescott's microbiology*. McGraw-Hill.
2. Brooks, G.F., Butel, J.S. and Morse, S.A., 2006. Medical microbiology. *United States, 25th*.
3. Carr, F. J. (2017). Microbiology: a fundamental introduction. *EC Microbiology*, *8*(3), 123-183.
4. Glazer, A. N., & Nikaido, H. (2007). *Microbial biotechnology: fundamentals of applied microbiology*. Cambridge University Press.

Course code	**Biomolecules**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BC0201		**DSC**	**3**	**0**	**0**	**3**	**4**

Course Objectives:

1. To study the structure of carbohydrates.
2. To understand the structures of Amino acids and proteins.
3. To provide among students the scientific understanding of the structure of Lipids.
4. To study the structures of Nucleic acids, their Isolation and sequencing.

Course Outcomes:

After completing the course, the student shall be able to:

1. Correlate knowledge of carbohydrates to central Biochemical processes.
2. Compare and contrast the structural organization and functions of Amino acids and proteins.
3. Correlate knowledge of Lipids to central Biochemical processes.
4. Compare and contrast the structural organization and functions of Nucleic acids.

5. To understand the Significance of Glycolipids
6. Compare and contrast the physicochemical properties of Nucleic acids.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS /COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	2	2	3	2	0	3	0	2	2	2	1	0	2	1
	CO2	2		2	0	2	3	0	3	0	3	1	1	2	0
B25BC0201	CO3	3	3	0	2	2	0	3	2	3	0	1	2	0	2
	CO4	1	0	2	3	1	1	0	2	2	1	1	2	2	1
	CO5	2	0	2	0	3	2	0	1	0	2	0	0	1	0
	CO6	1	0	2	0	2	0	2	0	3	0	1	0	2	0

UNIT I **12 hrs**

Introduction to Biochemistry: **Carbohydrates:** Definition, classification, biological importance. **Monosaccharides:** Configuration and relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidising and reducing property. Mutarotation and Howarth structure of galactose, mannose, ribose and fructose. Structure and biological importance of amino sugars, sugar acids, neuraminic and muramic acid. **Disaccharides:** Structures of Sucrose, Lactose, Maltose, Isomaltose, Cellobiose and Trehalose. **Polysaccharides:** occurrence and importance of Starch, Glycogen, Cellulose. Glycosaminoglycans: Occurrence, importance and the structure of the repeating units of Heparin, Hyaluronic acid and Chondroitin sulphate.

UNITII **12 hrs**

Amino acids and proteins: Structure and classification of α-amino acids based on the R-group, aminoacids as ampholytes, zwitterions, IsoelectricpH, titration curve of alanine. Reactions of aminoacids with ninhydrin, FDNB. **Peptides:** biological importance of peptides. **Proteins**: classification based on composition, shape and function with examples. **Overview of structural organization of proteins:** Primary structure-importance of primary structure by taking sickle cell anaemia as an example. Secondary Structure: Types, α- helix, β-pleated structure. Tertiary structure-factors stabilizing tertiary structure. Quaternary structure with haemoglobin as an example.

UNITIII **12 hrs**

Lipids: Classification and biological role. Fatty acids – Nomenclature of saturated and unsaturated fatty acids with an example. Properties of fatty acids: reaction with alcohol, catalytic hydrogenation. Rancidity: definition, oxidative and hydrolytic rancidity. Saponification number, Iodine number, Acid number and significance. Compound lipids: Structure and biological importance. **Glycosphingolipids**: Structure and importance of Gangliosides and Cerebrosides.

UNIT IV **12 hrs**

Nucleic acids: Nucleosides and nucleotides, Configuration and Conformation, Composition of RNA and DNA. Physico- chemical properties of nucleic acids - effect of alkali, acid and heat (denaturation and renaturation), Complementary base pairing, secondary structure of RNA, features of DNA double helix (Watson - Crick Model). Nucleoproteins – histone and non-histone.

Reference Books:

1. Biochemistry; Voet, D. and Voet, J. G. (2017);5th Ed. John Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., (2021) 8thEdn.; MacMillan Publishing company.
3. Principles of Biochemistry; Smith et al., (1983) [Ed.]19th Edn Mc Garw Hill.
4. Text Book of Biochemistry with Clinical correlations; Thomas Devlin (2010) 7th Ed., Wiley-Liss.
5. Outlines of Biochemistry by P.K. Stump et.al.,(2006), 5th edn., Wiley Eastern, New Delhi,

Course Code	Cytogenetics	Course Type	L	T	P	C	CH
B25GN0201		DSC	3	0	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have knowledge of cell organelles.
2. They should have the idea about cell cycle.

Course Objectives:

The objective of this Course is to

1. To equip with the knowledge of microscopy.

2. To explore cell biology and its characteristics.
3. To define the structure and organization of eukaryotic chromosomes.
4. To study the mechanism of linkage and recombination.

Course Outcomes:

After the end of the Course students will be able to:
1. Elucidate the structure and organization of cell organelles.
2. Describe the structure and organization of chromosomes.
3. Categorize the chromosomal aberrations.
4. Understand the mechanism of linkage and recombination.
5. Explain the inheritance followed by non-nuclear genes.
6. Illustrate the sex-linkage inheritance in organisms.

Mapping of Course Outcomes with program Outcomes

Course code		PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PS01	PS0 2	PS03
B25GN0201	CO1	2	2	2	2	1	0	0	0	1	1	2	3	3	2
	CO2	3	2	1	2	3	1	0	0	1	2	2	2	2	0
	CO3	3	2	1	0	2	1	0	0	1	1	0	3	1	0
	CO4	2	3	3	3	2	1	1	1	2	2	0	3	3	2
	CO5	2	2	2	2	2	1	0	1	1	1	0	3	2	0
	CO6	2	2	3	0	2	1	0	0	2	1	0	3	2	1

Course Contents

UNIT I **12hrs**

Cellular study and advance microscopy

Cell organelles: Plasma membrane, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies and Nucleus. Cell cycle and cell division. Apoptosis (extrinsic and intrinsic mechanisms).

Phase contrast, Confocal, Fluorescent and Electron microscopes (TEM and SEM, Cryo-EM) – principles and applications.

UNIT II

Ultrastructure of chromosomes **12 hrs**

Prokaryotic and eukaryotic genome organization: Molecular organization of chromatin. Primary and Secondary constriction, Sat-bodies, Telomeres, Heterochromatin and Euchromatin and its significance. Nucleosome model, solenoid, scaffold, domains. Types of chromosomes. **Special types of Chromosomes:** Structure and Significance of: Polytene Chromosome - Salivary gland chromosome, Lamp-brush chromosome. B-Chromosome. Chromosome theory of inheritance. Concept of Gene (cistron, muton, recon). **Chromosomal aberrations**

– Structural and numerical aberrations.

UNIT III **12 hrs**

Linkage: Definition of Linkage, Coupling and Repulsion hypothesis, Linkage group- *Drosophila*, maize and man, Types of linkage-complete linkage and incomplete linkage, Factors affecting linkage- distance between genes, age, temperature, radiation, sex, chemicals and nutrition, Significance of linkage.

Crossing over: Crossing over- definition and types of crossing over: Germinal and Somatic crossing over. Crossing over in *Drosophila.* Cytological basis of crossing over: Stern's experiments in *Drosophila,* Creighton and McClintock experiment in maize. Mechanism of crossing over: Chiasma type theory, Breakage first theory, Contact first theory, Strain or torsion theory. Molecular mechanism of crossing over - Holliday model, Interference and coincidence, Steps in Construction of genetic map *(Drosophila).*

UNIT IV **12 h**

Sex linkage: Definition of sex linkage; Sex linkage in Drosophila. Sex linked genes in poultry, moths. Sex linked inheritance in man (Colour-blindness, Haemophilia).

Meiotic behavior of chromosome and non - disjunction. Bridge's theory of non-disjunction. Attached X-chromosome.

Extra Chromosomal Inheritance / Cytoplasmic Inheritance: Characteristic features of Cytoplasmic Inheritance. Maternal effect inheritance. - Shell coiling in *Limnea peregra*. Structure and organization of Mitochondria and Chloroplast. Inheritance of: Mitochondrial DNA, Chloroplast DNA.

Kappa particles in *Paramecium*, Sigma factor in *Drosophila*. Cytoplasmic Male Sterility (CMS) in maize.

Reference Books:

1. P. K. Gupta. (2022). *Cytogenetics, including Molecular cytogenetics*. 2nd edition. Rastogi Publishers.
2. Thomas Liehr. (2022). *Cytogenetics and Molecular Cytogenetics*. 1st edition. CRC Press.
3. Phundan Singh. (2009). *Elements of Genetics* Kalyani Publishers.
4. R. Ushakumari & G. Thamodharan (2020). *Textbook of cytogenetic*s. , Jaya Publishing House.
5. Gardner, Simmons and Snustad. (2006). *Principles of Genetics.* 8th edition. Wiley publishers.

Course Code	**General Microbiology Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0202		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should have basic knowledge of microscopy & biology.

Course Objectives:

The objective of this Course is to:

1. To understand the working conditions in microbiology lab.
2. To explore microbial cultural techniques.
3. To handle the microbial samples and their maintenance.
4. To exploit microbiology for the benefit of mankind.

Course Outcomes:

After the end of the Course students will be able to:

1. Handle the microscopes and observe the live and fixed specimens.
2. Understand the various forms of microbial culturing techniques
3. Culture and maintain the microbial strains in laboratory.
4. Familiarize the characterization of isolated microbial strains.
5. Familiarize the concept of antibiotics and antibiotic resistance
6. Understand the concept of microbial cell viability

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0202	CO1	2	2	3	3	3	0	2	2	1	2	2	2	2	2
	CO2	1	1	2	1	2	0	2	2	1	2	2	2	2	2
	CO3	3	2	2	2	2	0	1	1	1	2	0	3	3	3
	CO4	3	2	2	2	2	0	1	1	1	2	0	3	2	2
	CO5	3	2	2	2	2	0	1	1	1	2	0	3	2	2
	CO6	3	2	2	2	2	0	1	1	1	2	0	3	2	2

Course Contents:

1. Microbiological media preparation with concept of sterilization -Bacterial and Fungal Media
2. Isolation of bacterial and Fungal cells and their identification and preservation
3. Staining Methods- Simple Staining, and Negative staining and Lactophenol Cotton Blue staining
4. Differential Staining Method: Gram Staining, Endospore Staining
5. Biochemical test- Starch Hydrolysis, Oxidase Test, Catalase Test
6. Biochemical Test – IMViC test

7. Study of bacterial motility
8. Antimicrobial Susceptibility Test.
9. Study of cell viability through cell counting method

Reference Books:

1. Samuel Singer, Experiments in Applied Microbiology. Academic Press, 2001.
2. Collins, C.H., Tatrica M. Lyne and Grange, J.M, Microbiological methods, 8th edition, Hodder Arnold publishers, 2004.
3. Alexander N. Glazer, Hiroshi Nikaido, Microbial Biotechnology, 2^{nd} Edition, Freeman Publishers. 2007.
4. Keith Wilson and John walker, Principles and techniques of Biochemistry and Molecular biology, 7th edition. 2009

Course Code	Laboratory Course II (Biochemistry)	Course Type	L	T	P	C	CH
B25BC0202		DSC	0	0	2	2	3

Prerequisites:

Requires theoretical knowledge of chemicals and bio techniques.

Course Objectives

1. To apply basic techniques in the organic laboratory for preparation, purification and Identification of organic compounds.
2. To develop the knowledge about quantitative analysis.
3. To provide among students the scientific understanding molarity and Normality of solutions.
4. To understand basic methods of protein estimations,

Course Outcomes

After completing the course, the student shall be able to:

1. Correlate knowledge of organic solutions
2. Compare and contrast the analysis of mono and disaccharides.
3. Correlate knowledge of qualitative analysis of organic compounds
4. Compare and understand the protein estimation methods.
5. Determinations of basic biomolecules by analytical methods.
6. Determinations of antioxidants by titrimetric methods.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PSO 1	PSO 2	PSO 3
B25BC0202	CO1	1	2	1	2	0	0	1	1	0	3	0	2	1	0
	CO2	1	2	2	1	0	0	1	0	0	2	0	1	1	0
	CO3	1	2	1	2	0	0	1	0	0	2	1	1	1	0
	CO4	1	2	1	2	0	0	1	0	0	2	1	1	1	0
	CO5	2	0	1	2	0	0	2	0	0	3	2	0	2	0
	CO6	2	0	2	2	0	2	0	2	0	2	0	2	0	2

Course Contents:

1. Systematic Qualitative analysis of organic compounds:
   a) Amides,
   b) carboxylic acids,
   c) alcohols,
   d) aldehydes,
   e) ketones and esters.
2. Preparation of normal, molar and percent solutions.
3. Estimation of ascorbic acid from biological samples by titrimetric method.
4. Qualitative tests for Carbohydrates-Monosaccharides, Disaccharides.
5. Qualitative tests for proteins-amino acids.
6. Estimation of protein by Biuret method, Lowry's and Bradford's method.

Reference Books:

1. An Introduction to Practical Biochemistry- by Plummer D.T, (2017),3 r rd edition., Publisher-McGraw-Hill
2. Modern Experimental Biochemistry R.F. Boyer (2002)3rd Edition; Publisher-pearson India
3. Fundamentals of Calculations by Krish Moorthy, (2007) 2nd Edition., Publisher-CRC Press.
4. Experimental Biochemistry, A student companion, by Beedu Sashidhar Rao and Vijay Deshpande (2005), IK international Pvt.Ltd. S

Course Code	**Cytogenetics Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25GN0202		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites for the course:

1. Students should have the knowledge of cell organelles.
2. They should have idea about cell cycle.

Course Objectives:

1. To enable students to handle the microscopes.
2. To familiarize the cell division processes.
3. To learn the culturing of *Drosophila*
4. To study the structure of chromosomes.

Course Outcomes:

After the end of the Course students will be able to:

1. Demonstrate the ability to induce polyploidy and analyse chromosomal changes.
2. Prepare and identify polytene chromosomes from salivary glands.
3. Interpret total chromosome counts from selected plant species for comparative cytogenetic analysis.
4. Assess chromosomal aberrations in plant root tip cells and evaluate the impact of mutagenic agents on genome integrity.
5. Quantitatively estimate DNA and RNA using colorimetric methods.
6. Isolate extranuclear DNA from chloroplast and mitochondria.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0202	CO1	2	3	2	2	2	2	0	0	1	1	0	2	2	1
	CO2	3	3	2	0	2	0	0	0	2	1	0	1	1	1
	CO3	2	3	3	2	3	1	0	1	2	1	0	3	3	2
	CO4	2	2	2	3	3	1	1	0	1	0	2	1	2	1
	CO5	1	3	3	2	2	2	1	1	1	0	1	3	3	0
	CO6	2	2	2	1	1	0	0	0	1	1	0	3	3	1

Course Contents

1. Induction of polyploidy in onion root tip cells.
2. Salivary gland Chromosome- Preparation of Polytene chromosome.
3. Total chromosome counts from 2 different plant species.
4. Identification of chromosomal damage in the root tips as a result of UV irradiation.
5. Estimation of DNA by Diphenyl amine method.

6. Estimation of RNA by Orcinol method.
7. Isolation of extranuclear DNA from chloroplast
8. Isolation of extranuclear DNA from mitochondria

Reference Books:

1. P. K. Gupta. (2022). *Cytogenetics, including Molecular cytogenetics*. 2nd edition. Rastogi Publishers.
2. Thomas Liehr. (2022). *Cytogenetics and Molecular Cytogenetics*. 1st edition. CRC Press.
3. Phundan Singh. (2009). *Elements of Genetics* Kalyani Publishers.
4. R. Ushakumari & G. Thamodharan (2020). *Textbook of cytogenetic*s. , Jaya Publishing House.
5. Gardner, Simmons and Snustad. (2006). *Principles of Genetics.* 8th edition. Wiley publishers.

Course Code	Cyber Security	Course Type	L	T	P	C	CH
B25AS0213		**VAC**	**1**	**0**	**0**	**1**	**2**

Prerequisites

The student should have prior knowledge of computer science

Course objectives

1. Learn the foundations of Cyber security and threat landscape.
2. To equip students with the technical knowledge and skills needed to protect and defend against cyber threats.
3. To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.
4. To expose students to governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security

Course Outcomes

After completion of this module, students would be able to

1. Understand the concept of Cyber security
2. Recognize the issues and challenges associated with Cyber security.
3. Understand the cyber-crimes,
4. Comprehend their nature of cyber crimes
5. Understand the legal remedies of cyber-crime
6. Understand the procedure to how report the crimes through available platforms and procedures

Course Code	PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	1	0	1	1	0	0	0	1	0	1	0	1	1	1

B25AS 0213	CO2	1	0	1	0	1	0	0	1	0	1	0	1	0	1
	CO3	1	1	0	1	1	0	1	1	1	0	0	1	1	1
	CO4	1	1	1	0	1	0	0	0	1	1	0	1	1	1
	CO5	1	1	1	1	1	0	1	0	1	0	0	1	1	1
	CO6	1	1	0	0	1	0	1	1	1	1	0	1	1	1

Course Content

Unit I: Introduction to Cyber security **12 Hr.**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

Unit II: Cyber-Crime and Cyber Law **12 hr.**

Classification of cyber-crimes, Common cybercrimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber-crimes, Remedial and mitigation measures, Legal perspective of cyber-crime, IT Act 2000 and its amendments, Cybercrime and offences, Organizations dealing with Cyber-crime and Cyber security in India, Case studies.

Reference Books

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Gupta, B. B., Perez, G. M., Agrawal, D. P., & Gupta, D. (2020). Handbook of computer networks and cyber security. *Springer*, *10*, 978-3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
4. Moseley, R. (2021). *Advanced cybersecurity technologies*. CRC Press.

B.Sc. – Biotechnology, Biochemistry, Genetics
Detailed Syllabus
THIRD SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHK303	**Language II: Kannada - III**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Overview

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯ ಪ್ರಕಾರವಾಗಿ ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Prerequisite / Pre reading for the course

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy:

- Direct method
- ICT and Digital support (Links attached)
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಒಳಗೊಂಡಂತೆ ವಿಷಯವಾರು ಪಠ್ಯಗಳನ್ನು ನೀಡಲಾಗಿದ್ದು, ಆ ಮೂಲಕ ಕನ್ನಡ ಭಾಷೆ, ಸಂಸ್ಕೃತಿಯ ಜೊತೆಗೆ ಮಾನವೀಯ ಗುಣಗಳನ್ನು ಪರಿಚಯಿಸುವ ಹಾಗೂ ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಪ್ರೇರೇಪಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಮೂರನೇ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ಮಾನವೀಯತೆ, ಪ್ರವಾಸ, ವಿಚಾರಕ್ರಾಂತಿ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂದಿಸಿದಂತೆ ವಿಷಯಗಳನ್ನು ನೀಡಿದ್ದು, ಅದಕ್ಕೆ ಪೂರಕವಾಗಿ ಸಾಹಿತ್ಯಿಕ ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ. ಈ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ. ಹಾಗೂ ವೈವಿಧ್ಯಮಯ ಭಾರತದ ಸಾಂಸ್ಕೃತಿಕ ನೆಲೆಗಳನ್ನು ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ
2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.
3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಬರಹ, ವೃತ್ತಿ ಪೂರ್ವಕ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ
4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

Course Outcomes:

ಮಾನವೀಯತೆ, ಪ್ರವಾಸ, ವಿಚಾರಕ್ರಾಂತಿ ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಸಾಹಿತ್ಯ ಪಠ್ಯಗಳ ಕಲಿಕೆಯ ಮೂಲಕ ಅವುಗಳ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

1. ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ಸೂಕ್ಷ್ಮತೆಯ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಸುತ್ತದೆ
2. ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳನ್ನು ವಿವಿಧ ಆಯಾಮಗಳೊಂದಿಗೆ ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.
3. ಉತ್ತಮ ಭಾಷಾ ಕೌಶಲ್ಯವನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.

4. ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.
5. ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯದ ಶ್ರೀಮಂತಿಕೆಯ ಜೊತೆಗೆ ಮಾನವೀಯಮೌಲ್ಯಗಳನ್ನು ಮೂಡಿಸುತ್ತದೆ.
6. ಸದೃಢ ಬೌದ್ಧಿಕ ಮತ್ತು ಮಾನಸಿಕ ವ್ಯಕ್ತಿತ್ವವನ್ನು ವಿಕಾಸಿಸುತ್ತದೆ.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PSO 1	PSO 2	PSO 3
B25AHK303	CO1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO6	1	2	0	0	0	0	1	0	1	1	0	2	1	0

COURSE CONTENT/ SYLLABUS

ಪರಿವಿಡಿ		
ಘಟಕ 1 – ಮಾನವೀಯತೆ **1.1 ಜನಪದ ಗೀತೆ (ಹಬ್ಬಲಿ ಅವರ ರಸಬಳ್ಳಿ)** **1.2 ದೇವರ ಹೆಣ** **1.3 ನೆಲ್ಸನ್ ಮಂಡೇಲ**	**ಜನಪದ** **ಕುಂ. ವೀರಭದ್ರಪ್ಪ** **ರಂಜಾನ್ ದರ್ಗಾ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 2 – ಪ್ರವಾಸ **2.1 ಮುಂಬೈ ಜಾತಕ** **2.2 ಹಬ್ಬ ಮತ್ತು ರಥೋತ್ಸವ** **2.3 ಬುದ್ಧ ಬಿಸಿಲೂರಿನವನು**	**ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ** **ಗೊರೂರು ರಾಮಸ್ವಾಮಿ ಅಯ್ಯಂಗರ್** **ನಾಗತಿಹಳ್ಳಿ ಚಂದ್ರಶೇಖರ್**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 3 – ವಿಚಾರಕ್ರಾಂತಿ **3.1 ವಚನಗಳು** **3.2 ಹರಕೆಗಳು** **3.3 ಚಾರ್ವಾಕರು**	**ಬಸವಣ್ಣ** **ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್** **ಪಿ ಎನ್ ರಂಗನ್**	**10 ಗಂಟೆಗಳು**

ಘಟಕ 4 – ಸಂಕೀರ್ಣ **4.1 ಯಾರೂ ಅರಿಯದ ವೀರ** **4.2 ಮೊಬೈಲ್ ಎಂಬ ಮೋಹಿನಿ** **4.3 ಸಾಮಾಜಿಕ ಜಾಲತಾಣಗಳಲ್ಲಿ ಕನ್ನಡದ ಕಂಪು**	**ಕುವೆಂಪು** **ಡಿ. ರಾಮನಮಿಲಿ** **ಶ್ರೀನಿಧಿ ಡಿ ಎನ್**	**9 ಗಂಟೆಗಳು**

TextBooks:
ಸಂಯೋಜಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ **'ವಿಜ್ಞಾನ ಸೌರಭ' – ಮೂರನೇ ಸೆಮಿಸ್ಟರ್ ಬಿಎಸ್ಸಿ (AS, AHS, SS)**

ಪರಾಮರ್ಶನ ಗ್ರಂಥಗಳು:
1. ವಚನ ಭಾರತ- ಎ ಆರ್. ಕೃಷ್ಣಶಾಸ್ತ್ರಿ, ಗೀತಾ ಬುಕ್ ಹೌಸ್, 2012
2. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಕೋಶ, ಸಂ. ಡಾ.ಸಿ.ಚಿ. ನಿಂಗಣ್ಣ, ಶ್ರೀ ಸಿದ್ಧಲಿಂಗಯ್ಯ ಪ್ರಕಾಶನ, ಗುಲ್ಬರ್ಗ, 2010
3. ಬದುಕು ಬದಲಿಸುವುದು- ನೇಮಿಚಂದ್ರ, ನವ ಕರ್ನಾಟಕ ಪ್ರಕಾಶನ, 2022
4. ದಕ್ಷಿಣ ಕರ್ನಾಟಕದ ಕಾವ್ಯ ಪ್ರಕಾರಗಳು- ಜಿ.ಶಂ.ಪ, ಅಭಿನವ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು, 2016
5. ಹೊಸ ವಿಚಾರಗಳು- ತೇಜಸ್ವಿ, ಪುಸ್ತಕ ಪ್ರಕಾಶನ, ಮೈಸೂರು, 2024
6. ಜಾಗತಿಕ ವಿಚಾರ ಸಾಹಿತ್ಯ- ಸಂ. ದಂಡಪ್ಪ, ಕುವೆಂಪು ಭಾಷಾ ಭಾರತಿ ಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು, 2017

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B25AHH303	Language-II: Hindi III	AEC	3	0	0	3	3

Course Overview: पाठ्यक्रम अवलोकन
यह पाठ्यक्रम नवशिक्षुओं को उनकी भाषा-प्रयोग की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक गतिविधियों के माध्यम से समाज, संस्कृति और जीवन के मूल्यों को समझने के लिए अभिप्रेरित करता है।

Prerequisites/Pre reading for the course: पूर्व-अपेक्षित ज्ञान:
- विद्यार्थियों ने पी.यू.सी. स्तर पर द्वितीय भाषा के रूप में हिंदी का अध्ययन किया होना चाहिए।
- हिंदी साहित्य के इतिहास का संक्षिप्त ज्ञान आवश्यक है।
- हिंदी व्याकरण की मूलभूत समझ होनी चाहिए।
- अंग्रेज़ी से हिंदी अनुवाद संबंधी जानकारी होना आवश्यक है।

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Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning

Objectives: पाठ्यक्रम के उद्देश्य:
- संदर्भानुसार उपयुक्त भाषा के प्रयोग की दक्षता विद्यार्थियों में विकसित करना।
- साहित्य के माध्यम से समाज एवं मानवीय मूल्यों की समझ को सुदृढ़ कर, उन मूल्यों की रक्षा हेतु प्रेरित करना।

- विद्यार्थियों में पुस्तक पठन और लेखन की स्वाभाविक प्रवृत्ति को स्थापित करना।
- साहित्यिक अध्ययन के माध्यम से प्रभावी एवं कुशल संचार कौशल का विकास करना।

Course Outcomes पाठ्यक्रम की समाप्ति पर विद्यार्थी:

- सामाजिक मूल्यों एवं नैतिक उत्तरदायित्व को स्वीकार करने में सक्षम होगा।
- साहित्य की प्रासंगिकता को अपने जीवन में समझने की योग्यता रखेगा।
- समाज में अंतर्निहित प्रवृत्तियों एवं विचारधाराओं का विश्लेषण करने में सक्षम होगा।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार कौशल विकसित कर सकेगा।

Mapping of Course Outcomes with program Outcomes

Course Code	Course Outcome	Program Outcomes													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B24AHH303	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0

Course Content : पाठ्यक्रम विषय सूची / पाठ्यक्रम सामग्री

इकाई – 1 (10 घंटे)

1. सामाजिक-आर्थिक एकांकी – थैक्लाइक – भुवनेश्वर
2. ऐतिहासिक-प्रतीकात्मक एकांकी – अशोक की प्रतीक्षा – डॉ. धर्मवीर भारती

इकाई – 2: [10 Hours]

3. दर्शनात्मक, प्रतीकात्मक एकांकी – महाभारत की एक सांझ – भारतभूषण अग्रवाल
4. नैतिक, प्रतीकात्मक, यथार्थपरक एकांकी – रीढ़ की हड्डी – जगदीशचंद्र माथुर

इकाई –3: [10 Hours]

5. प्रहसनात्मक सामाजिक एकांकी – जोकं – उपेन्द्रनाथ अश्क
6. सामाजिक-परिवर्तनशील एकांकी – नए मेहमान – उदयशंकर भट्ट

इकाई – 4 [09 Hours]

7. जनसंचार माध्यम का परिचय
8. वृतांत लेखन (विस्तृत अभ्यास):
9. क्षारोपण का वृतांत लेखन

10. अतिथि भाषण का वृतांत लेखन
11. अन्य संदर्भित विषयों (जैसे शैक्षणिक भ्रमण, सांस्कृतिक कार्यक्रम, कार्यशाला आदि) पर वृतांत लेखन

Text book/s: पा□ पु□क:

1. *हिंदी पाठ्यपुस्तक* – रेवा विश्वविद्यालय द्वारा प्रकाशित

References: संदर्भ ग्रंथ:

1. हिंदी एकांकी: विकास और विश्लेषण – **डॉ. राममूर्ति चतुर्वेदी**
2. **हिंदी** एकांकी के सौ साल – **संपादक: डॉ. नागेन्द्र**
3. **मीडिया** लेखन एवं जनसंचार – **डॉ. संजीव कुमार**
4. **हिंदी** साहित्य का इतिहास – **डॉ. नागेन्द्र**
5. **आधुनिक** हिंदी साहित्य का इतिहास – **डॉ. बैजनाथ सिंह**
6. **हिंदी** साहित्य का नवीन इतिहास – **डॉ. लाल साहब सिंह**
7. **शुद्ध** हिंदी कैसे बोलें, कैसे लिखें – **पृथ्वीनाथ पांडेय**
8. **कार्यालय** अनुवाद निर्देशिका
9. **मीडिया** विमर्श – **प्रो. रामशरण जोशी**
10. **संस्कृति**, जनसंचार और बाज़ार – **नंद भारद्वाज**

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25AHA301	Language II: Additional English II	AEC	3	0	0	3	3

Course Description:

This is a 3 credit course designed to help the learners gain competency in language and literature by exposing them to a variety of literary genres and, in the process also develop their subjective perception of the society and the world at large. This course offers an interdisciplinary exploration of literature from diverse cultures and time periods, focusing on the themes of love, identity, gender, war, and social justice. Through a rich selection of poetry, short stories, and essays, students will engage with voices ranging from classical Western canon to contemporary South Asian and global writers.

Course Objectives:

- To ensure the development of the linguistic prowess of the students.
- To motivate the students to appreciate literature.
- To promote an appreciable reading habit among the students.
- To explore the use of electronic media such as internet and supplement the learning materials used in the classroom.

Course Outcomes:

On completion of the course, learners will be able to:

- Analyze the themes of love, identity, and conflict in selected poetry and short stories from diverse cultural contexts.
- Evaluate the representation of gender roles and feminist perspectives in works by P. Lankesh, Banu Mushtaq, and Suniti Namjoshi.
- Compare and contrast the portrayal of war and its psychological impact in the writings of Thomas Hardy, Katherine Mansfield, and Czeslaw Milosz.
- Interpret the use of literary devices and narrative techniques in classical and contemporary texts to understand cultural and historical influences.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B23AHA301	CO1	2	0	0	0	0	0	0	1	1	1	0	2	1	0
	CO2	2	0	0	2	0	0	0	0	1	0	0	1	0	0
	CO3	2	0	1	1	0	0	2	2	1	1	0	1	1	0
	CO4	2	0	0	1	0	0	2	1	1	1	0	2	1	1
	CO5	2	0	0	1	0	0	2	1	1	1	0	2	1	1
	CO6	2	0	0	1	0	0	2	1	1	1	0	2	1	1

Unit	Description	Topics	Teaching Hours
I	**Gender & Identity**	P Lankesh – "The Classmate." Suniti Namjoshi – Extracts from *Feminist Fables* *Githa Hariharan's The Remains of the Feast*	10 hours
II	**Love & Romance**	Pablo Neruda – Tonight I can Write William Shakespeare – Sonnet 116 Erich Fromm-The Art of Loving	10 hours
III	**War ,Violence & Trauma**	Czeslaw Milosz – A song on the end of the world Thomas Hardy's – The Man I Killed Katherine Mansfield – The Fly	10 hours
IV	**Children's Literature**	Rabindranath Tagore – Paper Boats Sarojini Naidu – The Gift of India Ruskin Bond – The Blue Umbrella	9 hours

References:

- **Lankesh, P.** *The Classmate*. Translated by Tejaswini Niranjana, in *Anthology of Kannada Short Stories*, edited by K. M. George, Sahitya Akademi, 1991.

- **Hariharan, Githa.** *The Art of Dying*. Penguin Books India, 1993. *(Contains "The Remains of the Feast")*
- **Mansfield, Katherine.** *The Fly and Other Stories*. Penguin Classics, 1990.
- **Butalia, Urvashi, and Ritu Menon**, editors. *In Other Words: New Writing by Indian Women*. Kali for Women, 1992. *(Includes Hariharan and Namjoshi)*
- **Rampersad, Arnold**, editor. *The Collected Poems of Pablo Neruda*. Farrar, Straus and Giroux, 2008.
- **Greenblatt, Stephen**, editor. *The Norton Shakespeare*. 3rd ed., W. W. Norton, 2015. *(For deeper analysis of Shakespeare's sonnets)*
- **Fromm, Erich.** *The Art of Loving*. Harper Perennial Modern Classics, 2006.
- **Namjoshi, Suniti.** *Feminist Fables*. Sheba Feminist Publishers, 1981.
- **Neruda, Pablo.** *Tonight I Can Write*. Translated by W. S. Merwin, in *Twenty Love Poems and a Song of Despair*, New Directions, 1970.
- **Shakespeare, William.** *Sonnet 116*. In *Shakespeare's Sonnets*, edited by Stephen Booth, Yale University Press, 1977.
- **Milosz, Czeslaw.** *A Song on the End of the World*. Translated by Anthony Milosz, in *The Collected Poems: 1931–1987*, Harper & Row, 1988.
- **Tagore, Rabindranath.** *Paper Boats*. Translated by the author, in *The Crescent Moon*, Macmillan, 1913.
- **Naidu, Sarojini.** *The Gift of India*. In *The Broken Wing: Songs of Love, Death and Destiny*, William Heinemann, 1917.

Course Code	**Environmental Biotechnology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0301		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

The student should have knowledge of environmental science and chemistry.

Course Objectives:

The Objective of this Course is to:

1. To acquire the knowledge about environmental pollution sources, effect and control measures of environmental pollution, degradation and waste management.
2. To understand the importance about various types of energy i.e. conventional and non-conventional as well as natural resources.
3. To learn about the various strategies for the remediation of versatile forms pollutants and prevalent in environment.
4. Explore the ways for the management of different kinds of solid wastes.

Course Outcomes:

After completion of the course students will be able to:

1. Analyse the environmental issues and conditions and protect it.
2. List the causes of environmental pollution & find ways to overcome them.
3. List the ways to overcome pollution.
4. Search of new renewable energy resources which can be efficiently replace the need to non-renewable energy consumption
5. Design better remediation strategies to tackle the issue of pollution.
6. Design better waste management strategies to combat pollution problem.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0301	CO1	2	3	3	1	2	2	0	3	0	0	3	3	2	3
	CO2	2	3	3	3	2	2	0	3	1	1	3	3	2	3
	CO3	2	3	3	1	2	2	0	3	1	1	3	3	2	3
	CO4	2	3	3	1	2	2	0	3	1	1	2	3	2	3
	CO5	2	1	1	2	2	0	0	1	1	1	3	1	0	1
	CO6	1	2	1	2	2	0	0	1	1	1	3	1	1	0

Course Contents:

Unit-I

Energy Sources and Environmental hazards **12Hrs**

Various forms of Energy sources, Pollution and its hazardous impact on environment, Role of biotechnology to solve the environmental problems. Current scenario of environmental hazards. Biotechnological methods of pollution detection: general bioassay, cell biological methods, immunoassays, DNA-based methods, use of biosensors. Biotechnological methods in pollution abatement: Reduction of CO_2 emission. Wastewater treatment – conventional wastewater treatment, use of algae, application of cell immobilization.

Unit-II

Bioremediation **12Hrs**

Bioremediation: Concepts and principles, bioremediation using microbes, in situ and ex situ bioremediation, biosorption and bioaccumulation of heavy metals. Xenobiotics: Degradation by microorganisms with reference to pesticides, herbicides, polyaromatic hydrocarbons. Relevance of GMO to the environment. Status of biotechnology in environment protection.

UNIT III

Solid waste Management **12 Hrs**

Solid waste management: Treatment of Industrial wastes: Dairy, pulp and paper, dye, leather, wood, and pharmaceutical waste. Genetically engineered microbes for waste treatment, anaerobic and aerobic composting, vermiculture. Acts and Regulation for environment protection.

Unit-IV

Eco-friendly bio-products **12 Hrs**

Biomass resources, Biogas, alcohol as fuel, biological hydrogen generation, Bioplastics and Bio-polymers. Biofertilizers and Biopesticides, Biofuels and Biodiesel. Azola and Azotobacter, VAM, Sustainable Environment, and concept of Circular Economy. Current Rules and Regulations for eco-friendly biproducts

Reference Books:

1. P. K. Mohapatra (2006), Textbook of Environmental Biotechnology, I. K. International Pvt Ltd.
2. Gu, J. (2021). On Environmental Biotechnology of Bioremediation. *Applied Environmental Biotechnology*, *5*(2), 3–8. https://doi.org/10.26789/aeb.2020.02.002
3. Environmental Biotechnology, Foster C.F., John Wae D.A., Ellis Horwood Limited.
4. Introduction to Environmental Biotechnology. A. K. Chatterji. Prentice-Hall of India Pvt.Ltd. New Delhi, 2002.

Course code	Human Physiology	Course type	L	T	P	C	CH
B25BC0301		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

The student should have knowledge of biological sciences

Course Objective:

1. To understand the molecular mechanisms of early development
2. Define the molecular, cellular, and tissue-level organization of the central and peripheral nervous system.
3. To understand about the gastrointestinal physiology, digestive gland, digestion, absorption, and the muscular function
4. To know the male and female reproductive physiology and nervous system (need to add 6 course objectives)

Course Outcomes:

After completing the course, the student shall be able to:

1. To understand the composition of the various body fluid compartments, and associated disorders.
2. Apply the knowledge of renal physiology and respiration on various disorders and detect the real symptoms for curing certain diseases.
3. Develop surgical, medical, and also interventional and non-interventional treatment plans for gastro -intestinal and hepatic physiology.
4. Understand the mechanisms involved in sexual differentiation and relate the properties of individual cells to their function in organized neural circuits and systems.
5. To understand the composition of the neuronal compounds and associated disorders.
6. To understand the physiology of bone and muscles and its associated disorders.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
B25BC0301	CO 1	2	3	2	2	2	2	1	1	2	2	2	3	3	3
	CO 2	2	3	1	2	3	1	2	1	2	1	2	3	3	1
	CO 3	2	3	2	3	2	1	1	1	2	1	3	3	3	1
	CO 4	2	3	2	1	2	3	2	3	2	1	2	3	3	1
	CO 5	3	3	1	1	2	1	2	2	2	1	1	1	3	1
	CO 6	3	3	2	2	2	3	2	2	2	1	3	3	3	1

Course Content

UNIT I **12 hrs.**

The Body Fluid Compartments: Intracellular, extracellular, and interstitial fluid. plasma composition; plasma proteins and its importance. The Cardiovascular System: Structure of heart, cardiac cycle, heart sound and the ECG; Regulation of cardiac function and output. Regulation of blood flow to the tissues; Portal circulations. Arterial pressure and its regulation. Hypertension, Congestive heart disease.

UNIT II **12hrs.**

Renal Physiology: Structure of the nephron, Mechanism of Urine formation, GFR, Renal clearance with Inulin clearance with an example. Causes and symptoms of glomerular nephritis, renal failure. Dialysis-principle and application. Respiration: Organization of the pulmonary system, Mechanism of respiration, Principles of Gas exchange and transport, Regulation of respiration, Acidosis and Alkalosis. Hypoxia, hypercapnia.

UNIT III **12 hrs.**

Gastrointestinal and Hepatic system: composition, secretion and functions of saliva, gastric, pancreatic and bile. Gastro-intestinal hormones: Digestion, absorption and transport of carbohydrates, proteins, lipids. Liver function tests, Jaundice and Liver cirrhosis. Musculoskeletal system: Structure and formation of Bone, Types of muscles, Physiology of muscle contraction. Muscular Dystrophies and its significance.

UNIT IV **12 hrs.**

Reproductive Physiology: Structure of female and male genital tract, Spermatogenesis and Oogenesis. Outlines of IVF and its applications. Neurophysiology-Organization of the central nervous system-structure of neuron, types. Introduction to neural networks-central, autonomic, and peripheral, outline of membrane potential, mechanism and importance of myelination. Causes and symptoms of Alzheimer's and Parkinson's diseases.

Reference Books:

1. Guyton, A. C., & Hall, J. E. (2020). Guyton and Hall Textbook of Medical Physiology (14th ed.). Elsevier. ISBN: 978-0323597126
2. Boron, W. F., & Boulpaep, E. L. (2017). Medical Physiology (3rd ed.). Elsevier. ISBN: 978-1455743774
3. Widmaier, E. P., Raff, H., & Strang, K. T. (2020). Vander's Human Physiology: The Mechanisms of Body Function (15th ed.). McGraw-Hill Education. ISBN: 978-1260092844
4. Pocock, G., Richards, C. D., & Richards, D. A. (2018). Human Physiology (5th ed.). Oxford University Press. ISBN: 978-0198737223
5. Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X. J. (2019). Ganong's Review of Medical Physiology (26th ed.). McGraw-Hill Education. ISBN: 978-1260122404
6. Berne, R. M., Levy, M. N., Koeppen, B. M., & Stanton, B. A. (2018). Physiology (7th ed.). Elsevier. ISBN: 978-0323393940

Course Code	Molecular Genetics	Course Type	L	T	P	C	CH
B25GN0301		DSC	3	0	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of DNA structure and chromosomes.
2. They should know the concept of central dogma of molecular biology.

Course Objectives:

The objective of this Course is:
1. To study the discovery and structure of the genetic material.
2. To understand the processes of gene expression and gene regulation.
3. To facilitate students to understand the concept of microbial genetics.
4. To investigate the causes of genetic diseases.

Course Outcomes:
After the end of the Course students will be able to:

1. Understand the discovery of genetic material.
2. Sketch the molecular structure of DNA and RNA.
3. Deduce the mechanism of DNA replication.
4. Illustrate the mechanism of gene expression.
5. Provide an overview of epigenetic regulation of gene expression.
6. Understand the concept of mutations and types

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0301	CO1	3	2	3	3	2	3	1	1	2	2	0	2	3	2
	CO2	3	3	3	3	2	2	0	1	2	2	0	3	3	1
	CO3	3	2	3	3	3	2	0	1	1	2	0	2	2	1
	CO4	3	3	3	2	2	1	1	1	1	2	0	2	3	2
	CO5	3	2	3	3	2	2	0	0	1	1	0	3	3	1
	CO6	2	2	3	3	3	1	0	0	1	0	0	1	2	1

Course Contents:
UNIT I **12 hrs**
Chemical Basis of Heredity:
DNA as genetic material Experiments of Griffith; Avery, Mc Leod and Mc Carty; Hershey and

Chase. RNA as genetic material Experiment of Fraenkel and Singer.

Nucleic acids:

Molecular structure of DNA, Chargaff's rule, Forms of DNA A, B and Z forms.

RNA types, structure and functions– mRNA, tRNA (clover leaf model), rRNA, other types and their significance. Ribozymes

DNA Replication: Meselson and Stahl Experiment.

DNA Replication in prokaryotes – Initiation, Continuous and discontinuous synthesis, Events at the replication fork, Termination, Enzymology of DNA replication. Types of replication. DNA Replication in eukaryotes.

UNIT II **12 hrs**

Gene expression:

Transcription: Prokaryotes and eukaryotes - initiation, elongation and termination (rho-dependent and rho-independent). Post transcriptional modifications: methylation, polyadenylation, RNA splicing. **Translation:** Prokaryotes and eukaryotes, Genetic code and its properties; process of translation - Initiation, elongation and termination. Post-translational modifications of proteins. Protein sorting: protein packaging and trafficking.

UNIT III **12hrs**

Gene regulation in prokaryotes:

Concept of operon, Inducible operon – Lac operon – structure and mechanism, Catabolite repression. Repressible operon – Tryptophan operon – structure and mechanism. Industrial applications of operons. Multiple gene families.

Epigenetic Regulation of Gene expression: Overview of epigenetic regulation; Chromatin remodelling and gene expression; Histone modifications and gene expression; Small RNA based epigenetic regulation; genome imprinting.

UNIT IV **12 h**

Mutation : Introduction and Types of Gene mutations – Base substitution (Transition and transversion), Frame shift mutation, insertion, deletion, missense, nonsense, reverse, suppressor and lethal mutations).

Pleiotropy-definition and examples.

Mutagens – Physical (ionizing and non- ionizing radiations) and chemical (Base analogs, Alkylating agents, Acridine dyes, Deaminating agents, Hydroxylating agents, Tobacco carcinogens); Oncogenic Viruses.

DNA repair mechanisms (Mismatch repair, photoreactivation, excision and SOS repair).

Mutation as raw material for evolution.

Beneficial effects of mutation.

References Books:

1. Leland Hartwell, Leroy Hood, Charles (Chip) Aquadro, Michael L. Goldberg, Maria Papaconstantinou, Fischer, Janice, Jim Karagiannis. (2017). G*enetics – from genes to genomics. 8th edition.* McGrawHill Education.
2. K. P. Singh (2016) C*oncepts of Molecular Genetics*. 1st edition. Medtech Publishers
3. Gurbachan Miglani. (2015) *Essentials of Molecular Genetics*. 1st edition. Alpha Science International Ltd.
4. Daniel L. Hartl and Elizabeth W. Jones. (2011). *Genetics – Analysis of Genes and genomes. 8*th edition. Laxmi Publications.
5. Benjamin Lewin. (2008). *Genes IX*, 9th Edition, Jones and Bartlett Publishers.

Course Code	Environmental Biotechnology Lab	Course Type	L	T	P	C	CH
B25BT0302		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should be familiar with the basic knowledge of environmental science and chemistry.

Course Objective:

1. To impart knowledge on the role of pollutants & their effect on environment & human health.
2. To learn techniques of controlling the environmental pollution.
3. To facilitate the understanding of the impact of industrial affluents of environments.
4. To understand the role of micro-organisms in bioremediation process.

Course Outcomes:

After the completing the course, the student should be able to

1. Analyze the detrimental effect of the different pollutants
2. Understand water quality assessment.
3. Categorize the pollutants depending on their hazardous effect.
4. Establish and practice vermicomposting.
5. Understand the concept of remediation.
6. Develop remedies to control pollution and its related consequences.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0302	CO1	2	3	3	1	2	2	0	3	0	0	0	3	2	3
	CO2	2	3	3	3	2	2	0	3	1	1	2	3	2	3
	CO3	2	3	3	1	2	2	0	3	1	1	0	3	2	3
	CO4	2	3	3	1	2	2	0	3	1	1	2	3	2	3
	CO5	2	1	1	2	2	0	0	1	1	1	2	1	0	1
	CO6	1	2	1	2	2	0	0	1	1	1	3	1	1	0

Course Contents

1. Degradation of organic matter using Vermicomposting,
2. Determination of Biochemical oxygen demand of water sample.
3. Determination of Chemical Oxygen Demand of water sample.
4. Determination of Total dissolved solids.
5. Microbial analysis of water through MPN method.
6. Estimation of Hardness of water through calcium estimation.
7. Estimation of chromium in industrial effluents.
8. Phytoremediation of industrial pollutant.
9. Pollutant ecotoxicty analysis using catalase assay.

Reference Books:

1. P. K. Mohapatra (2006), Textbook of Environmental Biotechnology, I. K. International Pvt Ltd.
2. Gu, J. (2021). On Environmental Biotechnology of Bioremediation. *Applied Environmental Biotechnology*, *5*(2), 3–8. https://doi.org/10.26789/aeb.2020.02.002
3. Environmental Biotechnology, Foster C.F., John Wae D.A., Ellis Horwood Limited.
4. Introduction to Environmental Biotechnology. A. K. Chatterji. Prentice-Hall of India Pvt.Ltd. New Delhi, 2002.

Course code	**Laboratory course III (Biochemistry)**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BC0302		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites

Requires knowledge of biomolecules like carbohydrates, amino acids, and proteins etc

Course Objectives:

1. To gain practical knowledge on Hemotology.
2. To understand the composition of blood
3. To learn different blood estimation techniques.
4. To understand caluculations of estimation methods.

Course Outcome:

After completing the course, thes tudent shall be able to:

1. Analyze RBC, WBC, Leucocyte counts
2. Get the ability to evaluate amount of haemoglobin in blood.
3. Alnlyze the toxicity of ammonia in blood.
4. Understand the significance of vitamin C.
5. Separation of Lactate dehydrogenase and isoenzymes.
6. Understand the significance of measurement of BP, bleeding and blood clotting time.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO 3
B25BC0302	CO 1	2	3	2	2	2	2	1	1	2	2	0	3	3	3
	CO 2	2	3	1	2	3	1	2	1	2	1	0	3	3	1
	CO 3	2	3	2	3	2	1	1	1	2	1	0	3	3	1
	CO 4	2	3	2	1	2	3	2	3	2	1	0	3	3	1
	CO 5	3	3	1	1	2	1	2	2	2	1	1	1	3	1
	CO 6	3	3	2	2	2	3	2	2	2	1	1	3	3	1

Course Contents

1. Hematology
   a) RBC and WBC count (Healthy & Diseased Blood)
   b) Clotting & Bleeding time and Measurement or blood pressure & pulse rate.
   c) Differential Leucocyte count.
2. Estimate of inorganic phosphate by Fiske Subbarow’s method
3. Estimation of Hemoglobin by Wong’s method.
4. Estimation of ammonium by Nessler’s method.
5. Estimation of ascorbic acid by dye method.
6. Separation of isoenzymes of LDH by electrophoresis.

ReferenceBooks:

1. Burtis, C. A., Bruns, D. E., & Sawyer, B. G. (2019). Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (8th ed.). Elsevier. ISBN: 978-0323530444
2. Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2018). Clinical Chemistry: Techniques, Principles, Correlations (8th ed.). Wolters Kluwer. ISBN: 978-1496335586
3. McPherson, R. A., & Pincus, M. R. (2021). Henry's Clinical Diagnosis and Management by Laboratory Methods (24th ed.). Elsevier. ISBN: 978-0323661490
4. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., Rodwell, V. W., & Weil, P. A. (2021). Harper's Illustrated Biochemistry (31st ed.). McGraw-Hill Education. ISBN: 978-1260464252
5. Kaplan, L. A., Pesce, A. J., & Kazmierczak, S. C. (2019). Clinical Chemistry: Theory, Analysis, Correlation (6th ed.). Elsevier. ISBN: 978-0323352213
6. Tymoczko, J. L., Berg, J. M., & Stryer, L. (2019). Biochemistry: A Short Course (4th ed.). Macmillan Learning. ISBN: 978-1319114633
7. Devlin, T. M. (2017). Textbook of Biochemistry with Clinical Correlations (7th ed.). Wiley. ISBN: 978-1119155392

<table>
<tr><th>Course Code</th><th rowspan="2">Molecular Genetics Lab</th><th>Course Type</th><th>L</th><th>T</th><th>P</th><th>C</th><th>CH</th></tr>
<tr><td>B25GN0302</td><td>DSC</td><td>0</td><td>0</td><td>2</td><td>2</td><td>3</td></tr>
</table>

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of centrifugation.
2. They should know the concept of quantification methods.

Course Objective:

The objective of this Course is:

1. To facilitate students to extract DNA and analyze them.
2. To characterize DNA and proteins using electrophoresis.
3. To understand the mechanism of mutations.

Course Outcomes:

By the end of the course the student will be able to:

1. Demonstrate proficiency in isolating total genomic DNA different samples.
2. Perform agarose gel electrophoresis for the separation and visualization of DNA, and interpret electrophoretic patterns.
3. Quantify isolated DNA using UV spectrophotometry and isolate plasmid DNA.

4. Conduct SDS-PAGE for the separation of proteins and understand its relevance in protein analysis.
5. Evaluate mutagenic and radiological effects on biological systems using brine shrimp lethality assays.
6. Assess seedling injury under varying radiation doses

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0302	CO1	2	2	3	2	2	0	0	0	1	1	0	3	3	1
	CO2	2	3	2	3	2	2	1	3	2	2	1	3	3	2
	CO3	2	3	1	2	2	1	0	0	1	1	1	2	3	1
	CO4	3	2	3	2	2	1	0	1	1	1	0	3	3	1
	CO5	2	2	3	2	2	1	0	1	0	1	0	3	3	2
	CO6	2	3	3	3	2	2	1	0	1	1	1	3	2	1

Course Contents

1. Total Genomic DNA isolation in plants – Cauliflower, Coconut endosperm
2. Total Genomic DNA isolation from bacterial sample / animal tissue
3. Agarose gel electrophoresis
4. Quantification of isolated DNA by UV spectrophotometric method
5. Isolation of plasmid DNA
6. SDS PAGE – Poly Acrylamide Gel Electrophoresis
7. Brine shrimp lethality test for mutagens.
8. Calculation of seedling injury in irradiated seedlings with different doses of radiation.
9. Effect of dose rate on the seedling injury for a given dose of radiation.

Reference Books:

1. Leland Hartwell, Leroy Hood, Charles (Chip) Aquadro, Michael L. Goldberg, Maria Papaconstantinou, Fischer, Janice, Jim Karagiannis. (2017). G*enetics – from genes to genomics. 8th edition.* McGrawHill Education.

2. K. P. Singh (2016) C*oncepts of Molecular Genetics*. 1st edition. Medtech Publishers
3. Gurbachan Miglani. (2015) *Essentials of Molecular Genetics*. 1st edition. Alpha Science International Ltd.
4. Daniel L. Hartl and Elizabeth W. Jones. (2011). *Genetics – Analysis of Genes and genomes. 8*th edition. Laxmi Publications.
5. Benjamin Lewin. (2008). *Genes IX*, 9th Edition, Jones and Bartlett Publishers.

CourseCode	Hormonal Biochemistry	Course Type	L	T	P	C	CH
B25BCS311		**DSE**	**2**	**0**	**0**	**2**	**2**

Course Objective:

1. To understand about types of endocrine gland, hormone and signaling pathways
2. To know about hormones and their receptors, toxic compounds effectsignaling pathways.
3. To understand role of hormones in various disorders.
4. To learn about diseases associated with irregular production of hormones.

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the classification and their functions concerned with metabolism.
2. Gain knowledge about signaling molecule, pathways, and how toxic compound hamper normal pathways.
3. Know the types of disease related with endocrine disorder.
4. Understand about the sex hormone for male and female development and physiology.
5. Understand about the receptors and its importance
6. Know about the biochemical signal transduction in biological system.

Mapping of Course Outcomes with program Outcomes

Course Code	POS COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B5BCS311	CO1	2	0	3	0	2	0	2	0	0	0	0	2	2	1
	CO2	1	0	0	3	0	2	0	3	0	3	0	2	3	0
	CO3	1	0	3	0	0	0	0	3	0	3	0	2	0	2
	CO4	2	3	0	3	0	2	0	3	2	2	0	0	1	0
	CO5	2	0	2	3	0	0	0	2	0	2	0	0	2	0
	CO6	2	0	2	2	0	3	0	2	0	2	1	0	2	0

Course Content:

UNIT 1 **12 Hrs**

Types of hormones-protein and peptide hormones (Vasopressin and oxytocin), and steroid hormones. Hormones as chemical messengers. Mechanism of Hormone action-G-protein linked receptor family, Tyrosine kinase family, Insulin receptor family and cytokine receptor family. Hormone specificity. Intracellular Receptors: Sensitization & Desensitization of receptors. Thyroid hormone receptors.

UNIT-II **12 hrs**

Endocrine Disorders: Pancreatic Hormones-Diabetes Mellitus and its types. Thyroid hormone- Goiter, Grave's disease, Cretinism, Myxedema.GI tract Hormones-Gastrin, Secretin and GIP. Hormones of Adrenal Cortex-Aldosterone and Cortisol-Addison's disease, Conn's syndrome, Cushing's syndrome. Hormones of Adrenal Medulla, Epinephrine & nor epinephrine. Pituitatory hormones-GH-Gigantism and Acromegaly.

REFERENCE BOOKS:

1. Melmed, S., Auchus, R. J., Goldfine, A. B., & Koenig, R. J. (2020). Williams Textbook of Endocrinology (14th ed.). Elsevier. ISBN: 978-0323555966
2. Goodman, H. M. (2021). Basic Medical Endocrinology (5th ed.). Academic Press. ISBN: 978-0128153450
3. Hall, J. E. (2020). Guyton and Hall Textbook of Medical Physiology (14th ed.). Elsevier. ISBN: 978-0323597126
4. Hadley, M. E., & Levine, J. E. (2018). Endocrinology (7th ed.). Pearson. ISBN: 978-0134201658
5. Nussey, S., & Whitehead, S. (2013). Endocrinology: An Integrated Approach (1st ed.). CRC Press. ISBN: 978-1138453187
6. Straus, F. H. (2019). Endocrine Pathophysiology (2nd ed.). Wolters Kluwer. ISBN: 978-1496367891

Course Code	Nutritional Biochemistry	Course Type	L	T	P	C	CH
B25BCS312		DSE	2	0	0	2	2

Course Objective:

1. To understand the balanced diet, energy content of food.
2. To know about essential macronutrient and micronutrient roles in human physiology.
3. To get aware about anti nutrient factor and component influence on metabolism.
4. To know the nutrition requirement of men and women for the normal growth.

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the requirement of balanced diet, energy content of food.
2. Receive knowledge about the different types of macronutrients and micronutrients

required for normal physiological functions.

3. Understand the different types of anti-nutrient compound and croptohamper normal metabolism.
4. Understand the requirement of nutrition during normal and pregnancy conditions.
5. Understand the calorific value of various nutrients.
6. Understand the various food lifestyles and related diseases.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BCS312	CO1	2	1	1	0	1	0	1	1	0	0	0	2	1	1
	CO2	3	2	1	0	1	0	0	1	0	0	0	2	1	0
	CO3	2	2	2	0	1	0	0	1	0	0	0	1	1	0
	CO4	3	2	3	1	1	1	1	1	0	0	0	2	1	0
	CO5	3	2	2	1	1	0	0	1	0	0	0	2	1	0
	CO6	3	2	2	1	1	0	0	1	0	0	0	2	1	0

UNIT I **12 hrs**

Nutrition: Introduction**,** Energy content of food, Balanced Diet-Definition, characteristic feature. Proximate analysis of food- carbohydrate and proteins. Dietary fiber and its importance. Determination of calorific value of foods using Bomb calorimeter, BMR, Respiratory quotient of food and its significance. SDA- definition and its importance. Types of Nutrients- Macro and Micronutrients. Protein energy malnutrition-Kwashiorkor and Marasmus. Vitamin-classification and deficiency-hypervitaminosis. Fortification-Definition and biomedical importance.

Unit-II **12 hrs**

Food Adulterants-Anti-nutritional factors and artificial sweeteners and their impact on malnutrition. Nutrition and Lifestyle balance under different physiological conditions-children, adolescent, adult, pregnant, lactating women and elderly individuals. Diet and lifestyle related diseases and their prevention. Impact on malnutrition on immunity and occurrence of infections.

Reference Books:

1. Srilakshmi, B. (2018). Textbook of Human Nutrition (3rd ed.). Oxford and IBH Publishing Co. Pvt. Ltd. ISBN: 9788120416823
2. Srilakshmi, B. (2018). Food Science (5th ed.). New Age International (P) Ltd. Publishers. ISBN: 978-9386649136
3. Wardlaw, G. M., & Insel, P. M. (2003). Perspectives in Nutrition (6th ed.). Mosby.

ISBN: 978-0072506365

4. Swaminathan, M. S. (2008). Principles of Nutrition (1st ed.). The Bangalore Printing and Publishing Co. Ltd. ISBN: 978-8190561083
5. Sizer, F., & Whitney, E. (2020). Nutrition: Concepts and Controversies (15th ed.). Cengage Learning. ISBN: 978-0357368248

Course Code	Skill Enhancement Course -II	Course Type	L	T	P	C	CH
B25BC0303		SEC	0	0	3	3	3

Course Objective:

To carry out the academic training towards enhancing co-curricular knowledge research-based skills.

Course Outcomes

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

1. Understand the basic research skills.
2. Upgrade their knowledge about the analytical instrumentation.
3. Implement the subject specific practical knowledge into research studies.
4. Correlate the theoretical and practical understanding of research-based knowledge.
5. Develop critical thinking skills necessary to evaluate information, make decisions, and innovate within the field.
6. Analyze problems within the scope of the course and apply appropriate solutions.

Mapping of Course Outcomes with program Outcomes

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0303	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

Course Code	Health and wellness	Course	L	T	P	C	CH

		Type					
B25SB0301		**VAC**	**1**	**0**	**0**	**1**	**1**

Prerequisites

The student should have prior understanding of basic biology.

Course Objectives

1. To acquire basic understanding about public health and importance in day to day life
2. To understand the human dietary requirements and the nutritional diseases management.
3. To understand about various yogasanas.
4. To understand stress relief through exercise and yoga.

Course Outcomes

After completing the course students should be able to:

1. Describe about the concept of public health importance.
2. Understand objectives of health education and wellness.
3. Understand dietary requirements.
4. Apply knowledge about role of nutrition and health for disease prevention.
5. Learn the concept of stress management.
6. Conceptualize the process of exercise and yoga.

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25SB0301	CO1	2	3	3	3	3	3	1	3	3	3	0	1	3	3
	CO2	2	2	3	3	3	2	1	3	2	2	0	3	3	3
	CO3	2	1	3	3	3	3	2	3	2	2	0	2	3	2
	CO4	2	3	3	3	3	3	2	3	2	2	0	3	3	3
	CO5	2	3	3	3	3	2	3	3	2	2	0	2	3	3
	CO6	2	3	3	3	2	3	2	3	2	3	0	3	2	1

UNIT I

Introduction and Methods to Maintain Health and Wellness 12h

Meaning, Definition and dimensions of Health and Wellness (WHO/Yoga, Factors affecting Fitness and Wellness, Role of Fitness in maintaining Health and Wellness, Importance of Health Education and Wellness, Role of Physical Activities and Recreational Games for Health and Wellness, Role of Yogasanas and Meditation in maintaining Health and Wellness, Nutrition for Health & Wellness

Unit II

Anxiety, Stress and Aging **12h**

Meaning of Anxiety, Stress and Aging, Types and Causes of Stress, Stress relief through Exercise and Yoga, Future challenges in public health, Role of nutrition and health for prevention of disease caused by stress and anxiety. Public Health Challenges Related to Stress and Aging, Community-Based Stress Management Strategies, Technological Tools for Stress Monitoring and Management, Future Challenges and Research Directions in Stress and Aging.

Reference Books:

1. Gordon Edlin and Eric Golanty Health & Wellness (10th Edn) Jones & Barlett Publisher.
2. Mary Jane Schneider Introduction to Public Health (4th Edn,) Jones & Barlett
3. Adams MR and Moss M Food Microbiology (3rd Edition) RSC publications, UK.
4. Geofferey Campbell Platt (Editor) Food Science and Technology, Willey and Blackwell Publication, UK.
5. Lightfoot NF and Maier EA Microbiological analysis of food and water, Elsevier Publication, Netherland.
6. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg's Medical Microbiology. 25th Edition. McGraw Hill Publication.

Course Code	**NSS Activities**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25NS0108		**VAC**	**1**	**0**	**0**	**1**	**1**

Prerequisites

The students should have interest in social service

Course Objectives

1. To expose the students to the importance of NSS activities and awareness of resources.
2. To bring awareness to the students about Health first aid programmes and administrative skills during 7 days special Camp.
3. To aware and contribute the Unity in Diversity and Nation building activities.
4. To develop the skills to learn disaster management skills..
5. To equip the students In NSS Programme activities as volunteers.

Course Outcomes

After completing the course students should be able to:

1. Discussion to understand the importance of NSS activities
2. Practicing and acquire knowledge on Health first aid programmes
3. Summarize the Unity in Diversity and Nation building activities
4. Classify to learn disaster management skills develop skills of Social awareness
5. Demonstrate themselves to involve in NSS Programme activities as Volunteer
6. Apply the skill to identify and solve societal problems

Mapping of Course Outcomes with program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25NS0108	CO1	0	0	0	3	3	3	2	0	0	0	0	0	0	0
	CO2	0	0	0	2	3	3	2	0	0	0	0	0	0	0
	CO3	0	0	0	2	3	3	2	0	0	0	0	0	0	0
	CO4	0	0	0	2	2	3	1	0	0	0	0	0	0	0
	CO5	0	0	0	1	2	1	1	0	0	0	0	0	0	0
	CO6	0	0	0	1	2	1	1	0	0	0	0	0	0	0

Unit: I-NSS

NSS : Introduction –Origin and growth of NSS – Objectives – Motto – Symbol – NSS – Import National Days – NSS Song, Environmental Awareness : Natural Resources – Conservation and Management – Water conservation and Rain water harvesting – Solid waste management – Pollution control: Water, Air, Noise and Soil – Energy conservation – Wildlife Conservation Global warming.

Unit: II- Special Programme

Legal Awareness – Health awareness –Blood Donation Camp, First –Aid –Career Guidance – Leadership. Training cum –Cultural Programme –Globalization ant its Economic Social and Cultural Impacts. Planning and Preparation of special Camping Programme. Planning at institutions level – Guidelines for the success of camp- Importance of successful camping programme – Guiding principles – organization of camp – Administration of camp.

Unit: III- Social Awareness

Basics and Social Service, Weaker Section of our society and their needs – NGOs : Role and Contribution –Civic responsibility – causes and Prevention; role of youth –Drug Abuse and Trafficking –awareness of IV / AIDS.. National Integration: Importance and Necessity – Freedom Struggle and Nationalistic movement in India – National interests, Objectives, Threats and Opportunities – Unity in Diversity – Contribution of Youth in Nation Building.

Unit: IV- First Aid

Artificial Respiration – Control of Bleeding – Fractures – Burns – Shock – Wounds – Eye Injures – Heat Stroke – Snake Bite – Dog Bites – Poisoning., Disaster Management: Characteristics and types of Disasters (Geological and Mountain Area Disaster, Wind and Water Related natural Disaster, Man made Disaster) , Causes and effects, Assistance during Natural / Other Calamities Flood / Cyclone / Earth Quake / Accident etc.

Unit: V- Basic Concepts and Components

NSS Programme Officer – NSS Volunteer – Community – Aims of NSS Programme /Activities – Classification of NSS Programme – Adoption of Villages – Contacting Villages / Area Leaders – Survey of the Villages / Area Identification of Problem(s) Completion of Projects – Evaluation of Project – Adoption of Slums – Survey of the Slum – Services in Slums - Coordination with Voluntary – Organizations.

Reference Books:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. Avhan Chancellor's Brigade-NSS Wing, Training camp on Disaster Preparedness Guidelines, March 2012.
4. Rashtriya Seva YojanaSankalpana- Prof. Dr. SankayChakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.

5. National Service Scheme Manual for NSS District Coordinators, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya,
6. Annual report of National Service Scheme (NSS) published by Dept. of Higher and Technical Education, Mantralaya,
7. NSS Cell, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. Case material as a Training Aid for Field Workers, Gurmeet Hans.
9. Social service opportunities in hospita's, Kapil K. Krishnan, TISS
10. New Trends in NSS, Research papers published by University of Pune.
11. ANOOGUNJ Research Journal, published by NSS Unit C. K. Thakur college
12. Training Manual for Field Work published by RGNIYD, Shreeperumbudur
13. Prof. Ghatole R.N. Rural Social Science and Community Development.
14. PurushottamSheth, Dr. Shailaja Mane, National Service Scheme

Course Code	NCC Activities	Course Type	L	T	P	C	CH
B25NC0109		VAC	1	0	0	1	1

Prerequisites
The students should have interest in NCC

Course Objectives

1. To develop character, comradeship, discipline, secular outlook, spirit of adventure and the ideals of selfless service amongst the youth of the country.
2. To create a human resource of organized, trained and motivated youth, to provide leadership in all walks of life and always available for the service of the nation.
3. To provide a suitable environment to motivate the youth to take up a career in the Armed Forces

Course Outcomes

1. Developing character, comradeship, discipline, a secular outlook, the spirit of adventure and ideals of selfless service amongst young citizens
2. Creating a pool of organized, trained and motivated youth with leadership qualities in all walks of life, who will serve the Nation regardless of which career they choose
3. Summarize the Unity in Diversity and Nation building activities.
4. Provide a Suitable Environment to Motivate the Youth to Take Up a Career in the Armed Forces
5. Develop Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, and Ideals of Selfless Service amongst the Youth of the Country.
6. Apply the Leadership in all Walks of life and be Always Available for the Service of the Nation.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25NC0109	CO1	0	0	3	2	2	2	0	0	0	0	0	0	0	3
	CO2	0	0	2	3	3	2	0	0	0	0	0	0	0	3
	CO3	0	0	2	3	3	2	0	0	0	0	0	0	0	3
	CO4	0	0	2	3	3	1	0	0	0	0	0	0	0	3
	CO5	0	0	1	2	3	1	0	0	0	0	0	0	0	3
	CO6	0	0	1	2	3	1	0	0	0	0	0	0	0	3

Unit: I- NCC

NCC : Introduction –Origin and growth of NCC – Objectives – Motto, Duties of NCC cadets, NCC Song ,NCC camps- types and Conduct ,Unity in Diversity and role of NCC in nation building, Threats to national security, Freedom struggle and nationalist movement in India , Drill, Weapon Training.

Unit: II- Personality Development and Leadership

Group Discussion - Stress and emotions, change your mindset, interpersonal relations and team work, Time management , civic sense ,Carrier counseling, SSB procedure and interview skills, Public speaking, Case Studies - Mahatma Gandhi, Shivaji, APJ Abdul Kalaam, Deepa Malik, Maharana Pratap, Ratan Tata, Jhansi ki Rani, Narayan Murti, Prakash Padukone, Tipu Sultan, Rabindra Nath Tagore, Fire Service and fire fighting, Civil defence and NDMA, Initiative training, organising skills, do's and don'ts, natural disasters, man made disasters.

Unit: III- Social Awareness and Community Development

Road/Rail travel safety, Cyber and mobile safety awareness, Civic responsibilities, Causes and preventions of HIV/AIDS, Drug awareness , traffic awareness, First aid in common medical emergencies , treatment and care of wounds, Infectious and contagious diseases and its prevention, Introduction to yoga and exercises, Water conservation and rain water harvesting.

Unit: IV- Armed Forces

Armed Forces, Army, CAPF, Police, Basic organization of Armed Forces, Conduct to MR, Google & Tourist Maps and Apps, Prismatic compass and its use and GPS, Military History -Biographies of Renowned Generals, Study of Battles - Indo Pak war 1965, 1971, & Kargil ,Basic Communication Procedure ,Types of Communication, Characteristics of Wireless technology (mobile, Wi-Fi etc.)

Unit: V- Basics of Weapon Training

Stripping, assembling, loading, unloading of rifle, Light Machine Gun and Stern machine carbine, characteristics of weapons, (Rifle, LMG & Stern), safety procedures, loading, cocking and unloading of weapons, positions in shooting and its advantages, trigger control and firing a shot, theory of group and snap shooting, short range firing and aiming

References:

1. NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations,R.K. Gupta,2024
2. NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examination,RPH Editorial Board,2016
3. NCC Army Wing,RPH Editorial Board,2023

FOURTH SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B25AHK403	Language II: Kannada - IV	AEC	3	0	0	3	3

Course Overview

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯ ಪ್ರಕಾರವಾಗಿ ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Prerequisite / Pre reading for the course

1. ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
2. ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
3. ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy:

- Direct method
- ICT and Digital support (Links attached)
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಒಳಗೊಂಡಂತೆ ವಿಷಯವಾರು ಪಠ್ಯಗಳನ್ನು ನೀಡಲಾಗಿದ್ದು, ಆ ಮೂಲಕ ಕನ್ನಡ ಭಾಷೆ, ಸಂಸ್ಕೃತಿಯ ಜೊತೆಗೆ ಮಾನವೀಯ ಗುಣಗಳನ್ನು ಪರಿಚಯಿಸುವ ಹಾಗೂ ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಪ್ರೇರೇಪಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ದಮನಿತ ಲೋಕ, ಸಹಿಷ್ಣುತೆ, ಶ್ರೀಸಾಮನ್ಯನ ಬದುಕು ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂದಿಸಿದಂತೆ ವಿಷಯಗಳನ್ನು ನೀಡಿದ್ದು, ಅದಕ್ಕೆ ಪೂರಕವಾಗಿ ಸಾಹಿತ್ಯಿಕ ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ. ಈ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ. ಹಾಗೂ ವೈವಿಧ್ಯಮಯ ಭಾರತದ ಸಾಂಸ್ಕೃತಿಕ ನೆಲೆಗಳನ್ನು ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ

2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.

3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಬರಹ, ವೃತ್ತಿ ಪೂರ್ವಕ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ

4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

Course Outcomes:

ದಮನಿತ ಲೋಕ, ಸಹಿಷ್ಣುತೆ, ಶ್ರೀಸಾಮನ್ಯನ ಬದುಕು ಮತ್ತು ಸಂಕೀರ್ಣ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಸಾಹಿತ್ಯ ಪಠ್ಯಗಳ ಕಲಿಕೆಯ ಮೂಲಕ ಅವುಗಳ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

1. **ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ಸೂಕ್ಷ್ಮತೆಯ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಸುತ್ತದೆ**
2. **ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳನ್ನು ವಿವಿಧ ಆಯಾಮಗಳೊಂದಿಗೆ ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.**
3. **ಉತ್ತಮ ಭಾಷಾ ಕೌಶಲ್ಯವನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.**
4. **ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.**
5. **ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯದ ಶ್ರೀಮಂತಿಕೆಯ ಜೊತೆಗೆ ಮಾನವೀಯಮೌಲ್ಯಗಳನ್ನು ಮೂಡಿಸುತ್ತದೆ.**
6. **ಸದೃಢ ಬೌದ್ಧಿಕ ಮತ್ತು ಮಾನಸಿಕ ವ್ಯಕ್ತಿತ್ವವನ್ನು ವಿಕಾಸಿಸುತ್ತದೆ.**

Mapping of Course Outcomes with program Outcomes

COURSE CODE	Course Outcomes	Program Outcomes													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AHK 403	CO 1	3	1	0	1	0	0	0	0	0	0	0	3	0	1
	CO 2	1	0	1	0	0	1	1	0	1	0	0	2	1	1
	CO 3	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO 4	1	2	0	0	0	0	1	0	1	1	0	2	1	0
	CO 5	1	2	0	1	0	0	0	0	1	0	0	3	1	0
	CO 6	1	2	0	0	0	0	1	0	1	1	0	2	1	0

COURSE CONTENT/ SYLLABUS

ಪರಿವಿಡಿ :		
ಘಟಕ 1 – ದಮನಿತ ಲೋಕ **1.1 ಶಿಲುಬೆ ಏರಿದ್ದಾನೆ** **1.2 ಮುಟ್ಟಿಸಿಕೊಂಡವನು** **1.3 ಏಕಲವ್ಯ ನಾಟಕ- ದೃಶ್ಯ 3 ರಿಂದ 8**	**ಕೆ.ಎಸ್. ನಿಸಾರ್ ಅಹಮದ್** **ಪಿ.ಲಂಕೇಶ್** **ಡಾ. ಸಿದ್ಧಲಿಂಗಯ್ಯ**	**10 ಗಂಟೆಗಳು**

ಘಟಕ 2 – ಸಹಿಷ್ಣುತೆ **2.1 ಬಿದಿರು ನಾನಾರಿಗಲ್ಲದವಳು 2.2 ಮಾಂಟೆಗೊ ಮೇರಿ ಬಸ್ ಬಹಿಷ್ಕಾರ 2.3 ಬೆಂಕಿ ಮಳೆ**	**ಶಿಶುನಾಳ ಶರೀಫ ಎಂ.ಆರ್.ಕಮಲ ಬಾನು ಮುಷ್ತಾಕ್**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 3 – ಶ್ರೀಸಾಮಾನ್ಯನ ಬದುಕು / ವೈಜ್ಞಾನಿಕತೆ **3.1 ಮನೆಯಿಂದ ಮನೆಗೆ 3.2 ಮೊಸರಿನ ಮಂಗಮ್ಮ 3.3 ಜಾಗತೀಕರಣದ ಜಾರುಬಂಡೆ**	**ಕೆ.ಎಸ್.ನರಸಿಂಹಸ್ವಾಮಿ ಮಾಸ್ತಿ ಬರಗೂರು ರಾಮಚಂದ್ರಪ್ಪ**	**10 ಗಂಟೆಗಳು**
ಘಟಕ 4 – ಸಂಕೀರ್ಣ **4.1 ಕೃಷಿ ಸಂಸ್ಕೃತಿ ಮತ್ತು ಜಾಗತಿಕರಣ 4.2 ಮನುಕುಲದ ಕಥೆ 4.3 ಉದ್ಯಮಶೀಲತೆ ಕಲೆ ಮಾತ್ರವಲ್ಲ ಅದೊಂದು ವಿಜ್ಞಾನ**	**ಸಿ.ಹೆಚ್. ಹನುಮಂತರಾಯ ಶಶಿಕಲಾ ವೀರಯ್ಯಸ್ವಾಮಿ ರಶ್ಮಿ ಬನ್ಸಾಲ್**	**9 ಗಂಟೆಗಳು**

TextBooks:
ಸಂಯೋಜಿತ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ **'ವಿಜ್ಞಾನ ಸೌರಭ – ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್ ಬಿಎಸ್ಸಿ (AS,AHS,SS)**

ಪರಾಮರ್ಶನ ಗ್ರಂಥಗಳು:
1. ಸಾಹಿತ್ಯ ಸಲ್ಲಾಪ-1 – ಸಂ. ಡಾ. ಬಿ ಗಂಗಾವರ, ಪ್ರಸಾರಾಂಗ ಬೆಂಗಳೂರು ವಿ.ವಿ, 2011
2. ವಿಸ್ಮಯ (ಪರಿಸರ ವಿಶ್ವರೂಪ), ಪುಸ್ತಕ ಪ್ರಕಾಶನ, ಮೈಸೂರು, 2013
3. ಬಂಡಾಯ- ವ್ಯಾಸರಾಯ ಬಲ್ಲಳ, ವಸಂತ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು, 2006
4. ಜಾಗತಿಕ ವಿಚಾರ ಸಾಹಿತ್ಯ- ಸಂ. ದಂಡಪ್ಪ, ಕುವೆಂಪು ಭಾಷಾ ಭಾರತಿ ಪ್ರಾಧಿಕಾರ, 2017
5. ದಕ್ಷಿಣ ಕರ್ನಾಟಕದ ಕಾವ್ಯ ಪ್ರಕಾರಗಳು- ಜಿ.ಶಂ.ಪ, ಅಭಿನವ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು, 2016

Course Code	Course Title	Course Type	L	T	P	C	Hrs.
B25AHH403	Language – II: Hindi - IV	AEC	3	0	0	3	3

Course Overview: अध्ययन संरचनात्मक विवरण:
यह पाठ्यक्रम नवसिखुआ छात्रों में अपनी भाषा की क्षमता के विकास हेतु तथा विविध साहित्यिक प्रवृत्तियों के माध्यम से समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है।

Prerequisites/Pre reading for the course: पूर्वापेक्षाएँ
- छात्रों को हिंदी खंडकाव्य का संक्षिप्त ज्ञान होना आवश्यक है।
- हिंदी साहित्य के इतिहास की मूलभूत जानकारी अपेक्षित है।
- हिंदी व्याकरण का प्राथमिक अवबोधन आवश्यक है।

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning

Objectives: पाठ्यक्रम उद्देश्य

1. संदर्भानुसार उचित भाषा प्रयोग करने की दक्षता छात्रों में विकसित करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।
3. छात्रों में पुस्तक पठन एवं लेखन की प्राकृतिक प्रवृत्ति स्थापित करना।
4. विद्यार्थियों में साहित्य के माध्यम से प्रभावी एवं कुशल संप्रेषण का विकास करना।

Course Outcomes अधिगम परिणाम

पाठ्यक्रम पूर्ण करने के पश्चात विद्यार्थी–

- सामाजिक मूल्यों एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
- साहित्य की प्रासंगिकता को जीवन में समझने की क्षमता रखता है।
- समाज में अंतर्निहित प्रवृत्तियों एवं विचारधाराओं का विश्लेषण करने में सक्षम होता है।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार कौशल का विकास कर सकता है।

Mapping of Course Outcomes with program Outcomes

Course Code	Course Outcome	Program Outcomes													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B24AHH403	CO 1	0	0	1	0	1	1	1	1	1	2	0	2	2	0
	CO 2	0	0	1	0	1	1	1	3	3	3	0	2	2	0
	CO 3	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 4	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 5	0	0	0	1	0	1	1	3	3	3	0	2	2	0
	CO 6	0	0	0	1	0	1	1	3	3	3	0	2	2	0

Course Content :अ�यन िवषय सूची / पा��म

इकाई – 1:

उपन्यास – सपनों की होम डिलिवरी – ममता कालिया (अध्याय 1 से 3 तक) ***(10 घंटे)***

- लेखक परिचय
- प्रथम अध्याय
- द्वितीय अध्याय

इकाई – 2: (10 घंटे)

- तृतीय अध्याय
- चतुर्थ अध्याय

इकाई – 3 (10 घंटे)

- पंचम अध्याय
- छठा अध्याय

इकाई – 4: प्रयोगात्मक हिंदी (9 घंटे)

- विज्ञापन लेखन
- दूरदर्शन और मोबाइल
- विभिन्न मोबाइल ऐप्स और रोजगार के अवसर

Text book/s: **पाठ्यपुस्तक:**

1. उपन्यास – *सपनों की होम डिलिवरी* – ममता कालिया

References:

संदर्भ ग्रंथ:

1. **हिंदी साहित्य का इतिहास** – डॉ. नागेन्द्र
2. **आधुनिक हिंदी साहित्य का इतिहास** – डॉ. बैजनाथ सिंह
3. **हिंदी साहित्य का नवीन इतिहास** – डॉ. लाल साहब सिंह
4. **हिंदी साहित्य का इतिहास** – डॉ. सूर्यनारायण राणासुभे
5. **हिंदी उपन्यास और यथार्थवाद** – डॉ. शिवभवन सिंह
6. **प्रयोगात्मक हिंदी** – डॉ. अज्ञादास देशमुख
7. **प्रयोगात्मक हिंदी** – डॉ. माया सगरे (लखनऊ)
8. **प्रयोगात्मक हिंदी के आधुनिक आयाम** – महेन्द्रसिंह राणा

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25AHA401	**LanguageII: Additional English -IV**	**AEC**	**3**	**0**	**0**	**3**	**3**

Course Description:

This is a 3-credit course designed to help learners gain competency in language and literature by exposing them to a wider variety of literary genres and themes, encouraging their interests in critical social and cultural issues within both literary and non-literary domains.

Course Objectives:

- To introduce the students to the multiplicity of literature from all over the world.
- To contribute to the emotional and social development of the students.
- To develop in the students an ability to appreciate cultural and social diversity.
- To develop in the students the ability to read different genres of texts, adopting various reading strategies

Course Outcomes:

On completion of the course, learners will be able to:

- Demonstrate a visible understanding of the significant issues of the society.
- Summarize the basic as well as the latent concepts of the texts provided in the syllabus and do justice to them.
- Explain the major and minor themes of the select texts and their significance in the broader context of real life.
- Interpret audio files and comprehend different spoken discourses/ excerpts in different accents

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25AHA401	CO1	2	0	1	0	0	0	0	1	1	1	0	2	1	0
	CO2	1	0	1	1	0	0	0	2	1	1	0	1	1	0
	CO3	1	0	0	0	0	1	0	2	1	1	0	2	1	0
	CO4	1	1	2	0	0	0	1	3	1	1	0	3	1	0
	CO5	1	1	2	0	0	0	1	3	1	1	0	3	1	0
	CO6	1	1	2	0	0	0	1	3	1	1	0	3	1	0

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	**Myths & Mythology**	**25 Marks** Fill in the blanks/ MCQs/descriptive questions	John W. May – Narcissus W.B. Yeats – No Second Troy Devdutt Pattanaik - *Shikhandi and the Other Stories They Don't Tell You* (Extract)	11 hours
II	**Family & Relationships**	**25 Marks** Short Notes/ Descriptive Questions/ Comprehension	Robert Hayden – Those Winter Sundays Elizabeth Jennings – Father to son Kate Chopin – The Story of an Hour The Great Indian Kitchen – (Film Text)	11 hours
III	**Horror & Suspense**	**25 Marks** Short Notes/ Descriptive Questions	Charles Dickens – The Signal Man Kendrik Bangs - The Water Ghost of Harrowby Hall(9 pages) Bram Stoker – A Dream of Red Hands	11 hours
IV	**Education**	**25 Marks** Short Notes/ Descriptive Questions	Abraham Lincoln – A letter from Abraham Lincoln to his Teacher. Oliver GoldSmith – A Village School Master Rabindranath Tagore – The Exercise Book Frigyes Karinthy – *Refund*	11 hours

References:

- Finneran, Richard J. *The Collected Works of W.B. Yeats* (Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.
- Pattanaik, Devdutt. *Shikhandi: Ánd Other 'Queer' Tales They Don't Tell You*. Penguin Books, 2014.
- Karve, Irawati. *Yuganta: The End of an Epoch*. Orient Blackswan, 2007.
- Ezekiel, Nissim. *Collected Poems* (With A New Introduction By John Thieme). OUP, 2005.
- Hughes, Langston. *The Collected Poems of Langston Hughes*. Vintage, 1995.
- Chopin, Kate. *The Awakening and Selected Stories of Kate Chopin*. Simon & Schuster, 2004.
- Ibsen, Henrik. *A Doll's House*. Maple Press, 2011.
- Poe, Edgar Allan. *The Complete Poetry of Edgar Allan Poe*. Penguin USA, 2008.
- Stoker, Bram. *Dracula*. Fingerprint Publishing, 2013.
- Ray, Satyajit. *The Complete Adventures of Feluda* (Vol. 2). Penguin Books Ltd., 2015.
- Lama, Dalai. *Freedom In Exile: The Autobiography of the Dalai Lama of Tibet*. Little, Brown Book Group, 1998.
- Murthy, Sudha. *Wise and Otherwise: A Salute to Life*. Penguin India, 2006.
- Wsahington, Booker T. *Up from Slavery*. Infinity, 2015.

Course code	**Genetic Engineering**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0401		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Basics knowledge about the recombination of DNA for direct modification of the genetic structure of animals and other organisms is essential.

Course Objectives:

The overall objectives of the course are:

1. Acquire the knowledge of chromatin structure and gene expression
2. Explore the mechanism of stem cell regeneration
3. Understand the functions of recombinant and DNA and Protein
4. Basic information of genetics in agriculture, medicine and society

Course Outcomes:

After completing the course, the student should be able to:

1. Explain the basics and importance of genetic engineering and DNA manipulation tools.
2. Describe DNA-modifying enzymes and cloning vectors used in gene cloning
3. Apply techniques like PCR, gel electrophoresis, and blotting in genetic analysis.
4. Outline methods for screening, transformation, and gene library construction.
5. Identify applications of genetic engineering in agriculture, medicine, and industry
6. Discuss biosafety, ethics, and regulations related to GMOs and recombinant DNA use.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0401	CO 1	3	2	3	3	3	3	0	2	2	2	0	3	3	2
	CO 2	2	2	3	3	3	3	2	3	2	3	0	2	3	2
	CO 3	3	2	3	3	3	3	2	2	2	3	2	3	3	3
	CO 4	3	2	3	3	2	3	3	3	3	3	1	3	3	2
	CO 5	2	2	3	3	2	3	1	1	2	3	3	3	3	3
	CO 6	2	2	3	2	2	3	3	0	3	3	1	3	2	3

Unit I: Introduction to genetic engineering 12 hrs

Great milestones in Genetic Engineering, Importance of Genetic Engineering, Types of Genetic Engineering, Levels of genetics analysis, Enzymatic tools for DNA manipulation - Endo and Exonucleases, Restriction Enzymes -Type I, Type II, Type III, Type IV; *in vitro* restriction digestion, Ligases- *E.coli* Ligase and T4 DNA Ligase.

Unit II: DNA modification enzymes and cloning vectors 12 hrs

DNA modification enzymes and cloning vectors in genetic engineering DNA Modifying Enzymes - Nucleases, Polymerases, Enzymes that modify the ends of DNA molecules (Terminal Transferase, Alkaline Phosphatases, polynucleotide kinase), Introduction to cloning vectors - Prokaryotic & Eukaryotic - Plasmid Vectors (pBR, PUC); Phage Vectors (Bacteriophage lambda and Cosmid); Bacterial vectors (BACs); Yeast Vectors (YACs); Plant Vectors (Ti-plasmid); Animal vectors (SV40- Retrovirus).

Unit III: Techniques in Genetic Engineering 12hrs

Screening and selection of recombinants, Gene transformation (Physical & Chemical Transformation) plant transformation (Agrobacterium). Genomic library construction cDNA library construction (screening of gene libraries). DNA sequencing (Dideoxy method, Maxam and Gilbert method); Polymerase Chain Reaction (PCR); Gel electrophoresis - PAGE; DNA hybridization (Southern blotting); Northern blotting (RNA hybridization), Protein detection (Western blotting),

Unit IV: Applications of Genetic Engineering: 12 hrs

Production of Transgenic animals; Production of therapeutic products – blood proteins, human hormones, immune modulators, antibodies, antibiotics and vaccines; Plant genetic engineering - genetic modification or manipulation in crops; pesticide resistant, herbicide resistant, Insect resistant, fungicides, and fertilizers. Application of genetic engineering in food industry and environment. Safety of recombinant DNA technology - Restriction and regulation for the release of genetically modified organisms (GMO) into the environment.

Reference Books

1. Cooper, G.M., Hausman, R.E. The Cell: A molecular approach. (2009). ASM Press and Sinauer Associates (Fifth Edition).
2. De Robertis, E.D.P. Cell and Molecular Biology (2008). Lippincott Williams and Williams (Sixth Edition).
3. Desmond S.T. Nicholl, An Introduction to Genetic Engineering, Third edition (2008). Cambridge University Press. (Third Edition).
4. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
5. Craig, N. L., Green, R. R., Greider, C. C., Wolberger, C., & Storz, G. G. (2021). *Molecular biology: principles of genome function*. Oxford University Press, USA.
6. Brown, T. A. (2020). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
7. Nicholl, D. S. (2023). *An introduction to genetic engineering*. Cambridge University Press.

Course Code	Biochemical Techniques	Course Type	L	T	P	C	CH
B25BC0401		**DSC**	**3**	**0**	**0**	**3**	**4**

Course Objective:

The objective of the course is to understand the principle, instrumentation and applications of various analytical techniques used for biochemical characterizations.

Course Outcomes:

After completing the course, the student shall be able to:

1. Develop knowledge about the isolation, separation, and characterization of various biological samples.
2. Acquire knowledge about the interaction of electromagnetic radiations with matters.
3. Acquire analytical techniques to determine accurately the elements present in the biological samples.
4. Acquire knowledge about the biochemical importance of Radioisotopes.
5 Acquire knowledge about the molecular techniques and its significances.

6.To understand the importance of cell culture in various industries.

CourseCode	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
B25BC0401	CO 1	3	3	3	2	2	1	0	0	2	2	1	3	3	2
	CO 2	3	3	2	2	1	0	1	1	2	1	0	3	3	2
	CO 3	3	3	3	3	1	1	1	2	2	3	2	3	3	2
	CO 4	3	3	2	2	1	0	2	1	2	1	0	3	3	1
	CO 5	3	3	3	2	1	2	1	0	2	1	0	3	3	1
	CO 6	3	3	1	2	2	1	1	1	2	1	2	3	3	1

Course content:

UNIT I **12hrs**

Precipitation: methods and applications.

Centrifugation**:** Principle of centrifugation, types of centrifuges and rotors. Density gradient centrifugation and differential centrifugation -principle and applications. Dialysis-types, principle and applications. Electrophoresis: Principle, working procedure and applications of electrophoresis- Paper and gel electrophoresis (Agarose and SDS-PAGE).

UNIT II **12hrs**

Chromatography: Classification and General Principles of chromatography, working procedure and applications of paper chromatography, thin layer chromatography. Column chromatography–types, Principle, procedure and applications. HPLC and GLC and affinity chromatography.

UNIT III **12hrs**

Radio isotopic techniques: Outline of radioactive materials, atomic structure, radiation, type of radioactive decay, half-life, units of radioactivity, detection and measurement of radioactivity–methods based on ionization (GM- counter) application of isotope dilution technique. Biological hazards of radiation and safety measures in handling radioisotopes.

UNIT IV **12hrs**

Molecular Techniques: Isolation and purification methods of nucleic acids**,** Primer design, Polymerase chain reaction, RFLP, RAPD. Cloning, Cre/lox genetic recombination, Hydrolysis probe-based qPCR, RNA preparation and cDNA synthesis, SYBR based RTPCR, Protein Sequencing, DNA Finger printing, Cell culture, hybridoma technology, Microarray and its applications.

Reference Books:

1. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press. ISBN: 978-1107162273
2. Boyer, R. (2012). Modern Experimental Biochemistry (4th ed.). Pearson. ISBN: 978-0321644907
3. Berg, J. M., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2019). Biochemistry (9th ed.). W.H. Freeman. ISBN: 978-1319114671
4. Nelson, D. L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry (7th ed.). W.H. Freeman. ISBN: 978-1464187952
5. Freifelder, D. (2018). Physical Biochemistry: Applications to Biochemistry and Molecular Biology (2nd ed.). W.H. Freeman. ISBN: 978-0716714446

Course Code	**Developmental Genetics**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25GN0401		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

1. Students should have knowledge of developmental process.
2. Students should be familiar with gene expressions.

Course Objectives:

The objective of this Course is to

1. To learn the essentials of developmental biology.
2. To get familiarized with embryonic development.
3. To distinguish organogenesis and metamorphosis.
4. To study developmental disorders.

Course Outcomes:

By the end of the course the student will be able to:

1. Differentiate the developmental stages.
2. Compare the developmental milestones of different organisms.
3. Illustrate the phenomenon of embryogenesis and organogenesis.
4. Outline the characteristics of developmental disorders.
5. Comprehend the mechanism of metamorphosis.
6. Understand the concept of ageing.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0401	CO1	3	3	3	0	3	2	2	0	0	3	0	3	2	0
	CO2	3	3	0	0	0	2	0	0	0	3	0	3		0
	CO3	3	3	3	3	3	2	0	0	0	3	0	3	2	0
	CO4	3	3	3	0	0	3	3	2	0	3	0	3	2	0
	CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Course Contents:

UNIT I **12 hrs**

Essential Concepts in Developmental Biology

Early embryonic development in Frog, Gametogenesis, fertilization, cleavage, blastula and gastrula. Nuclear transplantation experiments in Amphibians and *Acetabularia*. Epigenesis and preformation Generating new cells and organs — Cell-cell communication in development – Fate Maps. Switching genes on and off during development Ex. Differential expression of hemoglobin.

UNIT II **12 hrs**

Embryonic Development and Germ Layer Specification

Genetics of development in plants – *Arabidopsis*: Flower development (Floral morphogenesis and Homeotic gene expression). Genetics of development in Animals *Drosophila*: Early development; Origin of anterior-posterior and dorso-ventral polarity: Role of Maternal genes, Zygotic genes-Segmentation genes (gap, pair rule and segment polarity genes) and Homeotic selector genes. *C. elegans* – Early development in Vertebrates – Early mammalian development – Origin and emergence of Ectodermal, Mesodermal and Endodermal cell layers

UNIT III **12 hrs**

Organogenesis

Central Nervous System and epidermis – Neural crest cells – tissue: Architecture of the Central Nervous System, Spinal cord and medulla organization. Cerebellar organization, Cerebral organization. Adult neural stem cells. The Somites and their derivatives – Development of tetrapod limb –Development of gonads– primary and secondary sex determination. Hormonal regulation of the sexual phenotype.

UNIT IV **12 hrs**

Metamorphosis, Regeneration and Ageing

Insect and amphibian metamorphosis. Regeneration in planaria and zebrafish – Biology of senescence, theories of aging and mechanism of aging – Eg. Role of mTOR pathway and telomeres in aging. **Developmental Disorders: G**enetic errors of human development, Developmental anomalies; Teratogenesis – types and mechanism of action.

Reference Books:

1. Lewis Wolpert et al. (2015). *Principles of Development*. 5th Edition. Oxford University press.
2. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2017). *Genes XII*, 12th edition Jones and Bartlett Learning.
3. Gilbert. (2013) *Developmental biology*.10th edition. Sinauer Associates Inc.
4. Brown, T.A., Chapman and Hall (2011). *Genetics a Molecular Approach*, 2nd edition, Garland science.
5. Gurbachan S. Miglani. (2006). Developmental Genetics. 1st edition. I K International Publishing house.

Course code	**Genetic Engineering Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0402		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

Fundamentals involved in molecular biology, biochemical techniques and microbiology is a prerequisite for this course.

Course Objectives:

The overall objectives of the course are:

1. Get exposure of various genetic manipulation techniques having industrial implications?
2. Exploit the knowledge of gene manipulations in related areas of research

Course Outcomes

After completing the course, the student should be able to:

1. Perform restriction digestion and analyze DNA fragments using agarose gel electrophoresis.
2. Construct restriction maps based on enzyme digestion patterns.
3. Carry out DNA ligation and assess ligation efficiency through gel analysis.
4. Perform the nucleic acid isolation (RNA)
5. Prepare competent cells and demonstrate bacterial transformation techniques
6. Analyze proteins using SDS-PAGE and Western blotting techniques

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0402	CO 1	3	3	3	2	3	3	2	0	2	3	2	3	2	2
	CO 2	2	2	2	3	2	3	1	1	2	2	2	3	3	2
	CO 3	2	3	3	3	2	3	2	2	2	2	2	1	3	2
	CO 4	2	2	2	2	3	2	2	0	2	2	2	3	2	3

	CO 5	2	2	2	3	2	3	3	0	2	2	2	2	3	2
	CO 6	3	3	3	2	2	3	2	1	2	3	2	2	2	2

Course Contents:

1. Restriction digestion of DNA and AGE analysis
2. Restriction mapping of DNA
3. Ligation of DNA and analysis by electrophoresis
4. Preparation of competent cells using $CaCl_2$ method
5. Study of DNA transformation and blue-white screening
6. DNA amplification by polymerase chain reaction
7. Determination of molecular weight of proteins by SDS PAGE through CBB Staining
8. Protein analysis through western blotting technique

References

1. Nicholl, D. S. (2023). *An introduction to genetic engineering*. Cambridge University Press.
2. Khan, F. A. (2020). *Biotechnology Fundamentals Third Edition*. CRC Press.
3. Schleif, R. (2023). *Genetics and molecular biology*. The Johns Hopkins University Press.
4. Allison, L. A. (2021). *Fundamental molecular biology*. John Wiley & Sons.

Course Code	Laboratory course IV (Biochemistry)	Course Type	L	T	P	C	CH
B25BC0402		DSC	0	0	2	2	3

Prerequisites /Pre reading for the course.

Gain knowledge about different chromatography tecniques.

Course Objectives:

1. To gain knowledge of chromatography tecniques.
2. To understand the isolation and purification techniques.
3. To understand the significance of biochemical techniques.
4. To gain knowledge about importance of handling of enzymes.

Course Outcome:

After completing the course, the student shall be able to:

1. Preparation and importance of buffers.
2. Isolation and centrifugation of enzymes.
3. Identify the different amino acids by circular and TLC

chromatography.

4. Identify the molecular weight of enzymes.
5. Evaluate the acivity of precipitated and dialyzed enzyme.
6. Evaluate different plant pigments on silics gel.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0402	CO1	3	2	2	2	2	3	3	3	2	0	0	3	3	1
	CO2	3	3	1	2	1	1	1	1	1	0	0	3	3	3
	CO3	3	3	3	3	2	1	2	0	2	1	1	3	3	1
	CO4	1	3	3	2	1	1	1	0	2	1	1	3	3	1
	CO5	2	3	3	2	3	2	2	2	2	1	1	3	2	1
	CO6	3	3	2	2	2	2	1	2	2	2	0	3	3	2

Course Contents:

1. Isolation and separation of genomic DNA from Chicken Liver.
2. Separation and identification of amino acids by circular paper chromatography.
3. Separation and identification of amino acids by thin layer chromatography.
4. Partial purification of acid phosphatase from sweet potato by
   - **I.** Ammonium sulphate precipitation
   - **II.** Dialysis.
   - **III.** Ion exchange chromatography-DEAE Cellulose (Column packing and sample loading from students).
5. Determination of molecular weight of partially purified acid phosphatase by SDS-PAGE.
6. Separation of plant pigments by silica gel column chromatography.

Reference Books:

1. Shanmugam, S., Kumar, T. S., & Panneer Selvam, K. (2019). Laboratory handbook on biochemistry. PHI Learning Pvt. Ltd.
2. Wilson, K., & Walker, J. (Eds.). (2000). *Principles and techniques of practical biochemistry*. Cambridge University Press.
3. Ninfa, A. J., Ballou, D. P., & Benore, M. (2009). Fundamental laboratory approaches for biochemistry and biotechnology. John Wiley & Sons.

Course Code	Developmental Genetics Lab	Course Type	L	T	P	C	CH
B25GN0402		DSC	0	0	2	2	3

Prerequisites/Pre reading for the course:

1. Students should know the developmental process.
2. They should be capable of Logical thinking.

Course Objectives:

1. To study the developmental pattern of different stages.
2. To understand the involvement of genes in development.
3. To study the potentiality of organ formation.

Course Outcomes:

By the end of the course the student will be able to:

1. Describe and identify the stages of early embryonic development in amphibians.
2. Interpret the genetic regulation and developmental genetics in *Arabidopsis thaliana* and *Drosophila melanogaster*.
3. Examine the structure of imaginal discs in *Drosophila* larvae as precursors to adult organs.
4. Identify the different stages of chick embryo development.
5. Assess the effects of toxins on vertebrate embryogenesis using windowing technique.
6. Evaluate the impact of UV radiation and toxins on bacterial growth and plant seed germination

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	**PO11**	PSO1	PSO2	PSO3
B25GN0402	CO1	3	3	0	0	3	2	0	0	0	3	0	3	2	0
	CO2	3	3	0	0	3	0	0	0	0	3	0	2	2	0
	CO3	3	3	0	0	3	0	0	0	0	3	0	3	0	0
	CO4	3	3	3	3	3	3	3	3	3	3	0	3	3	3
	CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Course Contents

1. Early embryonic development in Frog Egg, cleavage, blastula and gastrula.
2. Genetics of development in *Arabidopsis* – ABC model Homeotic gene

expression (Slide/Chart)
3. Genetics of development in *Drosophila* Anterior & posterior/dorso ventral polarity (Slide/Chart)
4. Study of imaginal discs in *Drosophila*
5. Effect of toxins on chick embryo development (Windowing method).
6. Study of toxins on plant germination.
7. Effect of UV on bacterial growth
8. Study of development of chick embryo and staging.

Reference Books:

1. Lewis Wolpert et al. (2015). *Principles of Development*. 5th Edition. Oxford University press.
2. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2017). *Genes XII*, 12th edition Jones and Bartlett Learning.
3. Gilbert. (2013) *Developmental biology*.10th edition. Sinauer Associates Inc.
4. Brown, T.A., Chapman and Hall (2011). *Genetics a Molecular Approach*, 2nd edition, Garland science.
5. Gurbachan S. Miglani. (2006). Developmental Genetics. 1st edition. I K International Publishing house.

Course Code	Introduction to AI in Life Sciences	Course Type	L	T	P	C	CH
B25AS0415		IDC	2	0	0	2	2

Prerequisites/Pre reading for the course:

1. Students should know the computer knowledge.
2. They should be capable of Logical thinking.

Course Objectives:

1. To introduce foundational concepts of Artificial Intelligence (AI) and its applications in biotechnology.
2. To develop student skills in prompt engineering for effective AI tool interaction.
3. To enable students to build simple AI-based models and chatbots relevant to biotechnology use cases
4. To instil awareness of ethical implications of AI in life sciences

Course Outcomes:

1. Describe fundamental concepts of Artificial Intelligence and its applications in biotechnology domains such as genomics, diagnostics, and drug discovery
2. Demonstrate the ability to use visual, no-code AI tools (e.g., Teachable Machine,

chatbot builders) to solve simple biotechnology problems.

3. Construct AI-driven image classification models using pre-curated datasets relevant to plant diseases, histopathology, or lab equipment identification.
4. Develop basic biotech-focused chatbots or FAQ assistants using drag-and-drop visual editors or prompt-based tools.
5. Formulate effective prompts to interact with generative AI tools for creating SOPs, scientific explanations, and biotechnology FAQs.
6. Evaluate the ethical, legal, and societal implications of AI applications in biotechnology, with specific reference to privacy, data bias, and misuse.

Mapping of Course Outcomes with Programme Outcomes

Course Code	PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	3	1	3	0	0	0	0	0	0	2	3	3	0
	CO2	1	3	2	3	0	2	1	2	1	1	3	3	3	1
B25AS 04 15	CO3	2	3	3	2	1	0	0	1	1	1	3	3	3	0
	CO4	3	3	2	2	0	0	1	1	1	0	3	2	3	2
	CO5	3	2	2	2	3	2	2	2	2	3	3	3	3	2
	CO6	3	2	1	2	3	3	1	1	1	3	3	3	2	1

Course Contents

Unit I: AI & Prompt Engineering for Lifescience 12 Hrs

Introduction to AI in Life Sciences: Uses of AI in various fields of Biotechnology, microbiology, genomics, vaccine design, plant biotech, diagnostics; Fundamentals of Prompt Engineering: Framing Effective Prompts for Life Science -related Queries; Practical Session: Designing and Testing Prompts to Retrieve Protocols, Gene Summaries, and Life Science Insights using Generative AI Tools; Introduction to AI-based Image Classification in Lifescience: Case Studies and Tools; Hands-on Activity: Training an AI Model to Classify Tissue or Plant Disease Images Using Google Teachable Machine.

Unit II: AI Applications, Project Development, and Ethics 12 Hrs.

Applied AI in Life Sciences: Case Studies on Drug Discovery, Protein Structure Prediction, and Disease Modeling; Introduction to Conversational AI in Life Science: Exploring Chatbots Using No-Code Platforms; Hands-on Exercise: Designing a -Themed Chatbot Using a Visual No-Code Tool/LLMs; AI-Driven Scientific Communication: Creating Educational Posters Using AI Tools; Ethical, Legal, and Social Implications (ELSI) of AI in Life Sciences: Data Privacy, Bias, Automation Risks;

Reference Books

1. Taulli T. (2019). **Artificial Intelligence Basics:** A Non-Technical Introduction. Apress Berkeley, CA.
2. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.

Course Code	**Environmental Studies**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25AS0412		**AEC**	**2**	**0**	**0**	**2**	**2**

Prerequisites:

Basic knowledge about environmental studies

Course Objectives:

This course enables graduating students to

- Understand the importance of interdisciplinary aspects of water.
- Know various water resources and water waste management.
- Realize the importance soil chemistry and its impact on environment.
- Understand the complexity of environment and its significance.

Course Outcomes:

1. Analyse the multidisciplinary nature of environmental studies
2. Present the significance of sustainable development
3. Assess the energy flow in different ecosystems
4. Understand the causes and impacts of deforestation
5. Recognise the levels of biological diversity
6. Analyse the biodiversity and threats to biodiversity in India

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

B25AS0412	CO1	2	1	1	2	3	1	0	0	1	1	1	1	1	0
	CO2	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO3	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO4	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO5	2	1	2	1	2	1	0	0	1	1	1	1	1	0
	CO6	2	1	2	1	2	1	0	0	1	1	1	1	1	0

Course Contents:

Unit – 1

Introduction to Environmental Studies **12h**

Multidisciplinary nature of environmental studies. Scope and importance; Concept of sustainability and sustainable development. What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Natural Resources: Renewable and Non-Renewable Resources

• Land resources and land-use change; Land degradation, soil erosion and desertification.

• Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

• Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (International & Inter-state).

• Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit – 2

Biodiversity and Conservation **12h**

Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hotspots. 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. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

TEXTBOOK/ REFERENCE BOOKS:

1. Textbook on Environmental Science, Siva Shanmugam P, New India Publishing Agency, 2018.
2. A text book of Environmental Science, Mr. Sourav Khawas, Dr. Omveer Singh, Prof. (Dr.) Shailesh Sharma, Mr. Hansraj Bishnoi, Mrs. Priyanka Jaiswal, Mr. Jay Chandra, 2023.

3. Environmental Policy and Public Health: Air Pollution, Global Climate Change, and Wilderness, William N Rom, 2011.
4. Environmental Pollution and Control, Fourth Edition, j. Jeffrey Peirce Ruth F. Weiner P. Aarne Vesilind, Elsevier Science & Technology Books, 1997.

B.Sc. – Biotechnology, Biochemistry, Genetics
Detailed Syllabus
FIFTH SEMESTER

Course Code	**Immunology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0501		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

- The student should have proper knowledge of cell biology and microbiology
- The student should have the basic knowledge of human physiology and anatomy

Course Objective:

1. To expose the students to the basics and advancement of immune response mechanism within the cell.
2. To explore various concepts of different cells and types of immune system with their detailed mechanism
3. To develop a strong knowledge on techniques and its mechanisms.
4. To impart knowledge on recent advances in drugs, therapeutics and vaccines.

Course Outcome:

After the end of the Course students will be able to:

1. Demonstrate the basic knowledge of immunological processes at a cellular and molecular level.
2. Outline, compare the key mechanisms and cellular players of innate and adaptive immunity and their correlation
3. To identify the main mechanisms of different immune cells
4. To understand the principles governing vaccination,
5. Understand the mechanisms of protection against disease and
6. Understand the basis of allergy and allergic diseases.

Mapping of Course Outcomes with programme Outcomes

Course Cod	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
B25BT0501	CO 1	2	2	2	2	2	3	1	1	2	3	3	3	3	2
	CO 2	3	2	2	1	2	3	1	1	2	3	3	3	2	2
	CO 3	3	2	3	2	2	3	2	0	2	3	3	3	3	2
	CO 4	3	3	2	2	1	3	2	1	2	2	2	3	3	2
	CO 5	3	1	2	3	3	0	2	2	2	2	2	3	3	1
	CO 6	3	2	3	2	2	3	2	2	2	2	2	3	3	2

Course Contents:

UNIT I Basics of Immunology 12Hrs

Immune Response- an overview, components of mammalian immune system, organs of immune response, active and passive immunity, Humoral & Cellular immune responses, T lymphocytes & immune response (cytotoxic T cell, helper T cell, suppressor T cells), T cell receptors, B lymphocyte differentiation, molecular structure of Immunoglobulins or Antibodies, Different types and functions of immunoglobulins.

UNIT II: Regulation of Immune Cells 12hrs

Cytokines: structure and function, Interferons: structure, mechanism and functions, antibody diversity, T cell and B cell mechanisms, compliment pathway: alternate pathway and lecithin pathway, NK cells, Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing mechanisms, production of hybridomas and monoclonal antibodies.

UNIT III: Immuno-Techniques 12 hr

Antigen Antibody reactions: Agglutination and Precipitation reactions, Blood grouping, immune electrophoresis, ELISA, RIA, compliment fixation test, vaccines and vaccination adjuvants, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines. Co-immunoprecipitation, Epitope Mapping.

UNIT IV: Autoimmunity and Autoimmune diseases 12 hr

Autoimmunity & auto immune diseases, factors contributing development of auto-immune diseases, mechanism of development, rejection of transplants, molecular mimicry, diagnosis & treatment of auto-immune diseases, 3D tissue engineering, Xenotransplantation, immune processes, nature of auto antigens, immunodeficiency, AIDS, allergy and allergic disease.

Reference Books:

1. Coico, R. (2021). Immunology: a short course. John Wiley & Sons.

2. Rich, R. R., Fleisher, T. A., Schroeder Jr, H. W., Weyand, C. M., Corry, D. B., & Puck, J. M. (Eds.). (2022). *Clinical Immunology E-Book: Principles and Practice*. Elsevier Health Sciences.

3. Parija, S. C. (2023). *Textbook of microbiology and immunology*. Berlin, Heidelberg, Germany: Springer.

4. Male, D. (2021). *Immunology: an illustrated outline*. CRC Press.

5. Owen, Judith A., author. (2013). *Kuby immunology. New York* :W.H. Freeman and Company,

Course Code	**Metabolism – I**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0501		**DSC**	**3**	**0**	**0**	**3**	**4**

Course Objective:

1. To understand the enzymes, their properties, activities and kinetics
2. To gain knowledge about carbohydrates. lipid metabolic pathways and biological oxidation

Course Outcomes:

1. Know about the basic principle of enzyme activity and their role in metabolism
2. Find out the various intermediate pathways and basic energy generation of synthesis and degradation of carbohydrates.
3. Know about the various intermediate pathways and basic energy generation of synthesis and degradation of lipids.
4. To understand about the biological oxidation and its significances.
5. Know about the basic principle of marker enzymes and its clinical values.
6. To understand about the various lipids with clinical disorders.

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PO11	PSO 2	PSO 3
B25BC0501	CO1	2	2	1	2	2	3	1	0	2	2	3	0	2	2
	CO2	2	2	2	2	1	2	1	1	1	3	2	0	2	1
	CO3	3	2	2	1	2	2	0	0	2	1	2	0	3	2
	CO4	2	2	1	1	2	1	1	0	0	1	2	0	2	1
	CO5	2	1	1	1	1	2	1	0	1	1	2	0	2	1
	CO6	1	0	1	2	1	1	0	0	1	1	2	1	1	0

Course Contents:

UNIT-I **12 hrs**

Enzymes: Definition, Nomenclature and classification of enzymes based on IUB with examples UNIT of enzyme activity – definition of IU, enzyme turn over number. Enzyme specificity. Concept of active site. Factors affecting rate of enzyme catalyzed reaction. Michaelis–Menten equation. Lineweaver Burk plot. Vmax and Km from L B plots and its significance. Enzyme

Inhibition: Competitive, noncompetitive and uncompetitive inhibition. Theories of Enzyme catalysis: Lock and key model, Kos land's induced fit theory. Regulation of enzymes: Allosteric enzymes, igmoidal curve, positive and negative modulators, Isoenzymes and its importance.

UNIT-II **12 hrs**

Metabolism of Carbohydrates: Definition, phases of metabolism, Anabolism and Catabolism Glycolysis and its regulation, Entry of sucrose and glycogen into glycolysis TCA cycle and Number of ATP molecules production. Functions of TCA cycle. regulation of TCA cycle, Gluconeogenesis and significance, CORI cycle explanation, Glycogenolysis and Glycogenesis. Pentose phosphate pathways (PPP/ HMP) and its Significance. Regulation of blood glucose level; role of Insulin and Glucagon

UNIT- III **12 hrs.**

Lipid metabolism: β oxidation of palmitic acid and stearic acid; role of carnitine, Oxidation of fatty acids with odd number of carbon atoms, oxidation of unsaturated fatty acids. Fatty acid synthetases; structure and functions. Biosynthesis of fatty acids Cholesterol structure, functions and biosynthesis. Atherosclerosis causes and symptoms. Ketone bodies Synthesis and degradation.

UNIT- IV **12 hrs**

Bioenergetics and Biological Oxidation: Laws of thermodynamics. Definition of bioenergetics, free energy change, exergonic and endergonic reactions, High energy compounds, Biological oxidation: Calculation of thermodynamic efficiency of biological oxidation for a mole of glucose; Calculation of energy yields from biological reaction; Electron transport chain and its significance. Oxidative phosphorylation definition, salient features of chemiosmotic theory, P: Oratio of carbohydrate and protein.

Reference Books:

1. Biochemistry; Voet, D. and Voet, J.G. (2017);5th Ed. John Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., (2021) 8thEdn.; MacMillan Publishing company.
3. Text Book of Biochemistry with Clinical correlations; Thomas Devlin (2010) 7th Ed., Wiley-Liss.
4. Outlines of Biochemistry by P.K. Stump, et.al., (2006), 5th edn., publisher-Wiley Eastern, New Delhi,

Course Code	Human Genetics	Course Type	L	T	P	C	CH
B25GN0501		DSC	3	0	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge.
2. They should have knowledge of morphology of chromosomes.

Course Objectives

The objective of this Course is:

1. To know the history of human genetics.
2. To employ the techniques such as karyotyping, FACS, genetic counselling.
3. To outline the inheritance pattern of genetic disorders.
4. To familiarize the diagnostic techniques used in medical and forensic fields.

Course Outcomes:

After completing the course, the student should be able to:

1. Identify chromosomes using standard nomenclature.
2. Analyse the aberrations by karyotypes.
3. Outline the different patterns of inheritance of allosomes and autosomes.
4. Interpret the inheritance by analysing pedigree tree.
5. Familiarize with the prenatal diagnosis, genetic counselling.
6. Determine the significance of dermatoglyphics in clinical analysis.

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO3
B25GN0501	CO1	3	3	3	0	0	0	3	3	0	3	2	3	0	2
	CO2	3	3	3	3	0	3	3	3	0	3	2	3	0	2
	CO3	3	3	3		0	2	2	2	0	3	1	3	0	2
	CO4	3	3	3	3	3	3	3	2	2	3	2	3	0	2
	CO5	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	CO6	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Course Contents:

UNIT I **12 Hrs**

History of Human Genetics: Relevance of Denver conference (1940 and 1960), Chicago conference (1966), Paris conference (1971). Human chromosomes and karyotyping: types of banding, FISH, GISH, Flow karyotyping, SKY, FACS. Nomenclature of chromosomes. ISCN rule and reporting of chromosome. Normal karyotypes, Abnormal karyotypes: Common syndromes due to numerical chromosome changes, Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites)

UNIT II **12 Hrs**

Genetic Diseases and Inheritance Pattern: Autosomal inheritance Dominant (Ex. Adult polycystic kidney, Achondroplasia and Neurofibromatosis) Autosomal inheritance Recessive (Ex. Albinism, Sickle cell anemia, Phenylketonuria) X-linked – Recessive: (Ex. Duchenne muscular dystrophy-DMD) X-linked- Dominant: (Ex. Rett syndrome, Xg blood group) Y-linked inheritance: Holandric gene (Ex. Testes determining factor TDF) Multifactorial inheritance: (Ex. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Ex. Leber's hereditary optic neuropathy)

UNIT III **12 Hrs**

Pedigree studies and Genetic Counselling: Pedigree analysis: Family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees,
Pedigree analysis for the inheritance pattern of genetic diseases.

Genetic Counselling.

Physical examination, Patterns of inheritance, risk assessment and counselling. Stages of counselling: History and pedigree construction, Examination, Diagnosis, Counselling, Follow up. Problems and case studies.

UNIT IV **12 Hrs**

Genetics and Society

Dermatoglyphics: Introduction and Patterns**.** Introduction and Patterns. Dermatoglyphics in clinical disorders Down's syndrome, Turner's syndrome, Klinefelter's syndrome and Cri du chat syndrome. Clinical applications, Advantages and Limitations.

Prenatal Diagnosis: Introduction and types Invasive Prenatal diagnosis - Amniocentesis, Chorionic villus sampling. Non – Invasive Prenatal diagnosis – Ultrasonography.

Concept of Eugenics, Euthenics, Euphenics.

Human genome project – Goals, ELSI of HGP, Beginning and Organization of the HGP, Sequencing of the Human Genome, Promises and Achievements.

Gene therapy with reference to SCID. Stem cells - Properties, types and sources. Stem cell therapy and Cord blood banking.

Reference Books:

1. Peter D Turnpenny, Sian Ellard, Ruth Cleaver. (2020). *Emery's Elements of Medical Genetics.* 16th Edition. Elsevier Health Sciences
2. S D Gangane. (2021). *Human Genetics*. 6th Edition. Elseiver Publishers.
3. Ricki Lewis (2020). *Human Genetics*, 12th Edition. McGraw Hill
4. Tom Strachan & Andrew Read. (2018). *Human Molecular Genetics*. 5th Edition. Garland Science
5. Bruce R. Korf, Mira B. Irons. (2012). *Human Genetics and Genomics*. 4th edition. Wiley-Blackwell Publishers.

Course Code	**Medical Genetics**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25GNS511		**DSE**	**2**	**0**	**0**	**2**	**2**

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge about pathology.

2. They should have a knowledge of cancer biology.

Course Objectives:

The Objective of this Course is:

To teach the basics of medical genetics and learn the patterns of heredity

1. To categorize the genetic disorders.
2. To explore the molecular therapeutics for disease management
3. To understand the mechanism of carcinogenesis.

Course Outcomes:

After completing the course, the student should be able to:

1. Predict the patterns of heredity.
2. Analyse the molecular reason of genetic disorders.
3. Illustrate the process involved in recombinant protein production.
4. Understand the characteristics and categories of cancer.
5. List out the chromosomal aberrations involved in leukemia.
6. Outline the molecular diagnostic techniques.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS511	CO 1	3	3	3	0	0	0	0	0	0	0	0	3	3	0
	CO 2	3	3	3	3	0	0	0	0	0	0	2	3	3	0
	CO	3	3	2	2	0	0	0	0	0	0	1	3	3	3

	3														
	CO 4	3	3	3	0	0	0	0	0	0	0	2	3	3	0
	CO 5	2	3	3	3	0	0	0	0	0	0	1	3	3	0
	CO 6	3	3	3	3	0	0	0	0	0	0	3	3	3	0

Course Contents:

UNIT I 12 Hrs.

Genetics in medical Practice:

Genetic Principles and their application in medical practice, Case studies (Interacting with patients, learning family history and drawing pedigree chart.

Patterns of Single Gene Inheritance: Haematopoietic systems Sickle cell Anemia, Thalassemias and Haemophilias, Muscle genetic Disorders Becker Muscular Dystrophy. Cystic Fibrosis, Tay Sach's Syndrome & Marfan syndrome. Inborn errors of metabolism: Phenylketonuria, galactosemia

UNIT II 12 Hrs.

Human Genetic Disorders of Nervous system and Eye: Charcot Marie tooth syndrome, Alzheimer's disease & Syndromes due to triplet repeat expansion, Parkinson's disease, Colour Blindness, Retinitis pigmentosa, Glaucoma & Cataracts.

Oncogenetics: A brief account of cancer definition, types Benign and Malignant; Sarcoma, Carcinoma,Lymphoma and Leukemia. Properties of malignant cells. Types of genes Proto oncogenes, Oncogenes, viral oncogenes, Tumor Suppressor genes p53, pRb.

Reference Books:

1. Lynn B. Jorde, John C. Carey, Michael J. Bamshad (2016). *Medical Genetics*. 5th edition. Elsevier.
2. Dorian J. Pritchard, Bruce R. Korf. (2013). *Medical Genetics at a Glance*. 3rd edition. Wiley.
3. G. P. Pal. (2009). *Medical Genetics.* 1st edition. A.I.T.B.S. Publishers.
4. Xavier Llor, Erin Wysong Hofstatter (2021). *Cancer Genetics: A Clinical Approach.* 1st edition. McGraw Hill LLC.
5. Ian D Young · (2010). *Medical Genetics*. 1st edition. Reissued. OUP Oxford.

Course Code	Genotoxicity	Course Type	L	T	P	C	CH
B25GNS512		**DSE**	**2**	**0**	**0**	**2**	**2**

Prerequisites/Pre reading for the course:

1. Students should know the concept of mutagenicity.
2. They should be aware of the chemical nature of compounds.

Course Objectives:

The Objective of this course is to:

1. Facilitate the understanding of general principles of toxicology, cellular mechanism against drug targets and regulatory protein functions.
2. Impart knowledge of mutagenesis and chemical carcinogenicity
3. Enable students to know the principles of absorption, distribution, metabolism, excretion and toxicity of the drug administration

Course Outcomes:

After completing the course, the student should be able to:

1. Design and assess exposed chemicals based on toxicity studies.
2. Categorize different mutations and aberrations.
3. Illustrate the DNA repair mechanisms.
4. Analyse and interpret exposure measurement applying different modelling tools for toxicity study.
5. Evaluate and measure the degree of toxicity.
6. Analyse reproductive and developmental toxicity.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS512	CO 1	3	3	0	3	3	3	0	0	0	0	0	3	3	3
	CO 2	3	3	0	0	0	0	0	0	0	0	0	3	3	0
	CO 3	3	3	0	0	0	3	0	3	0	0	0	3	3	0
	CO 4	3	3	3	3	3	0	0	0	0	0	2	3	3	3
	CO 5	3	3	0	3	3	3	0	0	0	0	2	3	3	3
	CO 6	3	3	0	0	3	3	0	0	0	0	2	3	3	3

Course Contents:

UNIT I: **12 Hrs**

General Principles and terminology, Types of toxicity, Factors affecting toxicity, Acute, subacute and chronic toxicity, Classification of toxicants, Estimation of toxicity; LD50; LC50, LT50. Teratogens, Food additives and contaminations; Classification of Genotoxic agents. Genetic effects of environmental agents and Genotoxic agents in various occupations. Toxicity studies-Acute, sub-acute and chronic studies: Protocols, objectives, methods of execution and regulatory requirement

UNIT II **12 Hrs**

Reproductive toxicology assessment: Male reproductive toxicity, female reproductive toxicology, oocyte toxicity, alterations in reproductive endocrinology, relationship between maternal and developmental toxicity.

Various assay procedures to determine genotoxicity, Methods of evaluation of mutagens.

Mutagenicity: In vitro tests for gene mutations in bacteria, chromosome damage, gene mutations in vivo (micronucleus tests and metaphase analysis) in rodents. Carcinogenicity studies: In vivo and In vitro studies.

References:

1. Shiv Shankar Shukla, Ravindra Kumar Pandey, Bina Gidwani, Gunjan Kalyani (2020). Insight on Genotoxicity. 1st edition. CRC Press.
2. Sonia Soloneski and Marcelo L Larramedy. (2021). Genotoxicity and Mutagenicity. Mechanisms and Test Methods. 1st edition. IntechOpen
3. David Jacobson-Kram, Michael J. Graziano. (2015). Genotoxicity and Carcinogenicity Testing of Pharmaceuticals. Springer International Publishing.
4. Alok Dhawan, Mahima Bajpayee. (2020). Genotoxicity Assessment Methods and Protocols. Springer New York.
5. Isabel Gaivão, L. María Sierra. (2014). Genotoxicity and DNA Repair A Practical Approach. Springer New York.

Course Code	Immunology Lab	Course Type	L	T	P	C	CH
B25BT0502		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

- The student should have knowledge of cell biology and microbiology.
- The student should have the knowledge of basic human physiology and anatomy.

Course Objectives:

1. To understand the basic concepts of immune system
2. To familiarize the students in the Immuno-Technology
3. To explore various aspects of immunology in the other field

4. To exploit the immunological methods for commercial needs

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the importance and scope of immunology
2. Handle immunological techniques for mankind
3. Explore various methods and new techniques in immunology
4. Take small research project in the field of immunology
5. Conceptulaize the knowledge of immunology to understand diseases
6. Implement the concept of immunology in life science research.

Mapping of Course Outcomes with programme Outcomes

Course Cod	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0502	CO 1	2	1	2	2	2	3	2	1	2	2	0	3	3	3
	CO 2	3	2	2	2	3	3	2	2	3	3	2	3	2	1
	CO 3	3	2	2	3	3	3	3	1	2	3	2	3	1	2
	CO 4	3	3	2	3	3	1	3	2	2	3	2	2	3	2
	CO 5	2	2	3	3	3	3	2	0	2	3	2	2	1	2
	CO 6	2	0	3	2	3	3	1	1	2	3	2	3	2	2

Course Contents:

1. Separation of Serum and Plasma from Whole Blood Samples
2. VDRL Test for Detection of Non-Treponemal Antibodies
3. WIDAL Test for Detection of Salmonella Antibodies
4. Ouchterlony Double Diffusion for Antigen-Antibody Interaction
5. Dot ELISA for Antigen or Antibody Detection
6. Rocket Immunoelectrophoresis for Quantitative Antigen Analysis
7. Estimation of C-Reactive Protein (CRP) in Serum
8. Radioimmunoassay (RIA) for antigen antibody detection

Reference Books:

1. Coico, R. (2021). Immunology: a short course. John Wiley & Sons.

2. Rich, R. R., Fleisher, T. A., Schroeder Jr, H. W., Weyand, C. M., Corry, D. B., & Puck, J. M. (Eds.). (2022). *Clinical Immunology E-Book: Principles and Practice*. Elsevier Health Sciences.

3. Parija, S. C. (2023). *Textbook of microbiology and immunology*. Berlin, Heidelberg, Germany: Springer.
4. Male, D. (2021). *Immunology: an illustrated outline*. CRC Press.
5. Owen, Judith A., author. (2013). *Kuby immunology. New York* :W.H. Freeman and Company,

Course Code	**Laboratory Course – V (Biochemistry)**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0502		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of enzymology and clinical biochemistry

Course Objectives:

1. To gain thorough practical knowledge on enzymes.
2. To understand the standard curves, total activity.
3. To learn factors affecting enzyme activity.
4. To determine biochemical metabolites by colorimetric methods.

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the assay of enzyme activity using their respective standards.
2. Avail the practical knowledge of optimum temperature and pH on enzyme activity.
3. Interpret the biochemical metabolites and clinical significance.
4. Understand the blood cholesterol and its significance.
5. Avail the practical knowledge of saponification and iodine values and significance.
6. Significance of glucose and tyrosine estimations.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0502	CO1	3	2	3	2	2	3	1	0	1	2	0	3	2	2
	CO2	2	1	1	2	1	3	1	0	1	1	1	2	1	1
	CO3	3	1	2	1	1	0	1	0	1	1	1	2	2	0
	CO4	1	1	1	1	1	1	0	0	1	1	0	2	2	1
	CO5	1	1	1	1	1	3	0	0	1	1	0	2	2	1
	CO6	1	1	1	0	1	3	0	0	1	1	0	2	2	1

Course Contents:

1. Estimation of blood glucose by DNS method.
2. Estimation of Tyrosine by Millon's method.
3. Colorimetric estimation of blood cholesterol by Zack's method.
4. Determination of Iodine number and Saponification value of lipids.
5. Assay of Amylase activity
   1. Preparation of standard curve
   2. Total activity
6. Determination of optimum temperature of amylase.
7. Determination of optimum pH of amylase.

Reference Books:

1. An Introduction to practical Biochemistr (2017) by PlummerD.T, 3 rd edition, - publisher- Tata McGraw Hill.
2. Biochemical methods S. Sadasivam A Manickam, (2005) Revised Second editionNew Age International Pvt Ltd Publishers
3. Experimental Biochemistry: A Student companion (2005) by Beedu Sashidhar Rao and Vijay Deshpande published by, I.K. International Publishing House Pvt. Ltd.
4. Introductory practical Biochemistry (2005) by S K Sawhney, Randhir singh,11th Edition, P ublished by Alpha Science International Ltd.

Course Code	Human Genetics Lab	Course Type	L	T	P	C	CH
B25GN0502		DSC	0	0	2	2	3

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge.
2. They should have knowledge of the morphology of chromosomes.

Course Objectives:

The Objectives of this course is to:

1. To study different banding techniques and karyotypes
2. To understand the concept of dosage compensation in different cells.
3. To analyse the count of blood cells
4. To construct the pedigree and record the fingerprints.

Course Outcomes:

After completing the course, the student should be able to:
1. Perform lymphocyte culture and karyotyping to visualize human chromosomes and analyse chromosomal organization.
2. Apply G-banding techniques to prepare and study banded chromosomes.
3. Analyze normal and abnormal human karyotypes to identify genetic syndromes.
4. Demonstrate the identification of sex chromatin in epithelial cells and drumsticks in neutrophils as indicators of sex chromosomal composition.
5. Accurately perform red and white blood cell counts using a hemocytometer.
6. Construct and analyze pedigrees for various patterns of inheritance and perform dermatoglyphic analysis for genetic and anthropological studies.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	3	3	2	1	2	2	2	1	2	1	3	3	2
	CO2	2	2	2	2	1	1	2	2	1	2	1	2	2	2
B25GN0502	CO3	3	3	3	2	1	2	2	2	1	2	3	3	3	2
	CO4	2	3	3	2	1	1	2	2	1	2	1	2	3	2
	CO5	3	3	3	2	1	2	2	2	2	2	1	3	3	2
	CO6	3	2	2	2	1	1	2	2	2	2	2	3	2	2

Course Contents:

1. Lymphocyte culture and karyotyping.
2. Study of banding techniques (G banding technique).
3. Study of Karyotypes: Normal Karyotyping in Human. Male (46, XY) Female (46, XX). Abnormal Karyotypes - Down's syndrome (autosomal). Turner's syndrome (sex chromosomal), Klinefelter's syndrome (sex chromosomal)
4. Study of sex chromatin in epithelial cells and drum sticks in Neutrophils.
5. Red Blood counting using Cell Haemocytometer
6. White Blood counting using Cell Haemocytometer
7. Pedigree analysis and construction: Symbols used and problems associated with autosomal recessive disorder, autosomal dominant disorder, Sex linked inheritance (X and Y). Collection of family history and construction of pedigrees. (5 family history/case study per student)
8. Dermatoglyphics: Recording of print of fingertips and palm. Classifying ridges on the Finger tips: arch, loop, and whorl. Palm print area demark as hypothenar, thenar

andinter digital areas, Recording presence or absence of Simian crease. Ridge Counting and angle calculation.

Reference Books:

1. Peter D Turnpenny, Sian Ellard, Ruth Cleaver. (2020). *Emery's Elements of Medical Genetics.* 16^{th} Edition. Elsevier Health Sciences
2. S D Gangane. (2021). *Human Genetics*. 6^{th} Edition. Elseiver Publishers.
3. Ricki Lewis (2020). *Human Genetics*, 12th Edition. McGraw Hill
4. Tom Strachan & Andrew Read. (2018). *Human Molecular Genetics*. 5th Edition. Garland Science
5. Bruce R. Korf, Mira B. Irons. (2012). *Human Genetics and Genomics*. 4th edition. Wiley-Blackwell Publishers.

Course Code	**"R" Programming**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25AS0501		**IDC**	**2**	**0**	**0**	**2**	**2**

Prerequisites/Pre reading for the course:

1. The student should be familiar with the basics of bioinformatics
2. The student should be familiar with the basics of computer science

Course Objectives

1. The course is mainly focused on the Understanding biological data types and file structures.
2. Emphasize on data analysis algorithms and pipelines to predict data structures and analysis methods.
3. The course also helps to understand the R programming techniques to analyze the statistical data.
4. The course also helps to create algorithms using R program to data analytics.

Course Outcomes

By the end of the course the student will be able to:

1. The students are more familiar about the statistics and analyze using R program.
2. Understand the statistical properties of data & how to implement hypothesis testing.
3. Implement statistical solutions using the R statistics software ecosystem.
4. Knowledge and awareness of descriptive statistics to analyze various industrial applications.
5. Understand the concept of sequencing technioues like NGS
6. Implicate the knowledge of R programming in life science research

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0501	CO1	3	3	3	3	1	0	1	0	1	2	2	3	3	2
	CO2	3	3	3	2	1	0	0	1	1	2	3	3	3	2
	CO3	3	3	3	3	1	0	1	1	1	2	2	3	3	2
	CO4	3	3	3	2	1	2	1	1	1	2	3	3	3	2
	CO5	3	3	2	3	1	1	0	2	1	2	2	3	3	2
	CO6	3	3	3	3	1	2	1	1	2	3	3	3	3	2

Unit-I: R Basics **12 Hr.**

Introduction to R, Applications of R, Installing R and RStudio, Running the R Application, entering input, Evaluation, R objects, Numbers, Attributes, Creating Vectors, Objects, Matrices, Lists, Missing Values, Data frames, CRAN, Command Packages: Installation and Usage,

Unit II: R Applications **12 Hr.**

Introduction to Bioconductor packages, R types and classes, Functions, Data Structures, Reading and writing Data from files, Variables, Control Structures, Input Output, Graphics, Data Visualization, Introduction to NGS, Microarrays, Databases, Application of Bioconductor analysis packages-NGS, Data visualization: Heatmaps, Pie-charts, Venn diagrams.

Reference Books

1. Dr. Mark Gardener Beginning R: The Statistical Programming Language, John Wiley & Sons, Inc. 2012.
2. Roger D. Peng (2018). R Programming for Data Science, Lean Publishing process.
3. David Dietrich, Barry Heller, Beibei Yang (2015). Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. John Wiley & Sons, Inc.
4. Rafael A. Irizarry (2019). Introduction to Data Science: Data Analysis and Prediction Algorithms with R. HarvardX Data Science Series.

Course Code	**Constitution of India and Professional Ethics**	**Type**	**L**	**T**	**P**	**C**	**CH**
B25LS0501		**AEC**	**2**	**0**	**0**	**2**	**2**

Course Objectives:

1. To provide and gain knowledge on Constitution of India
2. To know and understand the background of Indian Constitution
3. To attain knowledge about ethics and ideology of political leaders
4. To explore the philosophy and features of Indian Constitution

Course Outcomes:

After completion of this course the students will be able to:

1. Analyze the political foundation of India
2. Understand the colonial impact on Indian Constitution
3. Demonstrate the political views during freedom struggle
4. Understand the acts during constitutional development of India
5. Illustrate the working committees in Indian Constitution
6. Summarize ethical standards followed by different companies

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25LS0501	CO1	2	1	0	1	1	1	0	0	0	1	0	2	2	1
	CO2	1	1	1	0	1	1	0	0	1	1	0	2	2	1
	CO3	2	2	2	1	1	1	1	0	1	1	0	2	2	1
	CO4	2	1	1	1	3	1	0	0	1	1	0	2	2	0
	CO5	2	2	0	1	2	1	0	0	1	1	0	2	2	0
	CO6	2	2	1	1	3	1	1	0	2	1	0	2	2	0

Course Content:

Couse Content:
Unit I : Development and Philosophy of the Indian Constitution 12h

1. Evolution and Making of the Indian Constitution 3hrs

- **Historical Background** – Growth of Constitutionalism in India
- **Key Constitutional Acts** – Regulating Act, Charter Acts, Government of India Acts (brief overview)
- **Constituent Assembly** – Composition, Debates, and Role of Committees in Drafting the Constitution

2. Philosophy and Features of the Indian Constitution 4hrs

- **The Preamble and its Significance** – Interpretation & Judicial Perspective
- **Salient Features of the Constitution** – Federalism, Secularism, Parliamentary System, Judicial Review, etc.
- **Concept of Constitutionalism** – Limited Government, Rule of Law, Separation of Powers

3. Functioning of the Constitution **5hrs**

- **Fundamental Rights** – Key Provisions, Landmark Judgments, and Limitations
- **Contributions of Dr. B.R. Ambedkar and Jawaharlal Nehru** in Constitution-making
- **Union-State & Inter-State Relations** – Article 263, Interstate Disputes, Trade and Commerce Provisions
- **Major Constitutional Amendments** – 42nd, 44th, 73rd, 74th, 101st, and recent amendments
- **Parliamentary Committees** – Standing, Ad hoc, and Departmental Committees: Role & Importance

Unit II: Constitutional Institutions and the Role of Citizens **12h**

1. Parliamentary and Constitutional Institutions **5hrs**

- **Legislature** – Composition and Powers of Upper and Lower Houses
- **Executive** – Structure and Powers of the President, Prime Minister, and Council of Ministers
- **Judiciary** – High Courts and Supreme Court: Composition, Jurisdiction, and Landmark Cases
- **Key Constitutional Bodies** –
  - **Comptroller and Auditor General (CAG)** – Functions & Role in Financial Oversight
  - **Inter-State Council** – Role in Federal Cooperation
  - **Election Commission** – Structure, Powers, and Electoral Reforms

2. Citizenship and Responsibilities of Citizens **4hrs**

- **Concept of Citizenship** – Constitutional Provisions (Articles 5-11)
- **Citizenship Amendment Act** – Evolution and Key Changes
- **Fundamental Duties** – Constitutional Mandate and Significance
- **Right to Information Act** – Importance in Transparency and Governance
- **Role of Civil Society** – Social Movements, Public Participation, and Accountability

3. National Development and Constitutional Vision **3hrs**

- **Concept of National Development** – Constitutional Directives and Policy Framework
- **Unity and Integrity of the Nation** – Federalism, Secularism, and Social Justice
- **Educational Policies and Nation-Building** – Constitutional Goals, Role of Teachers and Students in Strengthening Democracy

Textbooks:

1. Desai, A R. 2016. Social Background of Indian Nationalism. Los Angeles: Papular Prakashan.
2. Harish Ramaswamy and S. S. Patagundi (Ed.) 2007. Karnataka- Government and Politics. Delhi: Concept Publishing Company

B.Sc. – Biotechnology, Biochemistry, Genetics
Detailed Syllabus
SIXTH SEMESTER

Course Code	Plant Biotechnology	Course Type	L	T	P	C	CH
B25BT0601		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

- The student should be familiar with the basic concepts in botany and plant physiology
- The student should know basics in molecular biology and genetic engineering

Course Objectives:

To enable the students

1. To introduce the underlying principles involved in plant tissue culture.
2. To familiarize the students with the concepts and techniques in plant genetic engineering.
3. To understand the significance of transgenic plants in molecular farming.

Course Outcomes:

By the end of the course, the students will be able to

1. Describe the various plant tissue culture techniques with the associated advantages and disadvantages.
2. Explain the significance of somatic hybridization in creating new varieties through tissue culture.
3. Choose alternative plant biotechnology tools in place of genetic modification by engineering.
4. Comprehend the process of production of commercially important compounds through molecular farming.
5. Demonstrate the importance of genetically modified plants in imparting resistance to biotic and abiotic factors.
6. Explain the various approaches through which gene of interest can be incorporated for better performance.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	2	3	3	2	2	1	0	0	3	0	3	2	3
	CO2	2	2	3	3	3	2	0	0	2	2	0	3	2	3
	CO3	3	2	3	3	3	2	0	0	2	2	2	3	3	3

B25BT0601	CO4	3	2	3	3	3	2	0	0	1	2	2	2	2	3
	CO5	3	2	3	3	2	2	0	0	2	3	2	3	2	3
	CO6	3	2	3	3	3	3	0	0	2	2	3	3	2	3

Course Contents:

UNIT I

Introduction to Plant tissue culture 12 hrs

Laboratory organization, Aseptic techniques, plant tissue culture media and growth regulators. Concept of totipotency. Micropropagation: Shoot tip and Axillary bud proliferation, Organogenesis and Somatic embryogenesis. Organ culture: Anther, embryo and endosperm culture. Ovary and ovule culture. Secondary metabolite production through cell culture and hairy root culture.

UNIT II

Somaclonal Variation and Somatic Hybridisation 12 hrs

Concept and Screening of somaclonal variants. Applications of variants. Protoplast culture isolation of protoplast mechanical and enzymatic methods, viability of protoplast, protoplast fusion PEG mediated and electrofusion, selection, culture of protoplasts, regeneration, screening and applications. Cybridisation and its applications.

UNIT III

Production of transgenic plants 12 hrs

Methods of plant transformation: *Agrobacterium* mediated gene transfer. Selectable and reporter genes. rDNA approaches for introducing herbicide tolerance, pest resistance *Bt* cottonproduction, plant disease resistance0bacterial and viral resistance. Ethical issues associated with genetically modified plants. Transgenic models in plants.

UNIT IV

Molecular Farming 12 hrs

Edible vaccines from plants water melon and banana as the host plant, Plantibodies Various approaches, Production of PHB targeted and non targeted approach, Therapeutic protein production: production systems and strategies Hirudin production, Industrial enzymes Amylase, cellulase, phytases and Proteases.

References

1. Adrian Slater, Nigel W. Scott, Mark R. Fowler. (2008).Plant Biotechnology: An Introduction to Genetic Engineering by Oxford University Press.
2. Heldt, H. W., & Piechulla, B. (2021). *Plant biochemistry*. Academic Press.
3. Gamborg O.L. and Philips G.C. (1998) Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. New Delhi.
4. Razdan. M.K. (2003). An introduction to Plant Tissue Culture. Oxford and IBH Publishing Co, New Delhi.

5. Singh B D (2006). Plant Biotechnology. Kalyani Publishers.
6. Chawla H S (2000). Introduction to Plant Biotechnology. Science Publishers.

Course Code	**Metabolism- II**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0601		**DSC**	**3**	**0**	**0**	**3**	**4**

Course Objectives:

1. Understand about the metabolism of amino acids.
2. Understand the metabolism of purine and pyrimidine nucleotides.
3. To know about the biochemical constituents related with diagnosis of diseases.
4. Understand the microbial pathogenicity and immune response.

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the general and various synthesis, degradation and diseases of animo acids.
2. Know biochemical constituent related with kidney's
3. Learn about biochemical constituent related to disorders with Nucleic acid contents.
4. Understand the biochemical constituent related with normal and abnormal constituents of Urine.
5. Know biochemical constituent related with liver and other organ function tests.
6. Identify the biochemical significance of Metabolomics and its importance.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0601	CO1	3	2	1	2	1	3	0	0	1	1	2	2	2	2
	CO2	2	2	1	1	1	1	0	0	1	2	2	2	2	2
	CO3	3	2	1	1	2	2	0	0	2	1	2	3	3	2
	CO4	3	2	1	1	1	2	0	0	1	1	2	2	2	2
	CO5	1	1	1	1	1	2	0	0	1	1	2	3	3	1
	CO6	2	0	1	2	1	0	0	1	1	1	2	2	3	0

Course Contents

UNIT- I 12 hrs

Amino acid metabolism: General reactions of transamination. Urea cycle, hyper ammonaemia, regulation of urea cycle. Epinephrine and Norepinephrine importance and biosynthesis from tyrosine. Histamine biological importance and synthesis. Biosynthesis of non-essential and Essential amino acids. Disorders of amino acid metabolism: Phenylketonuria, Alkaptonuria, Maple syrup urine disease.

UNIT- II **12 hrs**

Nucleic acid metabolism: Biosynthesis of purine and pyrimidine nucleotides sources of nitrogen and carbon atoms of purine and pyrimidine ring. Biosynthesis of IMP; pathways from IMP to AMP and GMP, salvage pathways; Biosynthesis of UMP, conversion of triphosphates. Deoxyribonucleotides and synthesis of dTTP inhibitors of nucleotide metabolism and their use as anti-bacterial / anticancer drugs. Degradation of purine and pyrimidine nucleotides. Disorders of nucleotide metabolism: Lesch Nyhan syndrome, Gout.

UNIT- III **12 hrs**

Urine: Urine examination-physical, chemical and microscopic examination. Blood: Normal constituents of blood. Urea, Uric acid, Creatinine, Glucose, Bilirubin, Total protein, Albumin/ globulin ratio Variation in pathological conditions. Lipid Profile Cholesterol, Triglycerides, lipoproteins, HDL and LDL. Diagnostic enzymes: SGOT, SGPT, Alkaline Phosphatase, CPK and LDH; examples.

UNIT- IV **12 hrs.**

Introduction to Metabolomics.

Introduction to Metabolomics: History and scope of metabolomics. Importance of metabolomics in biological research. Metabolome and Metabolites: Overview of the metabolome, Types of metabolites (primary and secondary metabolites), Metabolic pathways and networks. Metabolomics in Medicine: Metabolomics in disease diagnosis and biomarker discovery, Case studies in cancer, diabetes, and cardiovascular diseases. Environmental and Agricultural Metabolomics: Applications in environmental monitoring and toxicology, Plant metabolomics for crop improvement and stress response.

Reference Books:

1. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).
2. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer, W H Freeman and Co. (2006).
3. Biochemistry; David Rawn, J, Neil Patterson Publishers (1989).
4. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc. (2010)
5. Metabolomics: A Powerful Tool in Systems Biology by Jens Nielsen and Michael C. Jewett
6. Metabolomics: Methods and Protocols by Wolfram Weckwerth.

Course Code	Evolutionary and Biometrical Genetics	Course Type	L	T	P	C	CH
B25GN0601		DSC	3	0	0	3	4

Prerequisites for the course:

1. Students should have the knowledge of theories of evolution.
2. Students should be aware Basic mathematical concepts.

Course objectives:

1. To explain the concept of population genetics and its application in studying the evolution of the species.
2. To discuss the inheritance involving quantitative characters.
3. To study the basics of statistics and its applications.
4. To apply the knowledge of biometry in genetic variation.

Course outcomes

After the course, students will be able to:

1. Characterize the genetic variations observed in population.
2. Discuss the inheritance of quantitative characters.
3. Interpret the date using statistical tools
4. formulate hypothesis and test them using proper tools.
5. Apply the knowledge of biometry in the phenotypic variation of traits.
6. Demonstrate and calculate the heritability of the phenotypic traits.

Mapping of Course Outcomes with program Outcomes

	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0601	CO1	3	2	2	2	2	1	2	2	1	2	2	3	3	2
	CO2	3	3	2	2	2	2	1	2	1	2	2	3	3	2
	CO3	2	3	3	3	1	1	2	2	2	2	2	2	3	3
	CO4	2	3	3	3	1	2	2	2	2	3	2	2	3	3
	CO5	3	2	3	3	1	2	2	2	2	3	2	3	3	2
	CO6	3	2	3	3	1	2	2	2	2	3	2	3	3	3

Course contents:

UNIT-I 12 hrs

Darwinism, Neo Darwinism and Synthetic Theory. Population genetics: fitness; Gene pool, Gene and genotype frequencies: Hardy-Weinberg principle, Evolutionary agents: Migration;

Mutation, Random drift and Selection – directional, disruptive, stabilizing, Kin selection. Speciation: concepts and Methods of speciation, Isolating Mechanisms-Pre-mating and Post mating. Micro, macro and molecular evolution.

UNIT-II **12hrs**

Quantitative Characters and Inheritance:

Quantitative Characters: -Types- Continuous, meristic and threshold characters with examples. Quantitative inheritance: -Features of polygenic traits in relation to oligogenic traits. Inheritance of Kernel color in wheat and Skin colour in human. Transgressive inheritance in Poultry. Environmental effects–IQ in Humans. Significance of polygenic inheritance-Twin study

UNIT-III **12hrs**

Elements of Biometry

Measures of Central Tendency – Mean, Median and Mode

Measures of Dispersion – Variance and Standard deviation and standard error

Test of Hypothesis – Student's 't' Test, Chi square Test.

Probability – Definition and rules.

Distribution – Normal, Binomial and Poisson.

UNIT-IV **12hrs**

Biometrical Genetics:

An introduction to Correlation, Regression and ANOVA (Analysis of Variance).Genetic analysis of quantitative trait: - Ear length in Corn. Variances in polygenic traits: - Phenotypic, genotypic, environmental, additive, dominance and Epistatic variance; Genotype and environmental interaction. Heritability: - Broad sense and Narrow sense heritability, Quantitative trait loci (QTL). Problems related to Variance and Heritability.

References:

1. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.
2. Lexington Charles W. Fox. (2006). Evolutionary Genetics Concepts and Case Studies. Oxford University Press.
3. Glenn-Peter Sætre, Mark Ravinet. (2019). Evolutionary Genetics Concepts, Analysis, and Practice. Oxford University Press.
4. Brian K. Hall, Hall .(2010). Evolution Principles and Processes. Jones & Bartlett Learning.
5. Armando Caballero. (2020). Quantitative Genetics. Cambridge University Press.
6. Matthew B. Hamilton. (2011). Population Genetics. Wiley.

Course Code	Plant Biotechnology Lab	Course Type	L	T	P	C	CH
B25BT0602		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should have basic knowledge of botany, plant anatomy and histology

Course Objectives:

1. Introduce the basic techniques in plant tissue culture.
2. Familiarize the students with the techniques in plant regeneration.
3. Understand the significance of artificial seed production for propagation.

Course Outcomes:

After completing the course, the student shall be able to:

1. Acquire the knowledge about the techniques of Plant Tissue Culture, Lab organization
2. Formulate nutritional requirements of cultured tissues based on the nature of explant selected.
3. Explain the techniques of culturing tissues using various explants.
4. Apply the large-scale clonal propagation of plants through various micropropagation techniques.
5. Demonstrate the process of protoplast isolation for the preparation of somatic hybrids.
6. Prepare artificial seeds which could be a replacement for natural seeds.

Mapping of Course Outcomes with programme Outcomes

Course Cod	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0602	CO1	3	2	2	3	3	2	0	0	2	2	2	3	2	2
	CO2	3	2	2	3	3	2	0	0	2	2	2	3	2	2
	CO3	3	2	2	3	3	2	0	0	2	2	2	3	2	2
	CO4	3	2	2	3	3	2	0	0	2	2	2	2	2	3
	CO5	3	2	2	3	3	2	0	0	2	2	2	2	2	3
	CO6	3	2	3	3	3	2	0	0	2	2	2	2	2	3

Course Contents:

1. Preparation of tissue culture media: Murashige and Skoog's Medium
2. Preparation of tissue culture media: Nitsch Medium

3. Single node culture for micropropagation
4. Shoot tip culture for micropropagation
5. Callus culture and initiation of suspension culture
6. *Invitro* propagation through Embryo culture.
7. Isolation of Protoplast from various sources and PEG mediated fusion
8. Preparation of synthetic seeds

Reference Books:

1. Christou P and Klee H. (2004). Handbook of Plant Biotechnology. John Wiley and Sons.
2. Dixon RA. (2003). Plant Cell Culture. IRL Press.
3. George EF, Hall MA and De Klerk GJ. (2008). Plant Propagation by Tissue Culture. Agritech Publ.
4. Gamborg O.L. and Philips G.C. (1998) Plant cell, tissue and organ culture (2nd Ed.) Narosa

Publishing House. New Delhi.

5. Hammond J, P McGravey and Yusibov.V (2000). Plant Biotechnology, Springer verlag.
6. Kirakosyan A and Kaufman P.B. (2009) Recent Advances in Plant Biotechnology
7. Razdan. M.K. (2003). An introduction to Plant Tissue Culture. Oxford and IBH Publishing

Course Code	Laboratory Course –VI (Biochemistry)	Course Type	L	T	P	C	CH
B25BC0602		DSC	0	0	2	2	3

Prerequisites:

Requires knowledge of clinical biochemistry

Course Objective:

1. To analyzing the chemical and biochemical components of bodily fluids like blood and urine.
2. To diagnose, monitor, and manage diseases.
3. To identify abnormalities in blood and urine
4. To assess disease progression, and guide treatment decisions.

Course outcomes:

After completing the course, the student shall be able to:

1. Proficiency in laboratory techniques, understanding metabolic pathways and disorders.
2. The ability to interpret diagnostic results.
3. The course also emphasizes the importance of research.

4. Emphasizes the evidence-based practice, and ethical considerations in scientific work.
5. Biochemical basis of diseases, including the role of biomarkers.
6. Metabolic abnormalities in various clinical conditions.

Mapping of Course Outcomes with programme Outcomes

Course Cod	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC06 02	CO1	3	2	1	3	2	3	1	0	2	2	2	3	2	2
	CO2	3	1	2	2	1	3	1	0	2	2	2	2	2	1
	CO3	3	1	2	2	2	3	1	1	2	1	1	2	2	1
	CO4	3	2	1	2	2	3	1	1	1	1	1	2	2	2
	CO5	3	2	2	2	1	3	1	1	2	2	2	2	2	1
	CO6	3	2	2	2	1	3	1	1	2	2	2	3	2	0

Course Contents:

1. Estimation of serum creatine and creatinine by Jaffe's method.
2. Estimation of blood urea by DAM method.
3. Determination of activity of SGOT.
4. Determination of activity of SGPT.
5. Determination of titrable acidity of urine.
6. Determination of A/G ratio in serum by biuret method.
7. Qualitative analysis of abnormal constituents of urine.
8. Estimation of serum Uric acid by Caraway method

Reference Books:

1. Textbook of Clinical Chemistry Teitz
2. Practical Clinical Biochemistry Harold Varley CBS, 6thed. New Delhi
3. An Introduction to practical Biochemistry—PlummerD.T, Tata Mc Graw Hill
4. Lab manual of Biochemistry, Immunology and BioTechnology, Artinigam and Archana Ayyagiri Tata McGraw Hill.
5. Metabolomics: A Powerful Tool in Systems Biology by Jens Nielsen and Michael C. Jewett
6. Metabolomics: Methods and Protocols by Wolfram Weckwerth

Course Code	Evolutionary and Biometrical Genetics lab	Course Type	L	T	P	C	CH
B25GN0602		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

1. Students should have the knowledge of evolution.
2. Students should be aware of the basic mathematical concepts.

Course Objectives:

1. To study various inheritance involving quantitative traits.
2. To compute the statistical analysis for biological data.
3. To calculate the allelic and genotype frequencies with different inheritance data.

Course outcomes:

After completing the course, the student shall be able to:

1. Analyze patterns and principles of quantitative inheritance.
2. Solve genetic problems related to polygenic variance, heritability, and perform ANOVA in a randomized block design (RBD) for evaluating crop data.
3. Apply biometrical methods to compute statistical parameters.
4. Conduct and interpret Student's t-test and Chi-square test to analyze experimental data, including mutation induction in Drosophila melanogaster.
5. Investigate gene and genotype frequencies using Hardy-Weinberg equilibrium through PTC tasting, marble experiments, and allele frequency calculations.
6. Examine the genetic basis of human traits such and evaluate environmental influences using twin studies

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0602	CO1	3	3	2	2	2	1	2	1	1	2	2	3	3	2
	CO2	3	2	2	3	1	1	2	2	1	2	2	3	2	2
	CO3	3	3	3	3	1	1	2	2	2	2	2	3	3	3
	CO4	3	3	3	3	1	1	2	2	2	2	2	3	3	2
	CO5	3	3	3	3	2	1	2	2	2	2	2	3	3	2
	CO6	3	3	3	3	2	1	2	2	2	2	2	3	3	2

Course contents:

1. Study of Quantitative inheritance in Kernel color in Wheat/Skin color in man.
2. Genetic problems on polygenic variance, Heritability and ANOVA in RBD model in the allotted crop
3. Biometrical Computation of:
    a. Mean, Median and Mode
    b. Variance, Standard Deviation in any three experiments performed in the lab
4. Problems on: Student's 't' test and Chi square test in induction of mutation in Drosophila melanogaster

5. Hardy Weinberg Genetic equilibrium: Study of gene & genotype frequencies. (PTC Tasters & non tasters)
6. Blood group typing using hemagglutination tests and calculation of allele frequencies.
7. To test for color blindness using Ishihara charts and calculation of allele frequencies
8. Study of frequency of twins in the local population. Study of environmental effect and expression of genes

References:

1. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.
2. Lexington Charles W. Fox. (2006). Evolutionary Genetics Concepts and Case Studies. Oxford University Press.
3. Glenn-Peter Sætre, Mark Ravinet. (2019). Evolutionary Genetics Concepts, Analysis, and Practice. Oxford University Press.
4. Brian K. Hall, Hall .(2010). Evolution Principles and Processes. Jones & Bartlett Learning.
5. Armando Caballero. (2020). Quantitative Genetics. Cambridge University Press.
6. Matthew B. Hamilton. (2011). Population Genetics. Wiley.

Course Code	Python Programming	Course Type	L	T	P	C	CH
B25AS0601		IDC	2	0	0	2	2

Prerequisites/Pre reading for the course:

1. The student should be familiar with the basics of bioinformatics
2. The student should be familiar with the basics of computer science

Course Objectives

1. Introducing basic syntax, data types, variables, and operators in Python.
2. Teaching how to use control structures such as loops (for, while) and conditional statements
3. Understanding how to define functions, work with parameters and return values, and organize code into modules for reusability.
4. Understanding how to use regular expressions for pattern matching within strings.

Course Outcomes

After completion of the course, the student will be able to

1. Write Python programs that demonstrate understanding of syntax, variables, data types, and basic operation
2. Apply Python programming concepts to solve a variety of computational problems, both small-scale and larger projects.

3. Write modular and reusable code by defining functions and organizing code into modules and packages
4. Create graphical user interfaces using libraries.
5. Understand and apply the OOP principles (classes, objects, inheritance, polymorphism, encapsulation) to create robust and maintainable code.
6. Apply the knowledge of python program for biological data analysis

Mapping of course outcomes and program outcomes

Course Cod	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS 0601	CO1	3	3	2	2	2	1	2	1	1	2	2	3	3	2
	CO2	3	2	2	3	1	1	2	2	1	2	3	3	2	2
	CO3	3	3	3	3	1	1	2	2	2	2	2	3	3	3
	CO4	3	3	3	3	1	1	2	2	2	2	3	3	3	2
	CO5	3	3	3	3	2	1	2	2	2	2	2	3	3	2
	CO6	3	3	3	3	2	1	2	2	2	2	3	3	3	2

Course content

UNIT I: 12Hr

Overview and History: Introduction to Python, Why Python? Benefits and applications, Brief history of Python, Getting Started: Basic Concepts: Expressions and values, Variables and data types, Keywords and identifiers.

UNIT II: 12Hr

Basic operators (arithmetic, relational, logical), Control Structures: Conditional statements (if, elif, else), Looping structures (for, while), Control statements (break, continue, pass), Data Structures: Arrays and their operations, Object-Oriented Programming (OOP): Introduction to OOP concepts

Unit-III 12 Hr

Defining and calling functions, Function arguments and return values, Default arguments, importing modules, Creating and using custom modules, Built-in modules and the standard library

Unit-IV 12Hr

NumPy for numerical computations, Pandas for data manipulation and analysis, Matplotlib for data visualization, reading from and writing to files, File modes (read, write, append, binary), Working with file objects

Reference Books

1. Jalolov, Tursunbek Sadriddinovich. "TEACHING THE BASICS OF PYTHON PROGRAMMING." *International Multidisciplinary Journal for Research & Development* 10, no. 11 (2023).
2. Python, Why. "Python." *Python releases for windows* 24 (2021).

3. Hill, C., 2020. *Learning scientific programming with Python*. Cambridge University Press.

Course Code	Soft skill training-1	Course Type	L	T	P	C	CH
B25PT0601		SEC	1	0	0	1	2

Course Objective: To carry out the academic training towards enhancing co-curricular knowledge

Course Outcomes

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

1. Understand the basic communication skills.
2. Upgrade their knowledge about the career development.
3. Implement the subject specific practical knowledge into career development.
4. Correlate the theoretical and practical understanding.
5. Develop critical thinking skills necessary to evaluate information, make decisions, and innovate within the field.
6. Analyze problems within the scope of the course and apply appropriate solutions.

Course Cod	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25A S0601	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

Course Code	Internship/Project	Course Type	L	T	P	C	CH
B25AS0604		DSE	0	0	3	3	4

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and

methodology.

6. Describe the statistical procedures in the interpretation of results.

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25AS0604	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. Honors in Biotechnology
Detailed Syllabus
Seventh Semester

Course Code	Applied Microbiology	Course Type	L	T	P	C	CH
B25BT0701		DSC	3	0	0	3	3

Prerequisites/Pre reading for the course:

1. The student should be familiar with the basics of biology
2. The student should be familiar with the basics of microbiology

Course Objectives

The objective of this Course is to:

1. To understand applied microbiology.
2. To explore microbial cultural techniques and its utilization.
3. To handle the microbial samples and their maintenance.
4. To exploit microbiology for the benefit of mankind.

Course Outcomes:

After the end of the Course students will be able to:

1. Comprehend the application of microbes in medical sector
2. Know the application of microbes in pharmaceutical sector
3. Understand the application of microbes in industrial sector
4. Recognize the application of microbes in agriculture sector
5. Implicate the interdisciplinary knowledge of microbiology to life science sector
6. Apply the knowledge of microbiology towards advancement of environment

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0701	CO1	1	3	1	2	0	0	0	0	1	1	2	1	1	1
	CO2	2	2	3	2	2	0	0	0	1	1	2	2	2	2
	CO3	3	2	2	2	2	2	1	0	0	0	2	2	2	2
	CO4	3	3	2	2	2	2	1	0	0	1	2	2	3	1
	CO5	2	1	2	2	3	2	2	0	1	1	2	2	1	1

	CO6	2	2	1	2	3	2	1	2	0	2	2	2	3	2

Course content

UNIT I: Medical Microbiology **12 hr**

Infection: definition, sources of infection, types of infections, methods of transmission of infections. General attributes and virulent factors of bacteria causing infections. Collection and transport of specimens for microbiological examination. Clinical diagnosis of sexually transmitted diseases, microbial infections and hospital acquired infections. Methods of disposal of hospital waste. Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by microbial pathogens.

UNIT II: **Pharmaceutical Microbiology** **12 hr**

Introduction – Overview of products, classification of pharmacologic agents based on chemistry and source. Phytopharmaceuticals: screening tests for phytoconstituents – alkaloids and terpenoids. Drug development: Biology guided fractionation methods: in vitro assay systems based on enzymes, tissue, and organ or growth inhibition. Animal models: transgenic animals, cell lines. Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activities). Gene therapy: general introduction, ex vivo and in vivo gene therapy, potential targets for gene therapy, inherited disorders. Vaccine design, types and production.

Unit III: **Industrial Microbiology** **12 Hrs**

General concepts of industrial microbiology, principles of exploitation of microorganisms of their products, screening, strain development, immobilization methods, fermentation media, raw materials used in media production, antifoaming agents, industrial sterilization. Fermentation equipment and its uses, types of fermentation – single, batch, continuous, multiple, surface, submerged, and solid-state fermentation. Industrial products derived from microbes: Vitamins – riboflavin, cyanocobalamin. Vaccines: genetic recombinant vaccines. Organic acids: citric acid, acetic acid. Production of alcoholic beverages: beer and wine, biofuels: ethanol, methane, biogas. Disposal of industrial waste.

Unit IV: **Soil and Agricultural Microbiology** **12 hrs**

Introduction to soil microorganisms – bacteria (cyanobacteria and actinobacteria), algae, fungi, protozoans, nematodes and viruses – Role of microbes in soil fertility. Microbial associations in phytosphere: rhizosphere – phyllosphere – spermosphere. Mycorrhiza – types and importance to agriculture – organic matter decomposition – humus formation. Biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur cycles; nitrogen fixers – root nodule formation – nitrogenase, hydrogenase – biochemistry of nitrogen fixation. Biofertilizers – definition, importance – types and their application methods. Plant growth promoting rhizobacteria – Biological control of phytopathogens

Reference Books

1. Gadd, G.M. and Sariaslani, S., 2024. *Advances in applied microbiology*. Elsevier.
2. Doyle, M.P., Diez-Gonzalez, F. and Hill, C. eds., 2020. *Food microbiology: fundamentals and frontiers*. John Wiley & Sons.
3. Nagoba, B.S. and Pichare, A., 2020. *Medical Microbiology and Parasitology PMFU 4th Edition-E-book*. Elsevier Health Sciences.
4. Ogodo, A.C., Narayana, M.S.V., Vardhan, P.S., Gupta, R.K., Gautam, A.K., Egbuna, C., Kushwaha, P.P., Singh, A.K. and Kumar, S., 2021. Principles of applied microbiology and biotechnology: Technique for the screening of antimicrobial herbs. In *Preparation of Phytopharmaceuticals for the Management of Disorders* (pp. 185-214). Academic Press.

Course Code	**Bioprocess Engineering**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0702		DSC	3	0	0	3	3

Prerequisites/Pre reading for the course:

Students should have basic knowledge of microbiology, biochemistry and instrumentation.

Course Objectives:

The overall objectives of the course are:

1. Acquire the skills employed in upstream and downstream processes in fermentation technology.
2. Integrate the research perspectives in the field of bioprocess engineering with the industrial requirements.
3. Optimize the fermentation techniques and formulate the downstream products for maximum productivity.
4. Construct a business plan for industrial important product obtained through fermentation.

Course Outcomes:

After completing the course, the student should be able to

1. Describe the microbial growth and cultivation with respect to modes of fermentation and comprehend the role of biotechnology in improving microbial cells as factories.

2. Choose the ideal bioreactor models according to the final product, the microbial strain and market requirement employed in the process.
3. Optimise a suitable scheme of bioproduct separation and purification based upon the molecular characteristics of the product and other process criteria.
4. Apply the knowledge of fermentation process in the production of value added commercial products.
5. Formulate and optimise media composition for the upstream process of fermentation.
6. Comprehend the unit operations in downstream processing based on the specific requirements.

Mapping of Course Outcomes with program Outcomes

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
M23BT0702	CO1	1	2	1	0	1	2	0	3	1	0	2	2	1	0
	CO2	3	2	0	3	2	0	0	0	2	1	2	2	1	0
	CO3	3	3	3	3	3	3	2	0	2	1	2	3	2	1
	CO4	3	2	2	3	3	2	2	2	2	3	2	3	2	2
	CO5	2	2	3	2	3	2	2	2	2	2	2	3	3	1
	CO6	3	2	3	0	0	0	1	2	2	0	2	2	1	0

Course Content:

UNIT I **12 hrs**

Introduction to Bioprocess Engineering: Basic concepts of bioprocess engineering- A brief survey of organisms, processes, products. Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Industrial strain improvement for better productivity; Fermentation media and Fermentation Process: Natural and synthetic media; Sterilization- Dry and moist heat; Types of fermentation process- submerged, surface and solid state; Modes of cultivation- batch, fed-batch and continuous fermentation; Kinetics of fermentation, bioprocess control, monitoring of variables-Dissolved oxygen (DO), temperature, agitation, pH and pressure.

UNIT II **12 hrs**

Bioreactors: Architecture of advanced bioreactors and their working mechanisms; Design features; Heat and Mass transfer; Specialised bioreactors- design and their functions;

Bioreactors- Airlift Bioreactor and its applications, Tubular, Membrane bioreactor-features and applications, Tower bioreactor-features and applications, Fluidized-bed and Packed-bed bioreactor-features and applications; photo bioreactors and disposable reactors bioreactor-features and applications.

UNIT III **12 hrs**

Downstream processing: Overview of unit operations and their principles; Physical and rheological characteristics of fermentation broths; Pre-treatment-Cell disruption, heating and chemical treatment; solid-liquid separation- filtration and centrifugation; Product isolation-Adsorption, precipitation and extraction; Purification- Chromatography- Size exclusion, affinity and ion-exchange and HPLC; Finishing operations – Freeze drying and crystallization. Scale up of production.

UNIT IV **12 hrs**

Production of value-added products: Bio preservatives, Biopolymers, Industrial Enzymes, Bio fuels, Cheese, Beer and Single Cell Protein. Production of recombinant proteins having therapeutic and diagnostic applications, and vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture. By-product utilisation in various industries through bioprocess engineering tools.

Reference Books:

1. Satyanarayana, U (2005). "Biotechnology" Books and Allied (P) Ltd..
2. Kumar, H.D (1998). "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd.
3. Balasubramanian, D. etal (2004.). "Concepts in Biotechnology" Universities Press Pvt. Ltd.,
4. Dubey, R.C (2006). "A Textbook of Biotechnology" S. Chand and Co. Ltd.
5. Shuler and Kargi (1992). "Bioprocess Engineering ", Prentice Hall.
6. Peter F. Stanbury, Stephen J. Hall and A. Whitaker (2016), Principles of Fermentation Technology, third edition, Science and Technology Books.

10.Brod. H.Vester A, Kauling J (2012). Opportunities and limitations of disposable technologies in biopharmaceutical processes.ChemIng Tech 84(5):633-645

Course Code	Medical Biotechnology	Course Type	L	T	P	C	CH
B25BT0703		DSC	3	0	0	3	3

Prerequisites/Pre reading for the course:

1. Basic knowledge about bacterial and viral infection, antigen-antibody reaction.
2. Knowledge about developmental biology and concept of stem cells and recombinant DNA technology.
3. Basic knowledge of metabolism is a prerequisite.

Course Objectives:

The overall objectives of the course are:

1. Explore the fascinating field of immunology, organization and function of the immune system.
2. Provide deeper insight into production of diverse immune globulins from a single gene complex.
3. Understand the mechanism of the reaction of antibodies against antigens and also the advance concept of recombinant therapeutic products.

Course Outcomes:

After completing the course, the student should be able to

1. Understand the basic and advanced medical related issues in the society exploring the world of immunology and its relevant interactions.
2. Explore the recent research advancement in the medicinal research areas, including immunodiagnostics.
3. Develop skills in understanding disease biology and specific markers leading to the knowledge of disease diagnosis and management.
4. Exploit the knowledge in the development of therapeutic strategies for the treatment of genetic and acquired diseases.
5. Apply the knowledge of nanotechnology towards disease diagnosis
6. Understand recent advancement in molecular therapeutics

Mapping of Course Outcomes with program Outcomes

Course Code	POS COS	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PS0 1	PS0 2	PS0 3
M23BT0703	CO 1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO 2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO 3	3	2	0	2	3	3	3	1	2	2	2	3	1	1
	CO 4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO 5	3	2	0	2	1	0	1	0	2	1	2	3	2	0
	CO 6	2	0	0	2	3	2	0	0	1	0	2	2	2	0

Course Details

Unit I **12 hrs**

Fundamentals of Medical Biotechnology: Evaluation of organ functions: liver, kidney, cardiac and gastric function tests. Significance of biochemical markers, Human Diseases – Symptoms and Treatment: Tumors, Types, pre-disposing factors, cellular changes involved in tumor formation, genes associated with cancer (oncogenes, tumor suppressive genes etc.), tumor detection methods, tumor markers.

Unit II **12 Hrs**

Nanotechnology and molecular therapeutics: Liposome- and nanoparticle-mediated gene delivery. Nanobiotechnology: introduction, types and synthesis of nanomaterials, protein- and DNA-based nano structures, Applications of nanomaterials as therapeutics, nanobiosensors, drug and gene delivery, disease diagnostics and therapy, risk potential of nanomaterials.

Unit III **12 Hrs**

Regenerative medicine and tissue engineering: Definition and scope of regenerative medicine, Stem cells and regenerative medicine: Types of stem cells (embryonic, adult, induced pluripotent), stem cell niches and microenvironments, Biomaterials in regenerative medicine, Advances in invitro models for regenerative medicine: Organoids, Organ-on-a-Chip, Bioprinted Tissue Constructs, Humanized and Patient-Derived Models, High-Throughput Screening Platforms.

Unit IV **12 Hrs**

Precision Medicine and Personalized Healthcare: Definition and principles of precision medicine, Genomics in Precision Medicine: Basics of genomics and genetic variation, Genome-wide association studies (GWAS), Pharmacogenomics and genetic predispositions to disease, Types of biomarkers in personalized health care (genetic, proteomic, metabolomic), Challenges and opportunities in personalized drug development

Reference Books

1. Ian Tizard R. (2013). Immunology, 9th edition, Elsevier publisher.
2. Abbas & Lichtman & Pillai (2014). Cellular and Molecular immunology,8^{th} edition, Elsevier publisher
3. Bernhard Palsson and Sangeeta N Bhatia (2004)., Tissue Engineering, 2nd Edition, Prentice Hall,
4. Pamela Greenwell, Michelle McCulley (2008). Molecular Therapeutics: 21st century medicine, 1st Edition, Springer,
5. Andrew Read and Dian Donnai (2007). New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK,.
6. George Patrinos and Wilhelm Ansorage (2005). Molecular Diagnostics, 1st Edition, Academic Press,
7. Lela Buchingham and Maribeth L Flawsm (2007), Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition, F A Davis Company, Philadelphia, USA.

Course Code	**Applied Microbiology Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0704		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should have basic knowledge of microscopy & microbiology

Course Objectives:

The objective of this Course is to:

1. To understand the working conditions in microbiology lab.
2. To explore microbial cultural techniques.
3. To handle the microbial samples and their maintenance.
4. To exploit microbiology for the benefit of mankind.

Course Outcomes:

After the end of the Course students will be able to:

1. Handle the microscopes and observe the live and fixed specimens.
2. Understand the various forms of microbial culturing techniques
3. Culture and maintain the microbial strains in laboratory.
4. Familiarize the characterization of isolated microbial strains.

5. Apply the knowledge of microbiology towards sustainable environment
6. Apply the knowledge of microbiology towards life science research

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0704	CO1	3	2	3	3	3	2	3	2	2	3	2	3	2	3
	CO2	3	0	2	2	2	0	0	3	2	0	2	3	1	2
	CO3	3	3	3	3	3	3	2	3	3	3	2	2	3	3
	CO4	1	1	0	0	2	1	0	0	2	0	2	3	2	1
	CO5	3	2	3	3	2	0	0	1	2	3	2	3	2	3
	CO6	3	2	3	2	1	0	2	2	2	1	2	3	1	0

Course Contents:

1. Isolation of bacterial and Fungal cells from food samples.
2. Isolation of bacterial and Fungal cells from soil samples.
3. Morphological characterization of microbial isolates – Bacteria
4. Morphological characterization of microbial isolates –Fungi
5. Biochemical characterization methods- IMViC Test
6. Estimation of Growth curve of microbial cell
7. Determination of minimum inhibitory concentration
8. Isolation of microbial metabolites and its study
9. Study of bioremediation of xenobiotics using microbial isolates.

Reference Books:

1. Samuel Singer, Experiments in Applied Microbiology. Academic Press, 2001.
2. Collins, C.H., Tatrica M. Lyne and Grange, J.M, Microbiological methods, 8th edition, Hodder Arnold publishers, 2004.
3. Alexander N. Glazer, Hiroshi Nikaido, Microbial Biotechnology, 2nd Edition, Freeman Publishers. 2007.
4. Keith Wilson and John walker, Principles and techniques of Biochemistry and Molecular biology, 7th edition. 2009

Course Code	**Bioprocess Engineering Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0705		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

Students should have basic knowledge of microbiology, biochemistry and working principles of analytical instruments.

Course Objectives:

The overall objectives of the course are:

1. Educate the student how to perform and use the chromatographic techniques for identification and separation of compounds.
2. Gain knowledge about the enzyme kinetics practically.
3. Get hands on with respect to various types of fermentation techniques.
4. Acquire the practical skills in enzyme essays and antibiotic production and purification.

Course Outcomes:

After completing the course, the student should be able:

1. Apply their knowledge of fermentation in developing fermented products such as wine.
2. Demonstrate the importance of immobilisation of enzyme for better applications in industry.
3. Apply the knowledge of fermentation for the pilot scale production.
4. Understand the purification process of industrially important fermentation products such as antibiotics.
5. Formulate media for solid and submerged fermentation techniques.
6. Estimate the extend of fermentation based on lactic acid in the dairy products.

Mapping of Course Outcomes with programme Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0705	CO1	3	2	3	3	3	2	3	2	2	3	2	3	2	3
	CO2	3	0	2	2	2	0	0	3	2	0	2	3	1	2
	CO3	3	3	3	3	3	3	2	3	3	3	2	2	3	3
	CO4	1	1	0	0	2	1	0	0	2	0	2	3	2	1
	CO5	3	2	3	3	2	0	0	1	2	3	2	3	2	3
	CO6	3	2	3	2	1	0	2	2	2	1	2	3	1	0

Course content

1. Estimation of bacterial growth based on biomass and optical density.
2. Estimation of lactic acid in dairy products
3. Production and estimation of alpha amylase by solid-state fermentation

4. Production of wine and estimation of alcohol content by specific gravity method
5. Production of penicillin and antimicrobial assay
6. Immobilisation of yeast cells
7. Estimation of Vitamin A &B from microbial source.
8. Estimation of amino acids from microbial sources.

Reference Books

1) Robert A. Copeland, by Wiley-VCH Inc. (2000).Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis
2) Luo, Y., Kurian, V. and Ogunnaike, B.A., 2021. Bioprocess systems analysis, modeling, estimation, and control. *Current Opinion in Chemical Engineering*, *33*, p.100705.
3) Bhatt, A.K., Bhatia, R.K. and Bhalla, T.C. eds., 2023. *Basic Biotechniques for Bioprocess and Bioentrepreneurship*. Academic Press.
4) Balakrishnan, R., Mohan, N. and Sivaprakasam, S., 2022. Application of design of experiments in bioprocessing: process analysis, optimization, and reliability. In *Current Developments in Biotechnology and Bioengineering* (pp. 289-319). Elsevier.

Course Code	**Medical biotechnology Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0706		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

- Basic knowledge about bacterial and viral infection, antigen-antibody reaction.
- Knowledge about developmental biology and concept of stem cells and recombinant DNA technology.
- Basic knowledge of metabolism is a prerequisite.

Course Objectives:

The overall objectives of the course are:

- Explore the fascinating field of immunology, organization and function of the immune system.
- Provide deeper insight into production of diverse immune globulins from a single gene complex.
- Understand the mechanism of the reaction of antibodies against antigens and also the advance concept of recombinant therapeutic products.

Course Outcomes:

After completing the course, the student should be able to

1. Understand the basic and advanced medical related issues in the society, by exploring the world of immunology
2. Explore the recent research advancement in the medicinal research areas,
3. Develop skills in understanding disease biology and specific markers leading to the knowledge of disease diagnosis and management.
4. Exploit the knowledge in the development of therapeutic strategies for the treatment of genetic and acquired diseases.
5. Understand recent advancement in molecular therapeutics
6. Conceptualize the basics of medical biotechnology towards disease diagnosis.

Mapping of Course Outcomes with program Outcomes

Course code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0706	CO1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO3	3	2	0	2	3	3	3	1	2	2	2	3	1	1
	CO4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO5	2	0	0	2	3	2	0	0	1	0	2	2	2	0
	CO6	3	2	0	2	2	3	0	0	1	1	2	3	2	1

Course Details

1. Purification of IgG by column chromatography
2. Enzyme linked immunosorbent assay
3. Estimation of protein using serum samples
4. Estimation of Cholesterol by Zak's Method
5. Estimation of Blood Urea by diacetyl monoxime method
6. Estimation of Creatinine from urine samples
7. Analysis of acid phosphatase from serum samples
8. Analysis of alkaline phosphatase from serum samples

Reference Book

1. Bertram G. Katzung (2004) Basic and Clinical Pharmacology, 9th Edition, Mc GrawHill Publications
2. Devlin TM (2002), Textbook of biochemistry with Clinical Correlations 5th edition
3. Richard B Silverman (2014), Organic Chemistry of Drug design and Drug action Elsevier Science, Academic Press

4. Warren Levinson, Ernest Jawetz (2003), Medical Microbiology and Immunology: Examination and Board Review 7th edn. McGraw Hill Publications

Course code	**Aquatic Biotechnology**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BTS711		**DSE**	**3**	**0**	**0**	**3**	**3**

Prerequisite for the course:

- The student should have the basic knowledge of aquatic and marine biology
- The student should have the basic knowledge of different geomorphic formations of water bodies.

Course objectives:

1. To acquire fundamental knowledge about the properties of freshwater and seawater, the elixir of life
2. To understand ability to insight to aquatic flora and fauna.
3. Critically evaluate the pollution, its sources and eco-restoration of aquatic systems.
4. To explore the applications of aquatic biology

Course outcomes:

After the end of the Course students will be able to:

1. To develop skill to identify plankton and measure productivity.
2. Understand the application of phytoplankton in aquaculture sectors and aquatic resource management
3. Extract material from plankton has importance in commercial sector
4. Describe methods for selection and optimization of industrial enzymes using genetic and biochemical techniques from marine materials
5. Compare and contrast the historical uses of marine enzyme technology with current applications in a diverse range of industries
6. Implement the knowledge of marine biotechnology towards drug development.

Course code	Cos/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BTS711	CO1	3	2	3	3	3	2	0	0	2	3	2	2	2	2
	CO2	2	2	3	3	3	2	0	0	2	3	2	3	2	2
	CO3	3	2	3	3	3	2	0	0	2	3	2	2	2	2
	CO4	3	2	2	3	3	2	0	0	2	3	2	3	2	2
	CO5	3	2	2	3	3	2	0	0	2	3	2	3	2	3

	3	2	2	3	3	3	0	0	2	3	3	2	3	2	2

Syllabus:

UNIT I: Introduction to Aquatic biology **12 Hrs**

Aquatic Biology: Classification of organisms - Freshwater and Marine forms. Plankton (Phyto and Zooplankton), freshwater plants, seagrasses and weeds, nekton, neuston, periphyton and benthos. Organism classification based on zones – Littoral/riparian, limnetic and profoundal. Classification based on nutrition: Autotrophs, heterotrophs and saprotrophs.

UNIT II: Introduction to marine biology **12 hrs**

Introduction to Marine Biology, Oceanography, Estuarine Biology and Limnology. Water and water cycle. Significance and History of Marine Biology and Limnology. Human cultural relations with water. Ecosystem concepts and services of aquatic bodies. Properties of water – water as a solvent and temperature stabilizer. Physical and chemical properties of water and seawater.

UNIT III: Marine Pollution **12 hrs**

Major Pollutants- Sewage, heavy metals, radioactive compounds, petroleum hydrocarbons, industrial effluents; eutrophication; Fate of pollutants in the seas; impact of pollutants on marine life - plankton, nekton, benthos, coral, aquatic plants, marine birds and mammals; laws pertaining to protection of marine environment from impairments. Marine aerosols affecting human health, pharmaceutical effluents-fish health, fish endocrine

UNIT IV: Biosynthesis of marine natural products **12 hrs**

Methods for studying biosynthesis, isotope feeding, gene cluster identification, biochemical characterization; biosynthetic pathways – Polyketide synthase, hybrid pathways, Mevalonate pathway, hydrocarbon synthesis, polyether toxin biosynthesis. **Marine drugs:** Discovery and development cycle of drugs - toxicity evaluation, animal experiments, clinical trials protocols, ethical considerations; Marine derived drugs in preclinical and clinical trial- their source, nature, mode of action and targeted diseases.

Reference Books:

1. Branson, E.J. (2008). Fish welfare. Pub. Blackwell Publication, Oxford

2.. John Morrissey. (2010). Introduction of the marine life biology. Jones and Barilitte learning publisher.

3. A. K. Saxena & V. L. Saxena. (2012) Aquatic biology and Fisheries sciences. Apple books, New york, USA.

4. Kim Se-Kwon. (2019). Essentials of marine biotechnology. Springer Nature publishers, USA
5. Kim Berg (2024). Marine biotechnology. Discovery publishing house, UK.
6. Hopkins S (2022). Aquaculture and biotechnology. Kaufman Press, UK
7. DR. Khanna. (2010). Text book of blue biotechnology. Discovery publishing house, UK.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B25BTS712	**ANIMAL BIOTECHNOLOGY**	**DSE**	**3**	**0**	**0**	**3**	**3**

Prerequisites/Pre reading for the course:

Basic knowledge of Biotechnology and concepts of cloning is essential.

Course Objectives:

The overall objectives of the course are:

1. Explore the applications of concepts in animal biotechnology in various fields.
2. Provide perspective on the recent advances in the field of animal biotechnology.
3. Understand the pros and cons of applications of animal biotechnology in society.
4. Familiarize the concept and techniques of transgenic animals.

Course Outcomes:

After completing the course, the student should be able to:

1. Explain the fundamental techniques and scientific principles followed for animal cell culture.
2. Acquire knowledge of isolation, maintenance, growth of cell culture.
3. Acquire the knowledge of animal cloning, and applications in industry.
4. Understand the techniques and applications of transgenic plants in the field of medicine.
5. Acquire knowledge of stem cell biology.
6. Implicate the knowledge of transgenics in life science research

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS712	CO 1	2	2	0	1	2	3	1	1	1	0	2	2	2	2
	CO 2	3	2	1	3	3	2	2	1	1	3	2	2	3	1
	CO 3	3	2	0	2	3	3	3	1	2	2	2	3	1	1

	CO 4	3	2	1	1	2	2	0	0	1	1	2	3	2	0
	CO 5	2	0	0	2	3	2	0	0	1	0	2	2	2	0
	CO 6	3	2	0	2	2	3	0	0	1	1	2	3	2	1

Course Content:

Unit I **12 Hrs**

Animal Physiology

General physiology introduction: Cardiovascular Physiology-Electrical activity of the heart- ionic basis of action potential, conduction of action potential, cardiac hypertrophy, myocardial necrosis and myocarditis. Respiratory Physiology-Principles of respiratory mechanisms and regulations: Elastic forces, lung volumes, Pressure/volume relationship. Physical principles of gas flow and resistance; Lung function tests. Renal Physiology: Glomerular Filtration, Determination. Renal blood flow and its peculiarities. Introduction to Animal Cell Culture - Culture medium: natural media, synthetic media, sera. Physical, chemical and metabolic functions of different constituents of culture medium, role of carbon dioxide, serum and supplements.

Unit II **12 hrs**

Characteristics and maintenance of cell lines: Definition of cell culture; Primary cell culture, Secondary culture and cell line preparation; characteristics, maintenance and management of cell lines; cell adaptation. Measurement of viability and cytotoxicity. Cell cloning, cell synchronization and cell manipulation. Various methods of separation of cell types, advantages and limitations; flow cytometry.

Unit III **12 hrs**

Transgenic models and cell cloning – Cloning of Dolly; Transgenic animals –generation of Knockout mice, conditional gene knockout, knocking mice, generation of disease models in mice, transgenic ruminants' generation and their applications, transgenic silkworm generation. Baculo virus expression system and its applications; Rabies vaccine generation using transgenics.

Unit IV **12 hrs**

Commercial applications of cell culture - Mass production of biologically important compounds (e.g. Vaccines). Harvesting of products, purification, and assays. Three dimensional cultures and tissue engineering for skin, bone. Pharmaceuticals from animal systems for humanized pharmaceuticals - Animal system as bioreactors.; Cryopreservation. Stem cell biology - concept, methods and applications in medicine.

Reference Books:

1. John M. Walker (2007). Animal cell Biotechnology: Methods and protocols – Nigel Jenkins (Ed), Humana press, New Jersey.
2. Watson J.D.et al (2007). Molecular Biology of Gene (6^{th} Ed.) Publisher Benjamin Cummings.
3. Jan Freshnev. R (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6^{th} Ed.) Wiley and amp; Sons.
4. M.M. Ranga (2010). Animal biotechnology, Agrobios (India).

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS713	**AI Techniques in Biological Sciences**	**SEC**	**2**	**0**	**0**	**2**	**2**

Prerequisites: The student should know the basics of biology and computer science

Course Objectives

1. The course aims to understand the AI techniques used in Biological Sciences.
2. It introduced basic programming languages based on current industry applications.
3. It also helps to understand the existing AI tools used in various fields in Biological Sciences.
4. To understand AI techniques and integrate them in Biological Sciences.

Course Outcome

By the end of the course the student will be able to:

1. Students Can understand the AI based algorithm from a biological perspective.
2. Ability to perform basic programming related to AI techniques in Biology.
3. Analyze how AI can be implemented to better enhance the understanding of biological processes.
4. Evaluate existing AI tools and techniques to ensure they meet the requirements of biological research and processes.
5. Gain an understanding on the ethical aspects of AI in Biological Sciences
6. Ability to understand and apply basic AI algorithms in a research and industrial setting.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS713	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2

Unit-I: Introduction to AI and ML in Biology **12 Hrs**

Introduction to Machine Learning (ML) and Artificial Intelligence (AI), AI Basics: concepts, terminologies and workflow, Agents and Environments, Biological Intelligence Vs Artificial Intelligence Advantages and disadvantages, Neural Networks, Notations, Simple computing elements, network structures and applications, optimal network structures, comparing brains with digital computers.

Unit II: Applications of AI techniques in Biology **12 Hrs**

Applications of AI in Biological Sciences, AI-driven applications-drug discovery and development, Clinical research and Omics studies, understanding biological data and preprocessing, expression analysis using AI techniques, Data privacy and Ethical case studies of AI applications.

Reference Books

1. Shailza Singh, "Machine Learning and Systems Biology in Genomics and Health", Springer Singapore 2022.
2. Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan Mohanty, Xiaobo Zhang, "Data Analytics in Bioinformatics: A Machine Learning Perspective" Wiley Online Library, 2021.

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS714	**AI Literacy in Health care**	**SEC**	**2**	**0**	**0**	**2**	**2**

Course Objectives

1. Assess AI-based tools and datasets, exploring methods to guarantee they adhere to

medical standards.

2. Gain an understanding of the ethical challenges posed by AI in healthcare and ways to ensure minimizing biases in AI-driven decisions.
3. Gain an understanding of AI methodologies required for patient care.
4. Gain practical experience in identifying opportunities for AI applications to enhance patient care and research.

Course Outcome

By the end of the course the student will be able to:

1. Demonstrate the ability to understand the ethical challenges posed by AI in healthcare.
2. Demonstrate the ability to collaborate with AI scientists and healthcare professionals.
3. Analyse how AI can be implemented to better enhance healthcare initiatives.
4. Evaluate AI tools and techniques to ensure they meet medical standards.
5. Understand and apply basic AI algorithms in a healthcare setting.
6. Develop proficiency in utilizing existing AI tools for the management and analysis of patient data.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS714	CO 1	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1

Course content

Unit-I: Introduction to AI Principles 12 Hrs

Basics of machine learning, and artificial intelligence: Introduction Image processing, normalization techniques and interpretation of image data and applications, AI-driven decision support systems (ANN, KNN and SVM), Predictive modeling and patient monitoring using AI, AI applications in radiology and pathology for diagnostics, Role of AI in treatment planning and decision support.

Unit II: Challenges and Ethics in AI implementation 12 Hrs

Ethical case studies of AI applications, scenarios of data breaches in AI applications, challenges of integrating AI into healthcare systems, Ethical considerations surrounding AI in patient autonomy and data privacy, Bias identification within AI models, the role of AI in managing Electronic Health Records (EHRs), Cutting-edge applications of AI, augmented reality (AR) and virtual reality (VR) in medicine, impact of AI on genomics and global health initiatives.

Reference Books

1. Peter Lee, Carey Goldberg, Issac Kohane (2023). The AI Revolution in Medicine: GPT-4 and beyond, Pearson.
2. Hugh Cartwright (2008). Using Artificial Intelligence in Chemistry and Biology: A Practical Guide, CRC Press.

B.Sc. Honors in Biotechnology

Detailed Syllabus
Eighth Semester

Course code	Enzyme Technology	Course type	L	T	P	C	CH
B25BT0801		DSC	2	0	0	2	2

Prerequisite for the course:

- The student should have the basic knowledge of Enzyme properties and applications
- The student should have the basic knowledge of Physiology and pathophysiology of enzymes

Course objectives:

1. To acquire fundamental knowledge on enzymes and their importance in biological reactions.
2. To understand ability to difference between a chemical catalyst and biocatalyst.
3. Exposure to the nature of non-protein enzymes.

Course outcomes:

After the end of the Course students will be able to:

1. Explain the key structural and energetic factors which give rise to increased enzyme stability
2. Conceptulize the importance of enzymes for industrial application,
3. Summarize current processes involved in industrial enzyme production
4. Describe methods for selection of industrial enzymes using genetic and biochemical techniques.
5. Describe methods for optimisation of industrial enzymes using genetic and biochemical techniques.

6. Compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Mapping of course and program outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BT0801	CO1	3	2	3	1	1	3	0	2	2	0	2	3	2	2
	CO2	1	1	2	1	1	0	0	2	2	2	2	3	3	3
	CO3	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO4	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO5	2	3	3	2	1	0	0	2	2	2	2	3	3	3
	CO6	3	3	3	3	3	1	0	3	2	2	2	3	3	2

Syllabus:

UNIT I Introduction to Enzymology 6 Hrs

History of Enzymology; General characteristics of enzymes; advantages of enzymes over chemical catalysts, Nomenclature and classification of enzymes, Significance of Enzyme Commission number; Denaturation and renaturation; enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apo-enzyme, Isoenzymes, cofactor, coenzyme, prosthetic group; enzyme activity unit, turn over number and specific activity.

UNIT II: Regulation of Enzyme activities 6 hrs

Enzyme action; effect of enzyme on the rate and equilibrium of a reaction; principles that explain catalytic power and substrate specificity of enzymes; enzyme substrate complex (Lock & Key Model, Induced Fit Theory, Substrate Strain Theory), factors responsible for catalytic efficiency of enzyme; proximity and orientation effect, acid-base catalysis, covalent catalysis, strain and distortion theory; Nature of active site, identification of functional groups at active sites; regulatory enzymes- covalently modulated enzymes, allosteric enzymes and their mode of action; regulation of enzyme activity in the living system

UNIT III: Enzyme kinetics 6 hrs

An introduction to enzyme kinetics and its importance, Methods used for investigating the kinetics of enzyme catalysed reactions; factors that influence the velocity of enzyme catalysed reaction(effect of substrate concentration, enzyme concentration, pH, temperature, presence of activator/inhibitor etc.); Michaelis-Menten equation, Vmax, Km and its significance; enzyme inhibition, types of enzyme inhibitions- competitive, uncompetitive, non-competitive, mixed type inhibition and determination of Ki, Determination of Km and Vmax in the presence and absence of inhibitor; feed- back inhibition.

UNIT IV: Enzyme production **6 hrs**

Strategies used for enzyme production, isolation and purification at laboratory and industrial scale from plant, animal and microbial sources, method of calculating the purification fold; estimation of enzyme activity; characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight (MW) and the number of sub-units of an enzyme; enzyme immobilization and its importance; enzyme therapy, enzyme inhibitors and drug design; Applications of enzymes in medicine, textile, paper, dairy industry, beverage and fruit processing, food processing and preservation, clinical applications of enzyme estimation.

Reference Books:

1. Martin F. Chaplin, C. Bucke. (1990). Enzyme technology. Cambridge university press, UK
2. KHAN, FARHA. (2000). Principles of Enzyme technology. PHI Publications, UK
3. Karl-Erich Jaeger, Andreas Liese, Christoph Syldatk, Karl-Erich Jaeger, Andreas Liese, Christoph Syldatk. (2024). Introduction to Enzyme Technology. Springer Publications, USA
4. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche. (2010). Enzyme technology. Springer Publications, USA.
5. Ram Sarup Singh, Reeta Rani Singhania, Christian Larroche. (2019). Advances in Enzyme Technology. A volume in Biomass, Biofuels, Biochemicals. Springer Publications, USA

Course code	System	Course type	L	T	P	C	CH
B25BT0802	Biology	DSC	2	0	0	2	2

Prerequisite for the course:

- The student should have the basic knowledge of biology
- The student should have the basic knowledge of bioinformatics

Course objectives:

1. To acquire fundamental knowledge on importance in biological reactions.

2. To understand ability to understand the concept of genes through computational approach.

3. Exposure to the nature of biological pathways and its correlation to living system.

Course outcomes:

After the end of the Course students will be able to:

1. Construct computational models of biological systems
2. Analyse computational models of biological systems
3. Understand common mathematical approaches to study biological problems
4. Apply computational analyses to explore the behavior of biological systems
5. Summarize and critique papers from the literature describing systems biology approaches and analysis
6. Apply the concept of system biology in life science research.

Mapping of course and program outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BT0802	CO1	3	2	3	1	1	3	0	2	2	0	2	3	2	2
	CO2	1	1	2	1	1	0	0	2	2	2	2	3	3	3
	CO3	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO4	2	3	3	2	2	0	0	3	2	2	2	3	3	3
	CO5	2	3	3	2	1	0	0	2	2	2	2	3	3	3
	CO6	3	3	3	3	3	1	0	3	2	2	2	3	3	2

Syllabus:

Unit I: Introduction to Primary Databases 6 Hrs

Lectures Introduction to Primary Databases: Types of Biological data- Genomic DNA, cDNA, rDNA, ESTs, GSSs; Primary Databases -Nucleotide sequence databases- GenBank, EMBL, DDBJ, Protein Sequence Databases- UniProtKB, UniProt, TrEMBL, Swiss-Prot, UniProt Archive-UniParc, UniProt Reference Clusters-UniRef, UniProt Metagenomic and Environmental Sequences-UniMES. Literature Databases- PubMed, PLos, BioMed Central.

Unit II: File formats, sequence patterns and profiles: 6 Hrs

Sequence file formats – GenBank, FASTA, ALN/ClustalW2, PIR; Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations viz. consensus, regular expression (Prositetype) and sequence profiles; Sequence similarity-based search engines (BLAST and FASTA); Pattern based search using MeMe and PRATT); Motif-based search using ScanProsite and eMOTIF; Profile-based database searches using PSI- BLAST and HMMer.

Unit III: **Sequence Analysis and predictions** **6 Hrs**

Sequence Analysis and predictions: Nucleic acid sequence analysis- Reading frames; Codon Usage analysis; Translational and transcriptional signals, Splice site identification, Gene prediction methods and RNA fold analysis; Protein sequence analysis- Compositional analysis, Hydrophobicity profiles, Amphiphilicity detection, Moment analysis, Transmembrane prediction methods, Secondary structure prediction methods.

Unit IV: **Machine learning, systems biology** **6 Hrs**

Machine learning techniques: Artificial Neural Networks and Hidden Markov Models: Applications in Protein Secondary Structure Prediction and Gene Finding, Introduction to Systems Biology and its applications in whole cell modelling, Microarrays and Clustering techniques for microarray data analysis, informatics in Genomics and Proteomics, DNA computing.

Reference Books

1. Klipp, Edda, Wolfram Liebermeister, Christoph Wierling, and Axel Kowald. *Systems biology: a textbook*. John Wiley & Sons, 2016.
2. Palsson, B., 2015. *Systems biology*. Cambridge university press.
3. Alon, U., 2019. *An introduction to systems biology: design principles of biological circuits*. Chapman and Hall/CRC.
4. Voit, E., 2017. *A first course in systems biology*. Garland Science.

Course code	**Pharmacology and Toxicology**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0803		**DSC**	**2**	**0**	**0**	**2**	**2**

Prerequisites/Pre-reading for the course

Students should have knowledge on chemistry, biochemistry and basics of Biotechnology, which will help them to understand the adverse effects of chemical substances, diagnosis and treatment.

Course Objectives:

The overall objectives of the course are:

1. Build knowledge on pharmacology in living organism.

2. Focus on the pharmacokinetics of drug in living systems

3. Able to understand the toxicokinetic and other cellular responses due to toxic interaction to living system

3. Provide an opportunity to conduct research in an area of toxicology.

Course Outcomes:

After completing the course, the student should be able to:

1. Understand the basics of pharmacology of drugs within the living system
2. Understand the basics of pharmacokinetics of drugs within the living system.
3. Understand the basics of pharmacodynamics of drugs within the living system.
4. Understand the molecular mechanism of cell regulations based on various proteins, lipids and hormones that expose to the various chemical exposure and these bio molecules involved in the disease condition.
5. Analyse and interpret the toxic substances used for prolonged exposures based on acute, sub-Acute and chronic studies.
6. Analyse and interpret the toxic substances used for carcinogenicity and mutagenicity tests.

Mapping of Course Outcomes with program Outcomes

Course Code	**POS / COS**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PS01**	**PS02**	**PS03**
B25BT0803	CO1	3	3	1	3	3	1	1	2	1	1	2	3	0	2
	CO2	3	2	2	2	1	1	1	1	0	1	2	1	0	2
	CO3	2	1	2	2	1	1	1	0	1	1	2	1	0	1
	CO4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1
	CO5	2	2	1	3	2	0	1	0	1	1	2	2	0	1
	CO6	2	2	1	3	0	2	0	1	1	2	2	0	1	1

Course Contents

Unit I: – Introduction to Pharmacologic Principles 6hr

Consumer Safety and Drug Regulations, Drug Names and References- drug classification systems, drug names: generic name, official name, trade name, and chemical name, Sources and Bodily Effects of Drugs, Medication preparation and supplies- oral and rectal drug forms, injectable drug forms. Pathophysiology and pharmacotherapy of certain diseases. Drug safety and quality assurance.

Unit II: Pharmacokinetics **6Hr**

Pharmaceutical analytical techniques, Uptake and disposition of drugs in the body, ADME process-Absorption; Mechanisms of drug absorption, distribution of drugs, Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, non renal routes of drug excretion of drugs. Objectives of bioavailability.

Unit III: Molecular Mechanisms in Cell regulation **6 hrs**

Biosynthesis of Chemical Mediators such as mediators of inflammation and allergy, Histamine, Bradykinin, Eicosanoids: prostaglandins, thromboxanes, leukotrienesand related compounds, EDRF and vascular substances, oxygen free radicals, Cox- 1 and Cox-2 and their pathophysiological roles.

Unit IV: Toxicity studies **6 hrs**

Toxicokinetics, toxicodynamics, Toxicity studies-Acute, sub-acute, sub-chronic and chronic studies: Protocols, objectives, methods of execution and regulatory requirement, Carcinogenicity test, Mutagenicity test. Toxicokinetics and toxicodynamics.

Reference Books

1. Hodgson, E. (Ed.). (2011). *A textbook of modern toxicology*. John Wiley & Sons.
2. Timbrell, J., & Barile, F. A. (2023). *Introduction to toxicology*. CRC Press.
3. Gupta, P. K. (2016). *Fundamentals of toxicology: essential concepts and applications*. Academic Press.
4. Satoskar, R. S., & Bhandarkar, S. D. (2020). *Pharmacology and pharmacotherapeutics*. Elsevier India.
5. Finkel, R., Clark, M. A., & Cubeddu, L. X. (Eds.). (2009). *Pharmacology*. Lippincott Williams & Wilkins.

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./ Wk.**
B25BTS811	**NANOBIOTECHNOLOGY**	DSE	2	0	0	2	2

Prerequisites/Pre reading for the course:

Students should be familiar with the basic concepts of chemistry, spectroscopy techniques, microscopy techniques and chromatography techniques

Course Objectives:

The overall objectives of the course are:

1. Explore the students to the knowledge about the nanometric objects.
2. Train students in towards formulation and application of nanofabricated products.
3. Illustrate the creative knowledge of nanobiotechnology which will be helpful in research area
4. Understand the advantageous and harmful aspects of nanotechnology which can be helpful in society

Course Outcomes:

After completing the course, the student should be able to:

1. Explain the basic concepts in nanotechnology.
2. Illustration about various analytical instrumentation techniques for characterization of nanomaterials
3. Identify natural and manmade sources for nanoparticles.
4. Identify the routes of exposure of nanotoxicants to the human system,
5. Understand the effects and mechanism of action of nano toxicants on biological systems
6. Illustrate knowledge about the properties of engineered nanomaterial and its applications in life science sector.

Mapping of Course Outcomes with program Outcomes

Course Code	**POS/ CO S**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS811	CO 1	3	3	2	3	2	1	0	2	1	1	2	1	0	2
	CO 2	3	2	2	2	0	1	0	2	0	2	2	1	0	2
	CO 3	2	1	2	2	1	0	0	0	1	1	2	1	0	1
	CO 4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1
	CO 5	2	2	1	3	2	0	1	0	1	1	2	2	0	1
	CO 6	2	2	1	3	0	2	0	1	1	2	2	0	1	1

Course Content:

Unit I: Nanomaterial synthesis and characterization **6 hrs**

Principles, synthesis, and characterisation of Nanomaterial: Origin and concepts, General properties of nano materials, Top down and Bottom-up approaches of synthesis, Nanoparticle synthesis by physical, chemical, and biological methods (Ball Milling, Nanolithography) and bottom-up (Physical Vapour Deposition, Chemical Vapour Deposition, Sol-gel Method, Chemical reduction Method, Green synthesis).

Unit II: Characterization of Nanomaterial 6 **hrs**

Microscopy Techniques, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Spectroscopic techniques – UV Vis spectrophotometer and Fourier Transform Infrared Spectroscopy, X-Ray Diffraction, Atomic Absorption Spectroscopy, Dynamic Light Scattering methods for particle size analysis, Zeta potential, and Electrophoretic mobility.

Unit III: Nanotoxicology **6 hrs**

Nanoparticles & Environment Natural and manmade sources for nanoparticles, Nano-contamination - Environmental risk prevention - Disposal methods - Biosafety regulations - Nanoparticle absorbents - Bioethics - Risk management and Regulatory aspects. Concept of dose response, fate of nanoparticles in environment, routes of exposure to the human system, their effects and mechanism of action on biological systems at organ and cellular level, Concept of nanoparticle toxicity and ONE health.

Unit IV: Applications of Nanomaterials **6 hrs**

Engineered Nanomaterial and its Applications: Carbon nanotubes, Fullerenes, Core shell, nanoparticles, Quantum dots, hybrid nanomaterials, metal nano particles their properties and applications; DNA Based nanoparticles and their applications; Protein Based nanoparticles and their applications, Biomedical Applications of nanoparticles. Nanomaterial Application in food industries, environment and agriculture.

Reference Books:

1. T. Pradeep (2007) Nano: The essentials - Understanding Nanoscience and Nanotechnology, Tata McGraw- Hill Publishing Company Limited, New Delhi.

2. Stoytcheva, M., & Zlatev, R. (Eds.). (2020). *Applications of nanobiotechnology*. BoD–Books on Demand.
3. Ahmad (2010), Principles of Nanoscience and Nanotechnology, M.A. Shah& T., Narosa Publishing House Pvt Ltd, Kolkata.
4. Guozhong Cao, Ying Wang (2011), Nanostructures and nanomaterials: Synthesis, Properties and Applications, Vol 2, World Scientific Publishing.
5. Niemeyer, C. M., & Mirkin, C. A. (Eds.). (2004). *Nanobiotechnology: concepts, applications and perspectives* (Vol. 1). John Wiley & Sons.
6. Khan, F. A. (2018). Nano-biotechnology. In *Biotechnology Fundamentals* (pp. 421-444). CRC Press.

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./ Wk.**
B25BTS812	**Clinical Data Science**	DSE	2	0	0	2	2

Prerequisites/Pre reading for the course:

1. Students should have basic knowledge of Life Science including microbiology, biochemistry and human physiology.
2. Students should be familiar with ethical concepts and safety aspects of scientific research

Course Objectives:

The overall objectives of the course are:

1. Develop knowledge on various kinds of research questions and research design.

2. Acquire basic knowledge on qualitative, quantitative and mixed method research as well as relevant ethical considerations.

3. Enable students to formulate research questions and develop sufficient coherent research design and choose the right bio-statistical techniques to be used with the research methods.

4. Make informed choices with respect to methodology and research design.

Course Outcomes:

After completing the course, the student should be able to:

Course Outcomes

After the end of the course, the student will be able to

1. Understand different types of clinical data sources, including electronic health records (EHR), medical imaging data, genomic data, etc.
2. Hanle and pre-process the clinical data, including cleaning, integrating, and transforming data for analysis
3. Attain the knowledge and application of statistical methods and machine learning algorithms commonly used in clinical data analysis.
4. Analyze clinical data to derive meaningful insights and make data-driven decisions in healthcare settings.
5. Conceptualize the process of pre clinical studies
6. Understand the concept of clinical trial management & regulatory affairs

Mapping of course outcomes and program outcomes

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS812	CO1	2	2	3	1	2	3	0	2	1	1	2	1	1	2
	CO2	2	3	3	1	2	3	1	3	1	2	2	2	2	2
	CO3	2	2	3	2	2	2	0	3	1	2	2	2	1	2
	CO4	2	2	3	2	2	2	0	2	1	2	2	1	0	0
	CO5	2	3	3	1	2	2	1	2	2	2	2	0	1	0
	CO6	2	1	2	0	0	1	2	2	0	1	2	0	0	0

Unit I **6 hrs**

Introduction to Clinical Research: Definition of Clinical research, Terminologies & definitions used in Clinical Research, Difference between Clinical Research and Clinical practice, Types of Clinical research and Phases of Clinical Research, Features of Clinical Trials; The stand of Clinical Research in Scientific Arena, Basics of Bioavailability & Bioequivalence Studies, Clinical Research Methodology, Career Prospect in Clinical Research

Unit II **6 hr**

Preclinical Studies: HT screening, In vitro and In vivo studies, animal models of disease, teratogenicity, reproductive toxicity, mutagenicity, carcinogenicity, selection of initial human dose from animal data, Assessment; Extrapolation of animal data to clinical situation; Clinical significances, adverse event, serious adverse event, end point.

Unit III **6 hrs**

Basics of Clinical Pharmacology: Drug, Pharmacodynamics, Therapeutics, Toxicology, Chemotherapy, Pharmacoepidemiology, Pharmacoeconomics-First Human Dose; Drug

Development Process: Drug discovery, Preformulation, Formulation & Development, Preclinical testing, Preclinical, toxicity studies, evaluation of drugs and Indian regulatory framework, Clinical Development process.

Unit IV **6 hrs**

Clinical Trial Management & Regulatory Affairs: Defining Clinical Trial Process, Basics of Project Management-Definition of project, Stages of Project Development, definition of a clinical trial project management, concept of clinical Trial Management flow; Essential Document preparation (IB, ICF, PIS, TMF, ISF, Advertisements, CDA, CTA etc; Pharma Regulatory Affairs; Drug Policies; Adverse Drug Reactions; Management; Good Manufacturing Practices (GMP).

Reference Books:

1. Who Expert Committee on Specification for Pharmaceutical Preparation WHO-GENEVA, 2005 edition
2. Guidance for Industry, CDER, 2005 edition
3. ICMR Guidelines – 2008, ICMR-New Delhi, 2006 edition
4. Vishal Bansal Parar (2010). Clinical Research Fundamental and Practice –Medical Publisher
5. Dr. S. Gunasakaran and R. Salhesh Kumar (2010). Pharmacovigilance for Beginners – Tatamani Magalir Co-Operative Press,
6. Dr. Ravindra B. Ghooi and Sachin C (2010). Essential of Clinical Research –. Itkar Nirali Prakashan
7. Jaypee Brothers (2009). Basic Principles of Clinical Research and Methodology, Medical Publishers (P) Ltd

Course Code	**Enzyme technology Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0804		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should have basic knowledge of Enzyme properties and function.

Course Objectives:

The objective of this Course is to:

1. To understand the working conditions in Enzymologist lab.
2. To explore the production of enzymes techniques.

3. To handle the protein samples and their maintenance.
4. To exploit enzyme assay for the benefit of mankind.

Course Outcomes:

After the end of the Course students will be able to:

1. Explain the key structural and energetic factors which give rise to increased enzyme stability
2. Conceptulize the importance of enzymes for industrial application,
3. Summarize current processes involved in industrial enzyme production
4. Describe methods for selection of industrial enzymes using genetic and biochemical techniques.
5. Describe methods for optimisation of industrial enzymes using genetic and biochemical techniques.
6. Compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Mapping of Course Outcomes with programme Outcomes

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
	CO1	3	3	3	2	2	3	2	1	2	2	2	3	3	3
	CO2	3	2	3	2	1	3	2	1	2	2	2	3	3	2
B25BT0804	CO3	3	3	3	3	3	3	2	2	2	3	2	3	3	3
	CO4	3	3	3	3	3	3	2	0	2	2	2	3	3	3
	CO5	2	2	3	3	2	3	2	1	2	3	2	3	3	2
	CO6	3	3	3	3	3	3	1	2	3	3	2	2	3	3

Course Contents:

1. Identification of enzymes in different sources
2. Isolation of Amylase from different sources
3. Positive and negative controls of enzyme (Catalase) activity
4. Effect of temperature on enzyme (Catalase) activity
5. Effect of concentration on enzyme (Catalase) activity
6. Effect of pH on enzyme (Catalase) activity
7. Effect of enzyme (Catalase) inhibitor

8. Estimation of Protease activity in commercially available detergent

9. Determination of alkalinity in the given water sample.

Reference Books:

1. Jack Kyte, Thomas E. Crowley. (2014). Experiments in the Purification and Characterization of Enzymes: A Laboratory Manual. Academic press, UK
2. Thomas E. Crowley, Jack Kyte. (2019). Experiments in the Purification and Characterization of Enzymes. A Laboratory Manual. Elsevier publications. USA
3. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche. (2010). Enzyme technology. Springer Publications, USA.
4. Ram Sarup Singh, Reeta Rani Singhania, Christian Larroche. (2019). Advances in Enzyme Technology. A volume in Biomass, Biofuels, Biochemicals. Springer Publications, USA

Course code	**System Biology Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0805		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisite for the course:

- The student should have the basic knowledge of biology
- The student should have the basic knowledge of bioinformatics

Course objectives:

1. To acquire fundamental knowledge on importance in biological reactions.

2. To understand ability to understand the concept of genes through computational approach.

3. Exposure to the nature of biological pathways and its correlation to living system.

Course outcomes:

After the end of the Course students will be able to:

1. Construct computational models of biological systems
2. Analyse computational models of biological systems

3. Understand common mathematical approaches to study biological problems
4. Apply computational analyses to explore the behavior of biological systems
5. Summarize and critique papers from the literature describing systems biology approaches and analysis
6. Apply the knowledge of systems biology for life science research.

Mapping of course and program outcomes

Course Code	**POS / CO S**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
	CO1	3	3	3	2	2	3	2	1	2	2	2	3	3	3
	CO2	3	2	3	2	1	3	2	1	2	2	2	3	3	2
B25BT08	CO3	3	3	3	3	3	3	2	2	2	3	2	3	3	3
05	CO4	3	3	3	3	3	3	2	0	2	2	2	3	3	3
	CO5	2	2	3	3	2	3	2	1	2	3	2	3	3	2
	CO6	3	3	3	3	3	3	1	2	3	3	2	2	3	3

Course Contents

1. Sequence Analysis and predictions: Nucleic acid sequence analysis- Reading frames;
2. Codon Usage analysis; Translational and transcriptional signals, Splice site identification,
3. Gene prediction methods
4. RNA fold analysis.
5. Protein sequence Analysis-Compositional analysis,
6. Hydrophobicity profiles,
7. Amphiphilicity detection, Moment analysis,
8. Transmembrane prediction methods,
9. Secondary structure prediction methods.

Reference Books

1. Klipp, Edda, Wolfram Liebermeister, Christoph Wierling, and Axel Kowald. Systems biology: a textbook. John Wiley & Sons, 2016.
2. Palsson, B., 2015. Systems biology. Cambridge university press.
3. Alon, U., 2019. An introduction to systems biology: design principles of biological circuits. Chapman and Hall/CRC.
4. Voit, E., 2017. A first course in systems biology. Garland Science.

Course code	Pharmacology and Toxicology Lab	Course type	L	T	P	C	CH
B25BT0806		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre-reading for the course

Students should have knowledge on chemistry, biochemistry and basics of Biotechnology, which will help them to understand the adverse effects of chemical substances, diagnosis and treatment.

Course Objectives:

The overall objectives of the course are:

1. Build knowledge on pharmacology in living organism.
2. Focus on the pharmacokinetics of drug in living systems
3. Able to understand the toxicokinetic and other cellular responses due to toxic interaction to living system
3. Provide an opportunity to conduct research in an area of toxicology.

Course Outcomes:

After completing the course, the student should be able to:

1. Understand the basics of pharmacology of drugs within the living system
2. Understand the basics of pharmacodynamics of drugs within the living system.
3. Comprehend the basics of pharmacokinetics of drugs within the living system.
4. Understand the molecular mechanism of cell regulations based on various proteins, lipids and hormones that expose to the various chemical exposure and these bio molecules involved in the disease condition.
5. Analyse and interpret the toxic substances used for prolonged exposures based on acute, sub- Acute and chronic studies, carcinogenicity and mutagenicity tests.
6. Derive the concept of lethal indices from toxicity studies.

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS0	PS0	PS0
B25BT 0806	CO1	3	3	1	3	3	1	1	2	1	1	2	3	0	2
	CO2	3	2	2	2	1	1	1	1	0	1	2	1	0	2
	CO3	2	1	2	2	1	1	1	0	1	1	2	1	0	1
	CO4	3	2	1	2	2	1	1`	0	1	1	2	1	0	1

	CO5	2	2	1	3	2	0	1	0	1	1	2	2	0	1
	CO6	2	2	1	3	0	2	0	1	1	2	2	0	1	1

Course Content

1. Study of different routes of drug administration in *Drosophila melanogaster*
2. Protein estimation in *Drosophila melanogaster* larval homogenate and hemolymph
3. Study of inflammation in *Drosophila melanogaster* through hemocytes counting
4. Determination of ED50 of a drug
5. Antioxidant Test of a drug by DPPH assay
6. Estimation of lethal indices of a drug in *Drosophila melanogaster*
7. Determination of toxic dose of a drug in *Drosophila melanogaster*
8. Genotoxicity study through *Allium cepa* root assay

Reference Books

1. Goodman and Gilman (2001). The Pharmacological Basis of Therapeutics. (International Edition) McGraw Hill, New York , 10th edition.
2. Rang HP, Dale MM and Ritter JM (1999). Pharmacology , Churchill Livingstone, London, 6th 3. Edition.
3. Bertram G Katzung (2001). Basic and Clinical Pharmacology by (International Edition) Lange Medical Book/McGraw-Hill, U.S.A. 8th Edition.
4. D.R. Laurence, P.N (1997). Clinical Pharmacy by Bennett & Mi. Brown, 8th Edition Churchill Livingstone.

Course code		**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0807	**Research Project/ Internship**	**DSE**	**0**	**0**	**6**	**6**	**12**

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways

appropriate to their principal areasof study.

2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and methodology.
6. Describe the statistical procedures in the interpretation of results.

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BT0807	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. Honors in Genetics
Detailed Syllabus
Seventh Semester

Course code	**Plant Molecular Genetics**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0701		**DSC**	3	0	0	3	3

Prerequisites:

1. Students should be aware of basic plant biology.

2. They should know the fundamentals of gene expression.

Course Objective:

The objective of this course is to:

1. Study the gene expression of plant genes.
2. Predict the genes involved in the regulation in plants.
3. Know the molecular basis of host pathogen interaction.
4. Understand the protoplast technology and genetics transformation in plants.

Course outcomes:

After completing the course, the student shall be able to:

2. Elucidate the expression of genes in plants.

3. Comprehend the mechanism of gene regulation in plants.
4. Outline the response of genes to different abiotic stress.
5. Interpret the molecular basis of host-pathogen interaction.
6. Understand the application of protoplast technology.
7. Explain genetic transformation methods in plants.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0701	CO1	3	2	2	1	1	1	0	0	0	1	2	2	1	0
	CO2	3	3	2	2	1	2	0	0	0	0	2	2	3	1
	CO3	3	1	1	1	3	0	0	0	0	0	2	3	2	1
	CO4	3	2	1	2	2	0	0	0	0	0	2	2	2	0
	CO5	3	3	3	2	3	2	0	0	0	0	2	3	2	1
	CO6	2	2	2	2	1	1	0	0	0	0	2	2	2	0

Course contents:

UNIT I **12 h**

Gene expression in plants:

Gene structure, expression and regulation in plants- an overview of nuclear & organelle gene structure, function and expression with emphasis on aspects that are unique to plants genes; Development of Arabidopsis as a model for molecular genetic studies in plant biology.

UNIT II **12 h**

Gene regulation in plants: Over view of plants as genetic model systems, gene regulation in plants. Genes involved in regulation of flower development. Homeotic genes, Development of dorsal and ventral asymmetry in leaves. Role of KNOX genes in evolution of compound leaf. Types of abiotic stresses and gene regulation during water deficit and heat stress. Plant nodule genes. Mechanism of self-incompatibility in plants.

UNIT III **12 h**

Applied genetics of plants: Genetic basis of disease resistance and susceptibility in plants. Molecular basis of host pathogen interaction. Molecular and genetic basis of Crown Gall disease development. Agrobacterium- Genetics of Ti plasmid. Plant wound genes and control of 'vir' gene expression. Mechanism of T-DNA transfer and their utility in production of transgenic plants.

UNIT IV **12 h**

Protoplast technology: Isolation, maintenance and viability tests for protoplast, regeneration of plants from protoplast, methods of protoplast fusion and its application.

Genetic Transformation: Plant transformation vectors- T-DNA, viral vectors, transposon elements. Genetic transformation methods: Agro-bacterium system; Direct DNA transfer by ballistic gun method, electroproration, microinjection; Alternate in-plant methods, floral dip, silicon carbide, pollen tube pathway etc.; Marker-free and novel selection strategies; Gene silencing; RNA interference (RNAi) system; Gene knockdown.

References:

1. George Acquaah. (2012). *Principles of Plant Genetics and Breeding*. 2nd Edition Wiley-Blackwell Publishers.
2. Yunbi Xu. (2010) *Molecular Plant Breeding.* MPG Books Group Publishers
3. A.R. Dabholkar. (2006). *General Plant Breeding* 1st edition. Concept Publishing Company.
4. Roberta H. Smith. (2013). *Plant Tissue Culture: Techniques and Experiments*, 1st edition. Academic Press.
5. Ram J. Singh (2017). *Plant Cytogenetics*. 3rd edition. CRC Press.

Course code	**Immunogenetics and Immunology**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0702		**DSC**	3	0	0	3	3

Prerequisites:

1. Students should know the basics of immunology.
2. They should be aware of gene expression and post transcriptional processing.

Course Objective:

The objective of the course is to:

1. Know the fundamentals of immune cells and immunity.
2. Study the organization and expression of immune genes.
3. Understand the antigen processing and processing.
4. Explore the immunological disorders and immune- therapeutics.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the types of immune cells and immunity.
2. Interpret the mechanism involved in production of different immunoglobulins.
3. Illustrate the organization of T-cell and B-cell genes.
4. Elucidate the process of antigen processing and presenting.
5. Enlist the immune disorders and immune-deficiency.
6. Outline the process of immune-therapeutics and drug targeting.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0702	CO1	3	2	2	2	1	1	0	0	0	0	2	3	2	0
	CO2	3	2	2	2	1	1	0	0	0	0	2	2	2	0
	CO3	3	3	2	3	1	0	0	0	0	0	2	3	0	0
	CO4	3	2	2	2	1	0	0	0	0	0	2	2	2	0
	CO5	3	2	3	1	1	0	0	0	0	0	2	2	1	0
	CO6	3	2	3	2	2	1	0	0	0	0	2	2	2	0

Course contents:

Unit I: Biology of the immune system. 12 h

Biology of Immune cells: Dendritic cells monocytes and macrophages, Granulocytes, Natural killer cells, Lymphocytes Organs of the immune system. Innate Immunity, Characteristics, components and functions, Toll like receptors and other immune receptors. Adaptive Immunity, Humoral and Cell mediated Immune responses Antigens Structure and function of immunoglobulins and T cell receptors B and T cell receptors and coreceptors

Unit II: Immunogenetics 12 h

B cell receptor genes (Immunoglobin) Organization of Ig gene loci Molecular mechanisms of generation of antibody diversity Expression of Ig genes Regulation of Ig gene transcription, T cell receptor genes. T cell receptor genes Organization of TCR gene and diversity. The HLA complexes.

Unit III: Immune responses **12 h**

Antigen processing and presentation MHC-restriction Cytokines, T-Cell Maturation, activation and differentiation, B-Cell Generation, Activation and differentiation, Clonal selection and immunological memory Regulation of immune responses.

Unit IV: Disorders of Human Immune System **12 h**

Immunological Tolerance and Autoimmune diseases, Allergy and hypersensitivity Cytokine-related diseases. Immuno-deficiencies, Dynamics of the immune response in health and disease Experimental models, Immuno-therapeutics and Drug targeting Vaccines Transplantation immunology

References:

1. Abbas, Abul K., Andrew Lichtman and Pillai. (2014). *Cellular and Molecular Immunology*. 8th ed. Saunders.
2. Peter Parham. (2014). *The Immune System*. 4th Ed Garland Science. Taylor and Francis.
3. Lauren Sompayrac. (2016). *How the Immune System Works*, 5th Edition, Wiley Blackwell.
4. Kenneth Murphy. (2011). Janeway's Immunobiology. 8th New York, Garland Science.
5. Kuby, (2018) Immunology, 8th edition, WH Freeman Publishers.

Course code		Course type	L	T	P	C	CH
B25GN0703	Genomics and Proteomics	DSC	3	0	0	3	3

Prerequisites:

1. Students should be aware of the structure of gene sequences.
2. They should be knowing the basics of computer applications.

Course Objective:

The objective of the course is to:

1. Understand the origin of omics technology.
2. Know the genome databases and genome mapping.
3. Study different methods of structural genomics.
4. Explore the tools and techniques of proteomics.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the origin of omics theory.
2. Retrieve data from genome databases and analyse them.
3. Decide on the use of relevant markers to map the genomes.
4. Elucidate the different methods of structural genomics.
5. Highlight the importance of the genome projects and its contribution.
6. Understand the tools and techniques used in proteomics.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0703	CO1	3	2	1	2	1	1	0	0	0	0	2	3	2	0
	CO2	3	3	3	2	1	1	1	0	0	0	2	2	2	0
	CO3	3	2	2	2	1	1	0	0	0	0	2	3	3	0
	CO4	3	2	2	2	1	1	0	0	0	0	2	3	2	0
	CO5	3	3	3	2	1	1	0	0	0	0	2	1	1	0
	CO6	3	2	3	3	3	1	0	0	0	0	2	2	2	0

Course contents:

UNIT I **12 h**

Introduction: Genome, Genomics, Omics and importance, General features, The origin of genomes- Origin of macromolecules, RNA world and DNA world. Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).

UNIT II **12 h**

Gene identification; gene prediction rules and softwares; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, *Caenorhabditis, Arabidopsis*, etc.

Mapping genomes: Genetic mapping –DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT III **12 h**

Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing, Genome projects: The Human genome project, HapMap Project, The 1000 genome project, and The ENCODE Project.

UNIT IV **12 h**

Proteomics: Tools techniques, study of protein- protein interaction, protein analysis for gene identification, post translation modification. Proteome database etc.; Potentials of proteomics in biotechnology : Case studies related to clinical and biomedical application of proteomics

References:

1. Brown T. A. (2007). *Genomes 3*. Garland Science Publishing.
2. Primrose, S. B., and R. M. Twyman. (2006). *Principles of gene manipulation and Genomics*, Blackwell Publishing.
3. Ruchi Singh. (2015). *Bioinformatics: Genomics and Proteomics.* Vikas Publishing House.
4. Devarajan Thangadurai and Jeyabalan Sangeetha. (2021). *Genomics and Proteomics – Principles, technologies and applications*. CRC Press.
5. Rakeeb Ahmad Mir, Sheikh Mansoor Shafi, Sajad Majeed Zargar. (2023). *Principles of genomics and proteomics: A technical guide.* Elseiver.

Course code	Genetics of Infertility and ART	Course type	L	T	P	C	CH
B25GNS711		DSE	3	0	0	3	3

Prerequisites:

- Students should know the fundamentals of developmental biology.
- They should be aware of human reproductive system.

Course Objective:

The objective of the course is to:

1. Study the reproductive system and hormones related to reproduction in humans.
2. Understand the types of female infertility.
3. Learn the types and modes of male infertility.
4. Know the existing assisted reproductive techniques.

Course outcomes:

After completing the course, the student shall be able to:

1. Illustrate the structure and function of reproductive system.

2. Elucidate the role of hormones in fertility.
3. Deduce the mechanism of female fertility.
4. Interpret the modes and types of male fertility.
5. Explain the different assisted reproductive techniques in practice.
6. Enlist different types of prenatal diagnostic methods and its significance.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS711	CO1	3	2	3	1	1	0	0	0	0	0	2	2	2	0
	CO2	3	2	2	2	0	1	0	0	0	0	2	2	2	0
	CO3	3	2	3	1	1	1	0	0	0	0	2	1	2	0
	CO4	3	2	2	1	1	0	0	0	0	0	2	2	2	0
	CO5	3	2	3	2	1	2	0	0	0	0	2	2	0	0
	CO6	3	2	3	2	1	2	0	0	0	0	2	3	2	1

Course contents:

UNIT I **12 h**

Human Reproductive system:

Embryonic development of the female and male reproductive system, Oogenesis, Spermatogenesis, Fertilization

Reproductive hormones- Estrogen, Follicle Stimulating Hormone, Gonadotropin-Releasing Hormone, Human Chorionic Gonadotropin Hormone, Luteinizing Hormone, Oxytocin, Progesterone, Prolactin, Testosterone.

UNIT II **12 h**

Female infertility:

Types of female Infertility, amenorrhea, abnormal uterine bleeding, reproductive tract abnormalities (acquired and developmental), androgen disorders, recurrent abortion, adverse effect of chemo and radiotherapy on fertility.

UNIT III **12 h**

Male infertility:

The Genetics and types of male Infertility, meiotic errors, and male infertility, environmental influences on male infertility, cryptorchidism. Clinical evaluation of male infertility, Y-Chromosome microdeletions.

UNIT IV **12 h**

Assisted reproductive techniques:

Diagnosis- Prenatal diagnosis- amniocentesis, chorionic villus sampling, Preimplantation Genetic Diagnosis (PGD). Treatment – Assisted Reproductive Technologies (ART) –IVF, ICSI, GIFT and ZIFT, Recent advances in Artificial Reproductive Techniques. Sperm count management, Prenatal Testing & Eugenics. Ethical dilemmas in PGD and ART.

Socio-economic issues.

References:

1. Björn Glantz and Klas Edquist, Hauppauge, N.Y., (2011). *Male and Female Infertility: Genetic Causes, Hormonal Treatments and Health Effects (Human Reproductive System-- Anatomy, Roles, and Disorders)*. Nova Science Publishers.
2. Lipshultz, Larry I., Stuart S. Howards, and Craig S. Niederberger, eds. (2012). *Infertility in the Male.* 4th ed. Cambridge: Cambridge University Press.
3. Rizk, Botros R. M. B., et al., eds. (2010). *Infertility and Assisted Reproduction*. 2nd ed. Cambridge: Cambridge University Press,
4. Lewis Wolpert et al. (2015). *Principles of Development*. 5th Edition. Oxford University press.
5. Gilbert. (2013) *Developmental biology*. 10th edition. Sinauer Associates, Incorporated

Course code	**Analytical Techniques in Genetics**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GNS712		**DSE**	3	0	0	3	3

Prerequisites:

1. Students should have the basic knowledge of biomolecules.
2. They should know the basics of physical and chemical analysis techniques.

Course Objectives:

The Objectives of this course is:

1. To emphasis on the techniques and technologies used in genetics and molecular biology.
2. To understand the different methods used for analysis of biomolecules.
3. To interpret the presence of metabolite.

4. To outline the protocol used for different analysis.

Course outcomes:

After completing the course, the student shall be able to:

1. Visualize the microscopic images and document them effectively.
2. Elucidate the methodology and applications of nucleic acid hybridization techniques.
3. Blueprint the techniques used to detect proteins and DNA.
4. Understand the techniques of spectroscopy and computational biology.
5. Interpret the presence of metabolite using chromatographic techniques.
6. Illustrate the applications of radioactivity in the detection and measurement of biological molecules.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS712	CO1	3	2	3	2	0	0	0	0	0	0	2	2	3	0
	CO2	3	3	3	2	2	1	0	0	0	0	2	3	2	1
	CO3	2	3	3	3	2	2	0	0	0	0	2	2	2	0
	CO4	3	2	2	2	1	0	0	0	0	0	2	1	2	0
	CO5	3	2	3	0	0	1	0	0	0	0	2	2	1	0
	CO6	3	2	1	2	1	0	0	0	0	0	2	2	2	0

Course contents:

Unit-I **12 h**

Microscopy: Light Microscopy-Introduction, Geometrical optics, Image formation, Magnification and Resolution, Lens aberrations, Distortion of image and curvature of field; Types and principles of microscopes- Confocal, Phase contrast, Fluorescence, Polarized, Electron Microscopy (SEM &TEM) and applications.

Unit – II **12 h**

Principles and techniques of nucleic acid hybridization and cot curves; Sequencing of nucleic acids; Southern, Northern and Western blotting techniques; Protein sequencing, Polymerase chain reaction (PCR), Real Time-PCR, Methods for measuring nucleic acid and protein interaction. Electrophoresis: Principle, procedure and application of- Agarose, PAGE, SDS-PAGE, Pulse field electrophoresis, Paper cellulose acetate and High voltage electrophoresis; Isoelectric focusing (IEF).

Unit – III **12 h**

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy; Structure determination using X-ray diffraction and NMR analysis using light scattering; Different types of mass spectrometry and surface.plasma resonance methods; Computation methods; Nucleic method and protein sequence databases, data mining method for sequence searches, motif analysis and prediction.

Unit – IV **12 h**

Principle and applications of gel filtration, ion exchange & affinity chromatography; Thin layer chromatography; Gas chromatography; GLC; High pressure liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC); Ultracentrifugation (Velocity and buoyant density). Nature Radioactivity, detection and measurement, construction and use of scintillation counters, Autoradiography, preparation of labelled compounds. Applications in biological sciences, use of non-radioactive compounds.

References:

1. Sambrook and Russell (2007). *Molecular cloning A Laboratory Manual*. 3rd edition Vol. 1, 2, 3-, Churchill press.
2. Keith Wilson and John Walker. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 6th Edition. Cambridge University Press.
3. Azhar Rasul, Chukwuebuka Egbuna, Jonathan C. Ifemeje, Kingsley C. Patrick- Iwuanyanwu, Muhammad Ajmal Shah. (2021). Analytical Techniques in Biosciences. From Basics to Applications. Elsevier Science.
4. Rajan Katoch,. (2011). Analytical Techniques in Biochemistry and Molecular Biology. Springer New York.
5. Abhilasha Shourie. Shilpa S. Chapadgaonkar. (2015). Bioanalytical Techniques. Energy and Resources Institute

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS713	**AI Techniques in Biological Sciences**	**SEC**	**2**	**0**	**0**	**2**	**2**

Prerequisites: The student should know the basics of biology and computer science

Course Objectives

1. The course aims to understand the AI techniques used in Biological Sciences.

2. It introduced basic programming languages based on current industry applications.

3. It also helps to understand the existing AI tools used in various fields in Biological Sciences.

4. To understand AI techniques and integrate them in Biological Sciences.

Course Outcome

By the end of the course the student will be able to:

1. Students Can understand the AI based algorithm from a biological perspective.
2. Ability to perform basic programming related to AI techniques in Biology.
3. Analyze how AI can be implemented to better enhance the understanding of biological processes.
4. Evaluate existing AI tools and techniques to ensure they meet the requirements of biological research and processes.
5. Gain an understanding on the ethical aspects of AI in Biological Sciences
6. Ability to understand and apply basic AI algorithms in a research and industrial setting.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS713	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2

Unit-I: Introduction to AI and ML in Biology **12 Hrs**

Introduction to Machine Learning (ML) and Artificial Intelligence (AI), AI Basics: concepts, terminologies and workflow, Agents and Environments, Biological Intelligence Vs Artificial Intelligence Advantages and disadvantages, Neural Networks, Notations, Simple computing elements, network structures and applications, optimal network structures, comparing brains with digital computers.

Unit II: Applications of AI techniques in Biology **12 Hrs**

Applications of AI in Biological Sciences, AI-driven applications-drug discovery and development, Clinical research and Omics studies, understanding biological data and preprocessing, expression analysis using AI techniques, Data privacy and Ethical case studies of AI applications.

Reference Books

1. Shailza Singh, "Machine Learning and Systems Biology in Genomics and Health", Springer Singapore 2022.

2. Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan Mohanty, Xiaobo Zhang, "Data Analytics in Bioinformatics: A Machine Learning Perspective" Wiley Online Library, 2021.

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS714	**AI Literacy in Health care**	**SEC**	**2**	**0**	**0**	**2**	**2**

Course Objectives

1. Assess AI-based tools and datasets, exploring methods to guarantee they adhere to medical standards.
2. Gain an understanding of the ethical challenges posed by AI in healthcare and ways to ensure minimizing biases in AI-driven decisions.
3. Gain an understanding of AI methodologies required for patient care.
4. Gain practical experience in identifying opportunities for AI applications to enhance patient care and research.

Course Outcome

By the end of the course the student will be able to:

1. Demonstrate the ability to understand the ethical challenges posed by AI in healthcare.
2. Demonstrate the ability to collaborate with AI scientists and healthcare professionals.
3. Analyse how AI can be implemented to better enhance healthcare initiatives.
4. Evaluate AI tools and techniques to ensure they meet medical standards.
5. Understand and apply basic AI algorithms in a healthcare setting.
6. Develop proficiency in utilizing existing AI tools for the management and analysis of patient data.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS714	CO 1	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1

Course content

Unit-I: Introduction to AI Principles 12Hrs

Basics of machine learning, and artificial intelligence: Introduction Image processing, normalization techniques and interpretation of image data and applications, AI-driven decision support systems (ANN, KNN and SVM), Predictive modeling and patient monitoring using AI, AI applications in radiology and pathology for diagnostics, Role of AI in treatment planning and decision support.

Unit II: Challenges and Ethics in AI implementation 12 Hrs

Ethical case studies of AI applications, scenarios of data breaches in AI applications, challenges of integrating AI into healthcare systems, Ethical considerations surrounding AI in patient autonomy and data privacy, Bias identification within AI models, the role of AI in managing Electronic Health Records (EHRs), Cutting-edge applications of AI, augmented reality (AR) and virtual reality (VR) in medicine, impact of AI on genomics and global health initiatives.

Reference Books

1. Peter Lee, Carey Goldberg, Issac Kohane (2023). The AI Revolution in Medicine: GPT-4 and beyond, Pearson.
2. Hugh Cartwright (2008). Using Artificial Intelligence in Chemistry and Biology: A Practical Guide, CRC Press.

Course code	Plant Molecular Genetics Lab	Course type	L	T	P	C	CH
B25GN0704		DSC	0	0	2	2	3

Prerequisites:

1. Students should be aware of basic plant biology.
2. They should know the fundamentals of gene expression.

Course Objective:

The objective of the course is to:

1. Study the floral morphology and pollinating methods.

2. Learn haploid culture using anthers or pollen.
3. Know the significance of embryo culture, somatic embryogenesis and induction of organogenesis.
4. Understand the RAPD or SSR analysis.

Course outcomes:

After completing the course, the student shall be able to:

1. Understand the floral morphology and pollination methods.
2. Design the culture characteristics for haploid culture.
3. Elucidate somatic embryogenesis.
4. Isolate and culture protoplasts.
5. Understand soma clonal variation for disease resistance.
6. Design primers for marker analysis.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0704	CO1	3	3	3	2	1	1	2	1	0	3	2	2	2	0
	CO2	3	3	3	3	2	2	2	1	0	2	2	3	2	0
	CO3	3	1	3	1	3	2	1	2	0	2	2	2	2	0
	CO4	2	2	1	2	2	1	0	0	0	0	2	2	1	0
	CO5	3	2	3	2	3	1	1	0	0	1	2	2	1	0
	CO6	3	2	1	2	2	2	1	0	0	0	2	3	2	0

Course contents:

1 Floral morphology and pollination methods in self-pollinating and cross-pollinating crops

2 Anther and Pollen culture

3 Cell & explant culture/ Induction of organogenesis

4 Somatic embryogenesis

5 Isolation of protoplasts & culture

6 Embryo culture/Somaclonal variation to select disease resistance

7 Study of Heterosis

8 RAPD/SSR analysis

References:

1. George Acquaah. (2012). *Principles of Plant Genetics and Breeding*. 2nd Edition Wiley-Blackwell Publishers.
2. Yunbi Xu. (2010) *Molecular Plant Breeding.* MPG Books Group Publishers
3. A.R. Dabholkar. (2006). *General Plant Breeding* 1st edition. Concept Publishing Company.
4. Roberta H. Smith. (2013). *Plant Tissue Culture: Techniques and Experiments*, 1st edition. Academic Press.
5. Ram J. Singh (2017). *Plant Cytogenetics*. 3rd edition. CRC Press.

Course code	**Immunogenetics and immunology Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0705		**DSC**	0	0	2	2	3

Prerequisites:

1. Students should know the basics of agglutination reactions.
2. They should know the fundamentals of molecular techniques.

Course Objective:

The objective of the course is to:

1. Understand the agglutination and immunodiffusion techniques.
2. Study the lymphocyte culturing and understanding the toxicity studies.
3. Study the molecular techniques for relevant analysis.
4. Know the blotting techniques and flow cytometry.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the agglutination and immunodiffusion techniques.
2. Perform the lymphocyte culture and do toxicity analysis.
3. Decide the selection of the molecular techniques for relevant analysis.
4. Know the applications of ELISA and PCR.
5. Isolation of proteins and identification by blotting techniques.
6. Deduce applications of flow cytometer.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	CO1	3	3	3	2	1	1	2	1	0	3	2	2	2	0

B25GN0705	CO2	3	3	3	3	2	2	2	1	0	0	2	3	2	0
	CO3	3	1	3	1	3	2	1	2	0	2	2	2	2	0
	CO4	2	2	1	2	2	1	0	0	0	0	2	2	1	0
	CO5	2	2	3	2	1	1	1	0	0	2	2	2	1	0
	CO6	3	2	1	2	2	2	1	0	0	0	2	3	2	0

Course contents:

1. Haemagglutination method
2. Single Radial Immunodiffusion method
3. Isolation of lymphocytes and cell culture
4. Lymphocyto-toxicity assay
5. ELISA technique
6. HLA typing by PCR
7. Protein isolation and Western Blot technique
8. Study of FACS

References:

1. Abbas, Abul K., Andrew Lichtman and Pillai. (2014). *Cellular and Molecular Immunology*. 8th ed. Saunders.
2. Peter Parham. (2014). *The Immune System*. 4th Ed Garland Science. Taylor and Francis.
3. Lauren Sompayrac. (2016). *How the Immune System Works*, 5th Edition, Wiley Blackwell.
4. Kenneth Murphy. (2011). Janeway's Immunobiology. 8th New York, Garland Science.
5. Kuby, (2018) Immunology, 8th edition, WH Freeman Publishers.

Course code	**Genomics and Proteomics Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0706		**DSC**	0	0	2	2	3

Prerequisites:

1. Students should know the basics of gene structure and organization.
2. They should be aware of protein synthesis and structure.

Course Objective:

The objective of the course is to:

1. Learn about the biological databases and data retrieval.
2. Study the protein and nucleic acid structure.
3. Perform similarity searches using relevant tools.
4. Learn structural validation and homology modelling.

Course outcomes:

After completing the course, the student shall be able to:

1. Search for biological databases and retrieve data from a genuine source.
2. Deduce the structure of proteins and nucleic acids virtually.
3. Design the protocol for studying sequence similarities using alignment tools.
4. Design primers for PCR.
5. Validate the structure of proteins using proteomic tools.
6. Understand and apply the concept of homology modelling.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0706	CO1	2	3	3	2	1	1	2	1	0	1	2	2	2	0
	CO2	3	3	3	3	2	2	2	1	0	0	2	3	2	0
	CO3	3	1	3	1	1	2	1	0	0	0	2	2	2	0
	CO4	2	2	1	2	1	1	0	0	0	0	2	2	1	0
	CO5	2	2	3	2	1	1	1	0	0	2	2	2	1	0
	CO6	3	2	1	2	1	0	1	0	0	1	2	3	2	0

Course contents:

1. Retrieving data using bioinformatics tools
2. Visualization of protein and nucleic acid structure
3. ORF finding using bioinformatics tools
4. Searching similar sequences using BLASTp, BLASTt and BLASTn
5. Multiple sequence alignment and finding conserved sequences.
6. Designing primers for PCR
7. Structural validation using rasmol, PDB.
8. Homology modelling

References:
1. Brown T. A. (2007). *Genomes 3*. Garland Science Publishing.
2. Primrose, S. B., and R. M. Twyman. (2006). *Principles of gene manipulation and Genomics*, Blackwell Publishing.
3. Ruchi Singh. (2015). *Bioinformatics: Genomics and Proteomics.* Vikas Publishing House.
4. Devarajan Thangadurai and Jeyabalan Sangeetha. (2021). *Genomics and Proteomics – Principles, technologies and applications*. CRC Press.
5. Rakeeb Ahmad Mir, Sheikh Mansoor Shafi, Sajad Majeed Zargar. (2023). *Principles of genomics and proteomics: A technical guide.* Elseiver.

B.Sc. Honors in Genetics

Detailed Syllabus

Eighth Semester

Course code	Recombinant DNA Technology	Course type	L	T	P	C	CH
B25GN0801		DSC	2	0	0	2	2

Prerequisites:
1. Students should be knowing the basic gene transfer concepts.
2. They should be aware of genome organization of the organisms.

Course Objective:

The objective of the course is to:
1. Understand the fundamentals of genetic engineering.
2. Study the protocol of PCR and DNA sequencing.
3. Study the types and significance of molecular markers
4. Learn the applications of r-DNA technology.

Course outcomes:

After completing the course, the student shall be able to:
1. Comprehend the methods of genetic engineering.
2. Elucidate the mechanism and applications of PCR and DNA sequencing.
3. Enlist the types and significance of molecular markers.
4. Illustrate the mechanism of blotting and fingerprinting.
5. Deduce the protocol for production of recombinant proteins.

6. Converse the significance of Genetically modified organisms.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0801	CO1	3	3	3	3	2	2	2	3	2	2	2	2	1	3
	CO2	3	3	2	2	3	2	2	2	2	2	2	3	3	2
	CO3	3	2	1	2	3	2	2	2	2	2	2	3	2	3
	CO4	1	2	2	2	2	2	2	2	3	2	2	3	3	2
	CO5	3	2	1	2	2	3	1	1	1	1	2	3	3	2
	CO6	1	3	2	3	2	2	1	1	1	2	2	2	3	2

Course contents:

Unit-I **12 h**

Genetic Engineering: History, DNA modifying enzymes, Cloning vectors and Cloning hosts, Gene transfer and cloning methods, Gene Screening and isolation - Strategies, DNA libraries, Probe Selection and screening. PCR – Principle, Methodology, Types - RT-PCR, RAPD, AFLP, ISSR, inverse PCR and Real time PCR and their applications

DNA sequencing methods - Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing method, Capillary gel electrophoresis.

UNIT II **12 h**

Fluorescence *in-situ* hybridization (FISH), Genome *in-situ* hybridization (GISH), Gel electrophoresis for nucleic acids, Methods of labeling of DNA, Blotting of macromolecules and hybridization, Oligonucleotide synthesis, Promoter characterization, DNA fingerprinting, Microarray technology. Production of recombinant proteins, Vaccine and pharmaceutical compounds; application in agriculture, GMO crops and transgenic animals. Ethical concerns and issues in GMOs.

References:

1. Primrose SB and Old. (2013). *Principles of Gene manipulation.* 7th edition. Wiley-Blackwell Scientific Publications,
2. Terence A. Brown. (2020). *Gene cloning and DNA analysis: an introduction*, 8th edition. Wiley- Blackwell.
3. M. R. Green, J. Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*. 4th edition. Cold Spring Harbor.
4. M. Wink.(2011). *An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology. 2nd edition.* Wiley.

5. Monika Jain. (2011). *Recombinant DNA Techniques – A textbook.* 1st edition. Narosa Publishing House.
6. Vance Hunter and Franky Strickland. (2018). *Applications of recombinant DNA technology*. 1st edition. ED-Tech Press.

Course code	**Expression of Eukaryotic genes**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0802		**DSC**	2	0	0	2	2

Prerequisites:

1. Students should be aware of central dogma.
2. They should know the basics of cell cycle.

Course Objective:

The objective of the course is to:

1. Understand the various modes of regulation.
2. Study the factors of regulation.
3. Learn the interactions of proteins and DNA.
4. Know the transcriptional and translational gene regulation.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the different modes of gene regulation.
2. Elucidate the role of enzymes in gene regulation.
3. Diagram the structure of transcription factors.
4. Deduce the role of transcription factors.
5. Explain the molecular control of transcription.
6. Extrapolate the protein-DNA interactions in gene expression.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0802	CO1	2	2	2	2	2	2	2	2	2	2	2	2	3	2
	CO2	2	2	2	1	2	3	2	2	2	2	2	3	1	1
	CO3	2	2	2	2	2	3	2	1	2	3	2	3	2	2
	CO4	2	2	2	1	2	2	2	1	2	1	2	3	3	2

	CO5	1	2	2	2	3	2	2	1	2	2	2	2	3	2
	CO6	2	2	2	1	2	2	3	2	3	3	2	2	3	2
	CO3	2	2	2	2	2	3	2	1	2	3	2	3	2	2

Course contents:

UNIT I **12 h**

Cis-Acting Elements and Trans-Acting Factor

Eukaryotic RNA polymerases and basal transcription factors Diversity in core promoter elements Diversity in general transcription factors Proximal & Distal Promoter Elements, Enhancers and Silencers, Gene-specific Regulators. Domain Structure of Eukaryotic Transcription Factors Transcription factors – DNA binding domains Transcription factors – transcription activation domain. Protein-DNA interactions in gene expression. The DNA-binding proteins and their recognition motifs

Gene regulation in eukaryotes: 12 h

DNA alteration (Gene amplification, programmed DNA rearrangement, DNA methylation); Spatial and temporal control, Tubulin gene in plant, globin genes in animals); Molecular control of transcription in eukaryotes (Enhancer, Silencer, enhancer trap mutagenesis, transcription factors, alternate promoters, alternate splicing, molecular organization of transcriptionally active DNA); Induction of transcriptional activity by environmental and horizontal factors; Translational control. Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

References:

1. Michael F Carey, Craig L Peterson, Stephen P Smale. (2009). *Transcriptional regulation in eukaryotes: Concepts, strategies and techniques*. 2nd edition. CSH Press.
2. Ajit Kumar. (2013). *Eukaryotic gene regulation*. 2nd edition. Springer US.
3. David S Latchman (2008). *Eukaryotic transcription factors*. 5th edition. Elsevier.
4. Gerald M Kolodny. (2021). *Eukaryotic gene regulation*. Volume 2. Taylor & Francis.
5. Gurbachan S Miglani. (2013). *Gene regulation*. 1st edition. Alpha Science International Limited.

Course code	Cancer genetics	Course type	L	T	P	C	CH
B25GN0803		DSC	2	0	0	2	2

Prerequisites:

1. Students should be aware of basic estimation protocols.
2. They should be confident with the fundamentals of instrumentation.

Course Objective:

The objective of the course is to:

1. Learn the DNA repair mechanisms.
2. Study the characteristics of cancer and carcinogens.

Course outcomes:

After completing the course, the student shall be able to:

1. Illustrate the different DNA repair mechanisms
2. Outline the relevance of genes in cancer development.
3. Highlight the types and characteristics of cancer.
4. Deduce the effect of different types of carcinogens.
5. Predict the mechanism of action of carcinogens.
6. Understand the mechanism of viral oncogenesis.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0803	CO1	2	1	2	2	2	3	3	2	2	2	2	2	2	2
	CO2	3	3	2	2	2	3	3	3	3	3	2	3	2	2
	CO3	1	2	1	1	3	3	3	1	2	3	2	2	3	2
	CO4	3	1	3	1	3	1	2	3	3	1	2	3	3	2
	CO5	2	3	3	2	3	3	3	3	3	3	2	3	3	2
	CO6	2	3	3	3	2	2	3	2	3	3	2	1	3	2

Course contents:

UNIT I **12 h**

DNA damage and repair mechanisms: Introduction, DNA damage, types of DNA repair and their mechanisms – Direct repair, Base excision repair, Nucleotide excision repair, mismatch repair, recombinational repair, Photoreactivation, SOS repair; DNA repair genes, role of P53 gene in DNA repair and apoptosis. Brief mention of DNA repair defects in Human diseases – Ataxia telengiectasia, xeroderma pigmentosum.

Unit II **12 h**

Cancer and carcinogenic agents: Introduction, neoplasia, anaplasia, metaplasia and hyperplasia, types of cancer- benign, malignant, metastatic cancers. Carcinomas, sarcomas, adenomas, haemopoetic cancers. Characteristics of cancer cells - changes in cell membrane structure and functions, tumor angiogenesis.

Carcinogenic agents – Physical, chemical and biological agents in carcinogenesis. Historical highlights, types of chemical carcinogens; direct acting, pro-carcinogens, co-carcinogens, mechanism of their action. Viral carcinogenesis – Role of viruses in causation of human cancer; Tobacco and diet related cancers

References:

1. Francesco Pezzella, Mahvash Pavassolli and David J Kerr. (2019). *Oxford textbook of cancer biology.* 1st edition. OUP Oxford.
2. Raymond W. R (2007) *Cancer Biology*, Oxford University Press, New York.
3. Lewis J. Kleinsmith. (2016). *Principles of Cancer biology*. 1st edition. Pearson Education India.
4. Roger King and Mike Robins. (2006). *Cancer biology*. 3rd edition. Prantice Hall.
5. Robin Hesketh. (2023). *Introduction to cancer biology*. 2nd edition. Cambridge press.

Course code	Recombinant DNA	Course type	L	T	P	C	CH
B25GN0804	Technology Lab	DSC	0	0	2	2	3

Prerequisites:

1. Students should be knowing the basic gene transfer concepts.
2. They should be aware of genome organization of the organisms.

Course Objective:

The objective of the course is to:

1. Study the protocol of restriction digestion of DNA.
2. Prepare competent cells in E. coli.
3. Study the protocol of PCR and DNA sequencing.
4. Study the types and significance of molecular markers

Course outcomes:

After completing the course, the student shall be able to:

1. Illustrate the mechanism of restriction digestion of DNA.
2. Deduce the preparation of competent cells.
3. Equipped to perform transformation experiments through different methods.
4. Characterize the types and mechanism of blotting.
5. Elucidate the ligation of DNA.
6. Apply the knowledge of r-DNA techniques to their research ideas.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0804	CO1	2	2	2	2	2	2	1	2	1	1	2	2	3	2
	CO2	1	2	2	2	3	2	1	2	2	2	2	3	1	1
	CO3	3	2	1	2	3	2	2	2	2	2	2	3	2	2
	CO4	1	2	1	2	2	2	1	2	2	2	2	3	3	2
	CO5	2	2	2	2	3	2	2	2	2	1	2	2	3	2
	CO6	3	3	2	3	2	2	1	2	2	2	2	2	3	2

Course contents:

1. Restriction enzyme digestion of DNA
2. Capillary gel electrophoresis
3. Preparation of competent cells in *E. coli*
4. Transformation through $CaCl_2$ methods
5. Transformation through PEG methods.
6. Study of PCR methods
7. Study of Blotting techniques.
8. Study of Ligation of DNA

References:

1. Primrose SB and Old. (2013). *Principles of Gene manipulation.* 7th edition. Wiley-Blackwell Scientific Publications,
2. Terence A. Brown. (2020). *Gene cloning and DNA analysis: an introduction*, 8th edition. Wiley- Blackwell.
3. M. R. Green, J. Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*. 4th edition. Cold Spring Harbor.
4. M. Wink.(2011). *An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology. 2nd edition.* Wiley.

5. Monika Jain. (2011). *Recombinant DNA Techniques – A textbook.* 1st edition. Narosa Publishing House.
6. Vance Hunter and Franky Strickland. (2018). *Applications of recombinant DNA technology*. 1st edition. ED-Tech Press.

Course code	Eukaryotic gene regulation lab	Course type	L	T	P	C	CH
B25GN0805		**DSC**	0	0	2	2	3

Prerequisites:

1. Students should have the basics of DNA sequences.
2. They should be aware of the cell signalling cascade.

Course Objective:

The objective of the course is to:

1. Study differential gene expression.
2. Induce chromosomal abnormalities by cyclophosphamide.
3. Study the susceptibility and resistance at various levels
4. Learn the MTT assay and the concept of mutations.

Course outcomes:

After completing the course, the student shall be able to:

1. Demonstrate the differential gene expression in Drosophila.
2. Understand the mitotic and meiotic abnormalities due to mutation induction.
3. Highlight the genetics basis of insecticide and susceptibility.
4. Outline the process of MTT assay.
5. Deduce the cell viability using tryphan blue.
6. Identify and categorize different types of mutations.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0805	CO1	2	3	3	2	2	2	1	2	1	3	2	2	1	1
	CO2	2	2	3	3	3	3	3	3	3	3	2	3	1	1
	CO3	2	1	2	2	2	3	2	1	2	3	2	3	3	3
	CO4	2	1	1	1	1	2	2	2	3	3	2	3	3	1
	CO5	1	1	1	1	3	3	3	3	3	3	2	2	3	2
	CO6	2	2	2	2	2	2	3	2	2	3	2	2	3	1

Course contents:

1. Differential gene expression: demonstration of ecdysone/heat-induced gene expression in polytene chromosome of *Drosophila*
2. Induction of chromosomal abnormalities by treating with cyclophosphamide.
3. Genetic basis of insecticide resistance.
4. Susceptibility studies by using different insecticides in *Culicine* mosquitoes.
5. Genetic basis of insecticide resistance by using adulticide.
6. Gene expression profiling for normal genes *in-silico*.
7. Gene expression profiling for mutant genes *in-silico*.
8. Gene expression profiling for a plant gene *in-silico*.

References:

1. Michael F Carey, Craig L Peterson, Stephen P Smale. (2009). *Transcriptional regulation in eukaryotes: Concepts, strategies and techniques*. 2nd edition. CSH Press.
2. Ajit Kumar. (2013). *Eukaryotic gene regulation*. 2nd edition. Springer US.
3. David S Latchman (2008). *Eukaryotic transcription factors*. 5th edition. Elsevier.
4. Gerald M Kolodny. (2021). *Eukaryotic gene regulation*. Volume 2. Taylor & Francis.
5. Gurbachan S Miglani. (2013). *Gene regulation*. 1st edition. Alpha Science International Limited.

Course code	Cancer genetics Lab	Course type	L	T	P	C	CH
B25GN0806		**DSC**	0	0	2	2	3

Prerequisites:

Students should be having the knowledge of cell biology and cell cycle checkpoints.

Course Objective:

The objective of the course is to:

1. Know the cytotoxic assays
2. Evaluate the DNA damage by different assays.
3. Study the in-silico analysis of cancer genes.
4. Study the genetic damage by micronucleus assay.

Course outcomes:

After completing the course, the student shall be able to:

1. Elucidate the cytotoxic activity using different assays.

2. Deduce the genetic damage using micronucleus assay.
3. Interpret the diagnosis cytogenetically by karyotype analysis.
4. Identify cancer-related genes in silico by variant analysis.
5. Predict the importance of mitotic index in cancer diagnosis.
6. Perform comprehensive transcriptome analysis of cancer.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0806	CO1	2	1	3	1	3	3	3	2	3	2	2	3	2	2
	CO2	2	2	2	2	3	2	1	2	2	2	2	3	2	2
	CO3	3	2	1	2	3	2	2	2	2	2	2	3	1	1
	CO4	1	2	1	2	2	2	1	2	2	2	2	2	3	1
	CO5	2	2	1	2	2	3	2	2	2	1	2	2	3	2
	CO6	3	3	2	3	2	2	1	2	2	2	2	2	3	3

Course contents:

1. Comparative study between normal and cancer karyotypes.
2. Studying the prognostic role of Mitotic index calculation in cancer diagnosis.
3. Evaluation of DNA damage by single cell gel electrophoresis.
4. Trypan blue dye exclusion test.
5. Cell cycle analysis using flow cytometry.
6. Comprehensive transcriptome analysis of cancer.
7. Identification of cancer-related genes and subsequent variant analysis.
8. Study of genetic damage by micronuclei assay.

References:

1. Francesco Pezzella, Mahvash Pavassolli and David J Kerr. (2019). *Oxford textbook of cancer biology.* 1st edition. OUP Oxford.
2. Raymond W. R (2007) *Cancer Biology*, Oxford University Press, New York.
3. Lewis J. Kleinsmith. (2016). *Principles of Cancer biology*. 1st edition. Pearson Education India.
4. Roger King and Mike Robins. (2006). *Cancer biology*. 3rd edition. Prantice Hall.
5. Robin Hesketh. (2023). *Introduction to cancer biology*. 2nd edition. Cambridge press.

Course code		Course type	L	T	P	C	CH
B25GNS811	Applied Microbial technology	DSE	2	0	0	2	2

Prerequisites:

1. Students should know the basics of microbiology.
2. Students should be aware of the fundamentals of fermentation.

Course Objectives:

The objectives of the course is to:

1. Know the fundamental parameters of fermentation.
2. Study the upstream processing of microbial fermentation.
3. Understand the down stream processing of the fermentation.
4. Learn the scaling up of microbial production of recombinant proteins.

Course outcomes:

After completing the course, the student shall be able to:

1. Enlist the milestones of microbial innovations for human well-being.
2. Substantiate the requirements and regulation of fermentation process.
3. Plan the upstream process relevant to the desired product.
4. Strategize the downstream processing to obtain the optimum product.
5. Outline the production of recombinant molecules.
6. Explain the significance and limitations of metabolic engineering.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS811	CO1	1	2	2	1	2	1	2	2	1	1	2	2	1	2
	CO2	2	2	2	2	2	2	2	3	3	3	2	2	1	1
	CO3	2	2	2	1	2	3	2	1	2	3	2	3	2	2
	CO4	3	3	3	3	3	3	3	3	3	3	2	3	3	1
	CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	2
	CO6	3	3	2	3	2	2	1	1	1	1	2	2	3	1

Course contents:

Unit -I **12 h**

Introduction to microbiology. Microbial innovations in pharmaceutical, health, agricultural and industrial sectors; Strategies for selection and improvement of industrial strains of microorganisms; Metagenomics of the isolation of genes for novel compounds.

Process Development: optimization of bio-process development, scale up of bioprocess, general concepts of fermenter. batch, fed and continuous fermentation.

Unit -II **12 h**

Downstream process, purification and characterization of industrially important microbial products; Primary and secondary metabolites; Industrial production of antibiotics, biofuel, steroids and single cell proteins; Peptide antibiotics of bacteria and its role to combat antimicrobial resistance. Metabolic engineering of antibiotics. Maintenance and containment of recombinant molecules.

References:

1. Purohit, S.S., (2006). *Agricultural Biotechnology*, Agribios, Jodhpur.
2. Alexander N. Glazer & Hiroshi Nikaido. (2007). *Microbial Biotechnology – Fundamentals of Applied Microbiology*. 2nd edition. Cambridge University Press.
3. Shikie Liu. (2020). *Bioprocess Engineering. Kinetics, sustainability and reactor design*. 3rd edition. Elsevier.
4. Michael L. Shuler & Fikret Kargi. (2017). *Bioprocess engineering Basic concepts*. 3rd edition. Prentics Hall.
5. Pauline M. Doran. (2013). *Bioprocess Engineering Principles.* 2nd edition. Elsevier.

Course code	Pharmacogenomics and Nutrigenomics	Course type	L	T	P	C	CH
B25GNS812		DSE	2	0	0	2	2

Prerequisites:

1. Students should know the concepts of clinical trials and drug metabolism.
2. Students should be aware of the basics of nutrition.

Course Objective:

The objective of the course is to:

1. Know the concept of drug designing and genetic variation associated with personalized medicine.
2. Learn the pharmacokinetics and pharmacodynamics of the drug metabolism.
3. Know the basics of nutrition and nutrition-related management of diseases.
4. Study different biomarkers and tools used in nutrigenomics.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the drug designing process.
2. Elucidate the response of individuals to drug metabolism and effects.
3. Correlate the pharmacokinetics and pharmacodynamics of the drug.
4. Outline the significance of nutrition in management of certain diseases.
5. List out different biomarkers for genetic susceptibility.
6. Apply the relevant tools for nutrigenomic research and analysis.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GNS812	CO1	2	1	2	1	2	2	1	1	1	2	2	2	1	1
	CO2	2	3	3	1	3	2	2	2	1	1	2	3	1	1
	CO3	1	2	2	1	2	3	2	1	2	3	2	3	2	2
	CO4	2	2	2	2	2	2	2	2	2	2	2	3	3	1
	CO5	1	1	2	1	2	3	1	2	1	1	2	3	3	2
	CO6	3	3	2	3	2	2	1	1	2	2	2	2	3	2

Course contents:

UNIT I **12 h**

Fundamentals of Pharmacogenomics: Introduction to Basic Concept of Pharmacogenomics. Personalized Medicine- Introduction and Importance. Pharmacogenomics Necessity in Drug Designing Introduction to Genetic Variation. Types of Variants, SNPs, Coding and Cis/Trans Regulatory Variants, Insertion/Deletions Pharmacokinetics (PK), Pharmacodynamics (PD) Safety Metabolisms Pharmacology, ADME Definition of Toxico-genomics, Detoxification and Poisoning.

UNT II **12 h**

Fundamentals of Nutrigenomics

Introduction. Nutritional genetics vs nutritional genomics. Nutrients modulating genome expression – nutrient as signal molecule, mechanisms of nutrient perception Nutrigenetic diseases and Nutrigenomic diseases – PKU, Obesity, CVD, Cancer, Inflammation, Diabetes. Variation in human populations - gene polymorphism, SNP, nutritional implications; personalized nutrition Advanced Tools in Nutrigenomics - Genetic selection- insertional inactivation and alpha complementation.

References:

1. T.A. Brown (2010) *Gene cloning and DNA analysis*, 6th edition, Wiley Blackwell publication
2. N A Glick and Pasternak. (2010). *Molecular Biotechnology, Principles and application of recombinant DNA.* 4th Edition. American Society for Microbiology.
3. Prakash, Girish Sharma. (2013). P*hytochemicals of Nutraceutical Importance*. 1st edition CAB International
4. Gopinadhan Paliyath, Marica Bakovic, Kalidas Shetty. (2011). *Functional Foods, Nutraceuticals and Degenerative Disease Prevention.* Wiley-Blackwell.
5. J. Alfredo Martinez, Martin Kohlmeier, Raffaele De Caterina. (2019). *Principles of Nutrigenetics and Nutrigenomics Fundamentals of Individualized Nutrition.* Elsevier Science

Course code	**Research Project/ Internship**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0807		**DSE**	**0**	**0**	**6**	**6**	**12**

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and methodology.
6. Describe the statistical procedures in the interpretation of results.

Mapping of Course Outcomes with program Outcomes

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25GN0807	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. Honors in Biochemistry
Seventh Semester
Detailed Syllabus

Course Code	Clinical Biochemistry	Course Type	L	T	P	C	CH
B25BC0701		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stake holders have a basic knowledge of body fluids and their composition, role and metabolic activities with anatomy and physiology of vital organs.

Course Objectives:

1. To understand the need and methods of various biological sample collection.

2. To understand the pathogenesis, symptoms and complications of Diabetes Mellitus and the understand the relevant laboratory testing to evaluate the disease severity

3. To know the various disorders associated with electrolytes imbalance.

4. To understand the scope of clinical biochemistry testing in Laboratories.

Course Outcomes:

After completing the course, the student shall be able to:

1. To appreciate the biological significance of sample collection and awareness of the screening tests to detect common non-communicable diseases.
2. To understand the etiology of metabolic diseases like DM so as to modify the lifestyle and correlate the symptoms with pathology based on certain markers.
3. To understand the anemia and evaluate clotting based on specific diagnostic markers and for HbA1c concern
4. To understand the clinical significance of electrolyte imbalance which is critical.
5. To understand the clinical significance of Blood grouping and its importance.
6. To understand the clinical significance of HbA1c with Glucometers for maintain glucose level.

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO	PSO	PSO
B25BC0701	CO1	3	2	3	2	3	3	1	1	2	1	2	2	3	2
	CO2	3	0	1	2	3	2	0	1	2	1	2	2	3	2
	CO3	2	2	3	1	1	1	0	0	1	2	2	2	2	1
	CO4	2	2	3	2	2	1	1	0	1	2	2	1	2	1
	CO5	3	1	3	2	1	1	0	0	2	1	2	2	2	2
	CO6	3	1	3	2	1	1	1	0	2	2	2	2	2	3

Course Contents

UNIT- I **12 hrs.**

Biological investigations in diagnosis, screening, monitoring, prognosis:

Specimen collection–blood,(primary/Secondary specimen).,urine and CSF.Preservation of biological specimens-blood, urine, CSF and amniotic fluid; .Biological reference ranges of all secondary metabolites.

Disorders of Blood cells: Hemolytic, iron deficiency and aplastic anemia and diagnosis, sickle cellanaemia,thalassemia.Porphyrias,Thrombocytopenia,Causesofleucopenia,leukemiaandleucocytosis. Disorders of blood clotting mechanism - Von willebrand's disease, Hemophilia A, B and C, diagnostic test for clotting disorders.

UNIT-II **12 Hrs**

Diabetes mellitus: Pathology and complications: Acute changes; Chronic complications: Diabeticnephropathy, neuropathy, retinopathy and diabetic foot ulcers, Random/Fasting/PP glucose testing, Impaired glucose tolerance (IGT),Impaired fasting glucose (IFT), Diagnosis-by GTT, Pre-diabetes, Gestational DM,Glycosylated Haemoglobin (HBA1c) ; Glycated albumin, Hypoglycaemia and critical alert value for glucose. Markers of complications of Diabetes mellitus: Metabolic syndrome, Lipid profile & lipoproteinemia, Atherosclerosis, Diabetic nephropathy, Micralbuminuira, eGFR. Point of care testing for glucose (Glucometers) and continuous glucose monitoring (CGM): principle and its use. Major groups of anti-diabetic drugs with suitable examples like Metformin etc.

Unit-III **12 hrs**

Electrolyte imbalance:

Calcium: hypercalcemia and hypocalcemia; Calcium homeostasis in blood. Phosphorus: hyper phosphatemia or hypophosphatemia, Clinical significance of Serum Bicarbonate, potassium: hyperkaliemia and hypokalaemia, Sodium: hypernatremia and hyponatremia; Chloride: hyperchloremia and hypochloremia

Unit-IV 12 hrs

Diagnostic Enzymology: Clinically Important Enzymesand Isoenzyme as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK,γ-GT,amylase,pseudocholinesterase, Patternin.Myocardialinfarction;Liverdisease, Bone disease ,Muscle disease, Cancer (tumor markers),GI tract pancreatitis ;Enzymes as therapeutic agents.

Pre and postnatal testing: Amniocentesis, Inherited Metabolic Disorders (IMD) and the various types; Tandemmass spectrometry application for Newborn screening(NBS)

References:

1. Thomas M.Devlin (2014) Textbook of Biochemistry with Clinical Correlations(7th ed). John Wiley &Sons
2. MontgomeryR, Conway TW, ,Spector AA(1996),Biochemistry :ACase-Oriented Approach(6thed),Mosby Publishers, USA.
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2018) (8th ed), Saunders Ltd.
4. Dinesh Puri, (2020) Textbook of Biochemistry: A clinically oriented approach– 4th Edition,
5. M.N.Chatterjee and Rana Shinde (2012). Textbook of Medical Biochemistry (8th ed), Jaypee Brothers Medical Publishers.
6. .R. N. Walmsley, G. H. White, (1994) A Guide to Diagnostic ClinicalChemistry,3rd edition, Blackwell Scientific Publications.

Course Code	Molecular Endocrinology	Course Type	L	T	P	C	CH
B25BC0702		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stake holders have a basic knowledge of glands, their secretions, composition and its clinical significance.

Course Objectives:

1. To understand theIntroduction to Endocrinology and Hormone Action

2. To understand the location, anatomy and their physiological actions of Pituitary glands.

3. To understand the Hormones of Major Endocrine Glands like Adrenal, Thymus gland etc

4. To understandMolecular Techniques and Clinical Applications

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the various types of hormone s and their actions
2. Clear the hormones present in the pituitary hormones and their physiological actions.
3. To understand the mechanisms of actions of hormones like catecholamines and steorids
4. To understand the clinical significance of some hormones.
5. To understand the various types of Receptors and its importance.
6. To understand Molecular Techniques and Clinical Applications in hormone analysis.

Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO	PSO	PSO
B25BC070 2	**CO 1**	2	1	3	2	1	2	1	1	2	1	2	2	2	1
	CO 2	2	2	2	3	3	3	0	2	2	1	2	1	2	1
	CO 3	2	3	3	1	1	1	1	0	1	2	2	2	1	1
	CO 4	2	2	3	2	2	1	1	1	1	2	2	2	0	2
	CO 5	2	1	2	1	1	1	0	1	2	1	2	1	1	2
	CO 6	3	2	2	2	1	1	1	0	2	2	2	2	2	3

Unit- I **12 hrs**

Introduction to Endocrinology and Hormone Action

Basics of Endocrinology:

Definition, its scope and role at a molecular level; Chemical nature of hormones (Amino-acid derived hormones, Peptide hormones, Glyco-protein hormones, Steroid hormones); Mechanisms of hormone secretion and its regulation. Endocrine disruptors: examples and mechanism (Pesticides, Heavy metals and Microplastics) Hormone Transport and Metabolism: Transport of hormones in the blood, Hormone receptors: GPCRs and Enzyme-linked receptors, Hormone metabolism.

Unit- II **12 hrs**

Hypothalamic-Pituitary Axis:

Structure and Function of the Hypothalamus, Hypothalamic hormones, Regulation of pituitary function. Anterior Pituitary Hormones: Growth hormone (GH) and insulin-like growth factors (IGFs). Prolactin, adrenocorticotropic hormone (ACTH), and thyroid-stimulating hormone (TSH). Posterior Pituitary Hormones: Oxytocin and vasopressin: biosynthesis, regulation, and function. Hypothalamic-pituitary axis related disorders

Unit- III **12 hrs**

Hormones of Major Endocrine Glands:

Thyroid Gland: Synthesis and regulation of thyroid hormones, Mechanisms of action and physiological effects, Thyroid disorders. Adrenal Gland: Adrenal cortex hormones: glucocorticoids, mineralocorticoids, and androgens. Adrenal medulla hormones: epinephrine and norepinephrine, Stress response and adrenal disorders. Pancreatic Hormones: Insulin and glucagon: biosynthesis, secretion, and action, Regulation of blood glucose levels, Diabetes mellitus and hypoglycemia. Gonadal Hormones: Estrogens, androgens, and progesterone: biosynthesis and function Regulation of reproductive function, Reproductive endocrinology disorders.

Unit-IV **12 hrs**

Molecular Techniques and Clinical Applications

Molecular Techniques in Endocrinology: Polymerase chain reaction (PCR), real-time PCR, and DNA sequencing, Immunoassays and ELISA

Diagnostic techniques for endocrine disorders, Hormone replacement therapy.

Reference books:

1. "Molecular Endocrinology" by Franklyn F. Bolander (2000), 2nd edition, Publisher- Academic press.
2. "Basic and Clinical Endocrinology" by Francis S. Greenspan and Gordon J Strewler (1997), 5th edition, Publisher- Appleton & Lange.
3. "Textbook of Endocrine Physiology" by William J. Kovacs and Sergio R. Ojeda (2011), 6th edition, publisher: Oxford University Press.
4. "Molecular and Cellular Endocrinology" edited by John A. Thomas and Roy O. Greep
5. "Goodman and Gilman's: The Pharmacological Basis of Therapeutics" by Laurence L. Brunton, Randa Hilal-Dandan, and Bjorn C. Knollmann (2023), 14th Edition publisher: Mc Graw Hill

Course Code	Plant Biochemistry	Course Type	L	T	P	C	CH
B25BC0703		DSC	3	0	0	3	4

Prerequisites

The stake holders have a basic knowledge of Plant biochemistry and its significance.

Course Objectives:

1. To understand the Introduction to Plant growth regulators& Molecular view of in vitro morphogenesis.
2. To understand. Soma clonal and gametoclonal variations, in vitro mutant isolation, their characterization
3. To understand the Secondary metabolites and its importance.
4. To understandPhysiology and biochemistry of plant disease:

Course Outcomes:

After completing the course, the student shall be able to:

1. To understand the effects of plant growth regulators& its role.
2. To understand bioreactors. Genome reorganization & its role.
3. To understand the Secondary metabolites& its importance in plant kingdom.
4. To understand the Physiology and biochemistry of plant disease.
5. To understand the plant embryogenesis and its significance.
6. To understand Different types of cell cultures used in plant seed production.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO	PSO	PSO
B25BC0703	CO 1	3	3	2	1	1	1	0	0	2	0	2	3	2	0
	CO 2	3	2	2	3	3	1	2	1	2	1	2	3	3	1
	CO 3	3	2	1	1	2	1	2	0	2	1	2	2	1	0
	CO 4	3	2	3	2	0	1	1	1	2	2	2	2	2	0
	CO 5	3	2	0	2	3	1	1	0	3	1	2	2	1	1
	CO 6	2	1	1	3	2	0	1	0	1	1	2	2	3	2

Unit I: **12 hours**

Historical developments and basic techniques: Discoveries and landmarks in plant tissue culture; Formulation of media for plant tissue culture; Plant growth regulators - uptake, metabolism and action, their involvement in plant differentiation and morphogenesis. Concept of totipotency: Induction of morphogenesis in vitro. Somatic embryogenesis and organogenesis. Factors affecting somatic embryogenesis and organogenesis; Molecular view of in vitro morphogenesis.

Unit II: **12 hours**

Callus and cell suspension cultures: Initiation and maintenance, Continuous and Batch cultures, Mass cultivation of plant cells using bioreactors. Genome reorganization induced in vitro: Somaclonal and gametoclonal variations, in vitro mutant isolation, their characterization and uses. Different types of cultures: Meristem culture, zygotic embryo culture, endosperm culture, anther/pollen and unfertilized ovule cultures, synthetic seeds, germ plasm storage in vitro - Importance and applications.

Unit III: **12 hours**

Secondary metabolites: Cell cultures and hairy root cultures for secondary metabolite production, strategies used for enhanced production of secondary metabolites, Biotransformation using plant cell cultures. Protoplast isolation and somatic hybridization: Isolation, purification and culture of protoplasts, Methods used for protoplast fusion, somatic hybridization/cybridization –selection systems for somatic hybrids/cybrids, their characterization and applications.

Unit IV: **12 hours**

Physiology and biochemistry of plant disease: Primary metabolism, Secondary metabolism, role of cell wall in plant defense defensins, phytoalexins, common phenolics, host specific toxins, host non-specific Toxins. Host-pathogen interaction: hormones and signaling, systemic acquired resistance, Induce Systemic acquired resistance, Pathogenesis-related (PR)-proteins. Transgenic and genetic manipulation approaches: Molecular marker approach to tag disease resistance and virulence genes.

References.

1. Biochemistry and Molecular Biology of Plants by Bob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones: 2nd edition from 2015, Wiley.
2. Biochemistry & Molecular Biology of Plants by Bob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones: 2nd edition 2015, Wiley.
3. Plant Physiology by Lincoln Taiz and Eduardo Zeiger: 6th edition 2014, Sinauer Associates, Inc.
4. Plant Biochemistry by Hans-Walter Heldt: 4th edition 2011, Academic Press.

5. Plant Cell and Tissue Culture edited by Indra K. Vasil and Trevor A. Thorpe: The latest available edition 2010 by Springer (SpringerLink) (Barnes & Noble).
6. Natural Products from Plants by Leland J. Cseke et al.: 2nd edition 2006, CRC Press.
7. Plant Biochemistry and Molecular Biology by P.J. Lea and R.C. Leegood: 2nd edition 1999, John Wiley & Sons.
8. Natural Products from Plants by Peter B. Kaufman et al.: 1st edition 1999, CRC Press LLC.
9. Chemicals from Plants: Perspectives on Plant Secondary Products by N.J. Walton and Diane E. Brown: 1st edition 1999, Imperial College Press and World Scientific Publishing Co. Ltd.

Course Code	**Laboratory Course –VII**	**Course Typ**	**L**	**T**	**P**	**C**	**CH**
B25BC0704	**Clinical Biochemistry.**	**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Need the basic concept of Clinical biochemistry

Course Objective:

1. To learn and the investigation of biological samples, clinical approach, normal values of biochemical constituents and clinical interpretations
2. To inculcate the knowledge of collection, preservation of blood sample and learning various hematological parameters and their significance.
3. To evaluate lipid profile and assess the correlation to cardiac function.
4. To perform experiments to estimate blood glucose and glycosylated hemoglobin.

Course outcomes:

After completing the course, the student shall be able to:

1. Learn the normal values and its importance.
2. Collection and preservation process of clinical samples.
3. Identify the clinical importance of lipid profile.
4. The importance of HbA1c in the DM affected persons.
5. Identify the clinical importance GTT in the analysis of Sugars.
6. To determine the working procedure of kidney by Creatinine clearance test.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
B25B C 0704	**CO 1**	2	3	2	1	2	2	2	1	2	2	2	2	2	2
	CO 2	3	1	3	2	1	2	0	1	2	2	2	1	2	1
	CO 3	2	3	3	2	2	2	1	0	2	2	2	2	1	1
	CO 4	1	2	3	1	1	1	2	0	1	1	2	1	1	1
	CO 5	1	2	3	2	1	1	1	1	2	2	2	2	1	1
	CO 6	2	2	2	1	1	1	2	0	1	1	2	2	3	1

Course Contents

1. Determination of RBC count, WBC count.
2. To determine total differential count, ESR,
3. To determine PCV, MCV. Bleeding Time, Clotting Time.
4. Determination of glycosylated Hb. Kit method
5. To determine the Lipid profile in the serum sample.
6. Estimation of triglycerides in the serum sample.
7. Urea Clearance test like Creatinine clearance test
8. Performance of Glucose tolerance test

Reference.

1. Practical Clinical Biochemistry- Varley'sbyAlanHGowenlock, published by CBS Publishers and distributors,India, 6th Edition,1988.
2. Manipal Manual of Clinical Biochemistry (For Med.Lab.and MscStud.)2013 (4th Ed.)
3. Case Oriented Approach in Biochemistry-Dr. Rajesh Kawaduji Jambhulkar,Dr. AbhijitD. Ninghot:2019First Edition
4. Medical Lab Technology Vol. I&II, Kanai L Mukerjee NewDelhi: Tata Mc graw Hill Publishing Company,1996.
5. Practical Biochemistry– Plummer, New Delhi:Tata Mcgraw Hill Publishing Company, 2000.

Course Code	**Laboratory Course –VIII Molecular Endocrinology**	**Course Typ**	**L**	**T**	**P**	**C**	**CH**
B25BC0705		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Need the basic concept of molecular endocrinology.

Course Objective:

1. To learn and the estimation of T3&T4
2. To learn and the estimation of FSH and LH
3. To learn and the estimation of TSH
4. To learn about Triple test and its importance.

Course outcomes:

After completing the course, the student shall be able to:

1. Learn the normal values and its importance. of T3& T4
2. Learn the normal values and its importance of FSH &LH
3. Learn ELISA to diagnose Thyroid Disorders
4. Learn TRIPLE test and its importance.
5. Understand the thyroid functions using immunoassay.
6. Acquire the knowledge of PCR for nucleic acid study.

Mapping of Course Outcomes with programme Outcomes

Course Cod	POS / COs	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25BC 0705	**CO 1**	3	2	3	2	1	1	0	1	1	1	2	2	2	1
	CO 2	2	2	2	2	1	2	1	0	2	2	2	2	2	1
	CO 3	3	2	3	1	1	1	1	0	1	1	2	1	2	1
	CO 4	2	1	1	2	1	2	1	1	3	2	2	2	2	1
	CO 5	2	2	3	2	2	2	2	0	2	1	2	2	2	2
	CO 6	1	1	2	2	1	2	1	1	3	1	2	2	1	2

Contents:

1. To determine T3 concentration in serum sample.
2. To determine T4 concentration in serum sample.
3. To determine TSH concentration in serum sample.
4. To determine LH concentration in serum sample.
5. To determine FSH concentration in serum sample.
6. To perform TRIPLE test

7. To determine Prolactin concentration in serum sample

8. Nucleic acid extraction from Endocrine gland and its amplification through PCR

9. ELISA to diagnose Thyroid Disorders

<u>Reference Books:</u>

1. Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications
2. Bishop(2013),Clinical Chemistry,7th edition, Wiley Publications
3. Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22nd edition, Elsevier
4. D M Vasudevan, (2011),Text book of Medical Biochemistry,6th edition Jaypee Publishers
5. M N Chatterjee & Rana Shinde,(2012),Text book of MedicalBiochemistry,8th edition, Jayppe Publications
6. Singh & Sahni,(2008),Introductory Practical Biochemistry,2nd edition, Alpha science
7. Lehninger,(2013),Principles of Biochemistry,6th edition, W H Freeman.

Course Code	**Laboratory Course –IX**	**Course Typ**	**L**	**T**	**P**	**C**	**CH**
B25BC0706	**Plant Biochemistry lab**	**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Need the basic concept of Plant biochemistry.

Course Objective:

1. To learn the preparation and culturing of Tissue cells

2 To learn about immobilization of cells from plant tissues.

3. To learn about Xanthomatos with citric acid cells

Course outcomes:

After completing the course, the student shall be able to:

1. Understand the separation and importance of tissue cells.
2. Understand the separation and importance of immobilization cells.
3. Understand the importance of callus culture in the biological samples.
4. Determine the importance of callus culture by various techniques for checking the plant viability.
5. To determine the use of Direct and indirect organogenesis in plant cultures.

6. Understand the isolation of Xanthomonas citric acid and its importance.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25B C 0706	CO 1	3	2	3	2	2	1	1	2	1	2	2	3	2	2
	CO 2	3	2	1	2	3	0	2	2	3	0	2	2	1	3
	CO 3	1	0	1	2	3	2	0	0	1	0	2	1	0	2
	CO 4	2	2	2	0	1	0	3	1	2	1	2	2	3	2
	CO 5	1	2	1	2	3	2	1	2	2	1	2	2	1	1
	CO 6	3	2	0	2	2	0	2	0	2	1	2	2	2	3

Course Contents:

1. Media preparation and sterilization for culturing plant tissues cells.
2. Establishment of callus cultures from explants obtained from in vitro germinated seedlings and soil grown plants.
3. Regeneration of plants through direct organogenesis from cultured explants, and indirect organogenesis from callus cultures.
4. Establishment of direct somatic embryogenesis by culturing zygotic embryo axes explants.
5. Immobilization of cell/callus cultures by gel entrapment using calcium alginate and assessment of callus growth/cell viability.
6. Acclimatization of in vitro regenerated plants in the soil.
7. Estimation of plant hardening and monitoring of its growth.
8. Isolation of Xanthomonas citric acid from citrus canker infected plant leaves.

Reference:

1. Plant Biochemistry Hans-Walter Heldt; 5th Edition, 2021, Elsevier
2. Biochemistry and Molecular Biology of Plants Buchannan B, Gruiseem W, Jones R, ASPP, Maryland; 2nd Edition 2015, Wiley.
3. Plant Tissue Culture: Applications and Limitations By S. S. Bhojwani, 2013, Elsevier

Course Code	**System Biology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BCS711		**DSEC**	**3**	**0**	**0**	**3**	**2**

Course Objective:

- Understand the scope of biochemistry and molecular biology in animal sciences.
- Learn about the maintenance of cell culture, growth kinetics and type of media.
- To know about biochemical constituents in various tissues and their related disorders.
- To gain knowledge in clinical biochemistry

Course Outcomes:

After completing the course, the student shall be able to:

1. Understand the scope of biochemistry and molecular biology in animal sciences.
2. Learn about the cell culture, growth of cell culture and different types of media.
3. Know various metabolic disorders concerned with deficiency and excess of biochemical constituents.
4. Acquire practical skills in clinical diagnostics of various diseases
5. To determine the importance of Mapping in the transcription networks

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO	PSO	PSO
B25B C S711	CO1	2	3	3	2	1	1	1	1	2	2	2	3	3	2
	CO2	2	3	3	2	1	1	1	1	2	2	2	3	3	2
	CO3	2	2	3	2	1	1	1	1	2	2	2	3	3	2
	CO4	2	2	3	2	1	1	1	1	2	2	2	3	3	2
	CO5	2	3	3	2	1	1	2	1	2	2	2	3	3	2
	CO6	2	3	3	3	2	1	2	1	2	2	2	3	3	2

Course Contents

UNIT I **6hrs**

Introduction and basic concepts in Biological systems : Definition and scope, Historical perspective and development, Importance and applications in modern biology, Biological networks and pathways, System-level properties (emergence, robustness, modularity), High-throughput data generation (genomics, proteomics, metabolomics), Data integration and pre-processing

UNIT II **6hrs**

Genotype-phenotype mapping, Concepts of genotypes and phenotypes, genotype networks and fitness Negative and positive regulation in transcription networks (Feed-forward loop, Oscillatory circuits)

UNIT III **6hrs**

Optimality and robustness in biological systems Principles of optimality. stochasticity in biological Data analysis investigating stochasticity. Next generation sequencing (NGS) and its applications NGS technologies.

UNIT IV **6 hrs**

Bioinformatic tools and techniques for high-throughput data analysis, Applications of NGS, Applications and Case Studies: Case Studies in Systems Biology: Cancer systems biology, Systems immunology, Neuro-informatics Applications: Drug discovery and personalized medicine, Synthetic biology and metabolic engineering, Evolutionary systems biology

REFERENCE BOOKS:

1. Alon, U. (2019). *An Introduction to Systems Biology: Design Principles of Biological Circuits* (2nd ed.). CRC Press. ISBN: 978-0367221094
2. Kitano, H. (2021). *Foundations of Systems Biology* (2nd ed.). MIT Press. ISBN: 978-0262044729
3. Pevsner, J. (2015). *Bioinformatics and Functional Genomics* (3rd ed.). Wiley-Blackwell. ISBN: 978-1118581789
4. Aderem, A., & Hood, L. (2016). *Systems Biology: Its Role in Disease and Medicine* (1st ed.). Springer. ISBN: 978-3319425233
5. Luscombe, N. M., & Greenbaum, D. (2020). *Bioinformatics for Systems Biology* (2nd ed.). Humana Press. ISBN: 978-1493981182
6. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. C. (2021). *Molecular Cell Biology* (9th ed.). W.H. Freeman. ISBN: 978-1319244361
7. Voit, E. O. (2017). *A First Course in Systems Biology* (2nd ed.). Garland Science.ISBN: 978-0815345688

Course Code	**Phytochemistry of Medicinal plants.**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BCS712		**DSE**	**3**	**0**	**0**	**3**	**2**

Course Objective:

1. To understand the field of phytochemistry, its scope, and significance in the context of medicinal plants.
2. To understand and identify different classes of phytochemicals, such as alkaloids,

flavonoids, terpenoids, and phenolics.

3. To understand phytochemical profiles and biological activities of different medicinal plants.
4. To understand the role of phytochemicals in drug discovery and development

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on fundamental concepts and historical development of phytochemistry.
2. Achieve knowledge on the structure of phytochemicals to their biological activities and potential health benefits.
3. Achieve knowledge on the phytochemical profiles of various medicinal plants and understand their diverse biological activities.
4. Achieve knowledge on how specific phytochemicals are used to prevent and treat diseases
5. Achieve knowledge on the Glycosides and Saponins in the biological activities.
6. Achieve knowledge on the Comparison of phytochemical profiles and biological activities of different medicinal plants.

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO	PSO	PSO
B25BCS712	CO 1	3	2	1	2	2	0	1	0	2	1	2	3	2	1
	CO 2	2	3	1	1	3	1	0	1	2	0	2	2	2	0
	CO 3	3	2	2	2	3	0	1	0	2	1	2	2	2	1
	CO 4	3	2	1	2	3	2	1	0	2	1	2	2	1	1
	CO 5	3	2	3	1	0	0	1	0	2	1	2	3	2	0
	CO 6	2	2	2	2	3	0	1	0	2	1	2	3	2	2

UNIT I **6 Hours**

Introduction to Phytochemistry and Medicinal Plants

Fundamentals of Phytochemistry: Definition, scope, and significance. Historical perspective and contemporary relevance. Chemical Composition of Medicinal Plants: Overview of plant primary, secondary metabolites, and introduction to key phytochemical classes such as alkaloids, flavonoids, terpenoids, phenolics, etc. Phytochemical Extraction and Analysis: Techniques for phytochemical extraction. Bioactivity Screening: Methods for evaluating biological activities of phytochemicals. Importance in drug discovery and development

UNIT II **6 Hours**

Phytochemicals and Their Biological Activities

Alkaloids: Structure, classification, and examples and biological activities and therapeutic applications. Flavonoids and Phenolics: Structure, classification, and examples and Antioxidant properties, anti-inflammatory and other biological activities. Terpenoids and Essential Oils: Structure, classification, and examples and biological activities and therapeutic applications. Glycosides and Saponins: Structure, classification, and examples and biological activities.

UNIT III **6 Hours**

Phytochemistry of Selected Medicinal Plants

Detailed Study of Select Medicinal Plants. Active constituents, therapeutic uses, and mechanisms of action of Turmeric (Curcuma longa), Neem (Azadirachta indica), Aloe Vera (Aloe barbadensis) and Ginseng (Panax ginseng). Comparative Phytochemistry: Comparison of phytochemical profiles and biological activities of different medicinal plants and Case studies and current research trends

UNIT IV **6 Hours**

Applications

Modern Applications of Phytochemicals: Role in drug discovery and development and Phytochemicals in nutraceuticals and functional foods and agriculture. Phyto-chemicals in Disease Prevention and Therapy: Anticancer, antidiabetic, cardiovascular, and neuroprotective properties and Mechanisms of action and clinical evidence.

Suggested Textbooks and References:

1. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson, E. M. (2018). Fundamentals of Pharmacognosy and Phytotherapy (3rd ed.). Elsevier. ISBN: 978-0702070082
2. Evans, W. C. (2021). Trease and Evans' Pharmacognosy (17th ed.). Elsevier. ISBN: 978-0702078668
3. Gilbert, N., & Maffei, M. (2020). Phytochemistry: The Chemistry of Plants (1st ed.). Oxford University Press. ISBN: 978-0198833031
4. Harborne, J. B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis (3rd ed.). Springer. ISBN: 978-0412572609
5. Balunas, M. J., & Kinghorn, A. D. (2018). Drug Discovery from Nature (1st ed.). CRC Press. ISBN: 978-1138556000
6. Croteau, R., Kutchan, T. M., & Lewis, N. G. (2000). Natural Products (Comprehensive Natural Products II) (1st ed.). Elsevier. ISBN: 978-0080912837
7. Tiwari, P., & Sinha, S. K. (2021). Phytochemistry of Medicinal Plants (1st ed.). Springer. ISBN: 978-3030736941

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS713	**AI Techniques in Biological Sciences**	**SEC**	**2**	**0**	**0**	**2**	**2**

Prerequisites: The student should know the basics of biology and computer science

Course Objectives

1. The course aims to understand the AI techniques used in Biological Sciences.
2. It introduced basic programming languages based on current industry applications.
3. It also helps to understand the existing AI tools used in various fields in Biological Sciences.
4. To understand AI techniques and integrate them in Biological Sciences.

Course Outcome

By the end of the course the student will be able to:

1. Students Can understand the AI based algorithm from a biological perspective.
2. Ability to perform basic programming related to AI techniques in Biology.
3. Analyze how AI can be implemented to better enhance the understanding of biological processes.
4. Evaluate existing AI tools and techniques to ensure they meet the requirements of biological research and processes.
5. Gain an understanding on the ethical aspects of AI in Biological Sciences
6. Ability to understand and apply basic AI algorithms in a research and industrial setting.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
B25BTS713	CO 1	3	3	2	3	3	2	1	1	2	3	2	3	1	2
	CO 2	3	3	3	2	2	2	1	1	2	2	2	3	1	2
	CO 3	2	2	2	2	3	2	1	0	2	3	2	2	1	3
	CO 4	2	3	3	2	3	3	1	2	3	3	2	3	2	3
	CO 5	3	3	2	2	2	3	2	0	2	3	2	2	2	2
	CO 6	1	3	2	3	2	1	3	3	3	3	2	3	2	2

Unit-I: Introduction to AI and ML in Biology 12 Hrs

Introduction to Machine Learning (ML) and Artificial Intelligence (AI), AI Basics: concepts, terminologies and workflow, Agents and Environments, Biological Intelligence Vs Artificial Intelligence Advantages and disadvantages, Neural Networks, Notations, Simple computing elements, network structures and applications, optimal network structures, comparing brains with digital computers.

Unit II: Applications of AI techniques in Biology 12 Hrs

Applications of AI in Biological Sciences, AI-driven applications-drug discovery and development, Clinical research and Omics studies, understanding biological data and preprocessing, expression analysis using AI techniques, Data privacy and Ethical case studies of AI applications.

Reference Books

1. Shailza Singh, "Machine Learning and Systems Biology in Genomics and Health", Springer Singapore 2022.

2. Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan Mohanty, Xiaobo Zhang, "Data Analytics in Bioinformatics: A Machine Learning Perspective" Wiley Online Library, 2021.

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B25BTS714	**AI Literacy in Health care**	**SEC**	**2**	**0**	**0**	**2**	**2**

Course Objectives

1. Assess AI-based tools and datasets, exploring methods to guarantee they adhere to medical standards.
2. Gain an understanding of the ethical challenges posed by AI in healthcare and ways to ensure minimizing biases in AI-driven decisions.
3. Gain an understanding of AI methodologies required for patient care.
4. Gain practical experience in identifying opportunities for AI applications to enhance patient care and research.

Course Outcome

By the end of the course the student will be able to:

1. Demonstrate the ability to understand the ethical challenges posed by AI in healthcare.
2. Demonstrate the ability to collaborate with AI scientists and healthcare professionals.
3. Analyse how AI can be implemented to better enhance healthcare initiatives.
4. Evaluate AI tools and techniques to ensure they meet medical standards.
5. Understand and apply basic AI algorithms in a healthcare setting.

6. Develop proficiency in utilizing existing AI tools for the management and analysis of patient data.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PS01	PS02	PS03
B25BTS71 4	**CO 1**	3	0	1	1	1	2	1	2	1	1	2	3	0	1
	CO 2	2	1	2	1	1	1	2	2	2	1	2	2	1	2
	CO 3	2	2	3	2	2	1	2	2	2	2	2	2	2	3
	CO 4	2	1	2	3	2	1	1	2	2	2	2	2	1	2
	CO 5	2	1	1	2	3	2	2	1	3	1	2	2	1	1
	CO 6	2	0	1	2	2	2	2	1	3	2	2	2	0	1

Course content

Unit-I: Introduction to AI Principles **12 Hrs**

Basics of machine learning, and artificial intelligence: Introduction Image processing, normalization techniques and interpretation of image data and applications, AI-driven decision support systems (ANN, KNN and SVM), Predictive modeling and patient monitoring using AI, AI applications in radiology and pathology for diagnostics, Role of AI in treatment planning and decision support.

Unit II: Challenges and Ethics in AI implementation **12 Hrs**

Ethical case studies of AI applications, scenarios of data breaches in AI applications, challenges of integrating AI into healthcare systems, Ethical considerations surrounding AI in patient autonomy and data privacy, Bias identification within AI models, the role of AI in managing Electronic Health Records (EHRs), Cutting-edge applications of AI, augmented reality (AR) and virtual reality (VR) in medicine, impact of AI on genomics and global health initiatives.

Reference Books

1. Peter Lee, Carey Goldberg, Issac Kohane (2023). The AI Revolution in Medicine: GPT-4 and beyond, Pearson.
2. Hugh Cartwright (2008). Using Artificial Intelligence in Chemistry and Biology: A Practical Guide, CRC Press.

B.Sc. Honors in Biochemistry

EIGHTH SEMESTER

Detailed Syllabus

Course Code	Cell and membrane biochemistry	Course Type	L	T	P	C	CH
B25BC0801		DSC	3	0	0	3	4

Prerequisites

The stake holders have a basic knowledge of Cell and membrane biochemistry

Course Objectives:

1. To understand the various components of cell membranes, including lipids, proteins, and carbohydrates.
2. To understand viscosity of membrane and various membrane transport mechanisms.
3. To understand basic steps involved in signal transduction pathways from ligand binding to cellular response.
4. To understand diseases that result from defects in membrane proteins and knowledge of drug delivery methods across the membrane.

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on basic composition and structural organization of membrane.
2. Achieve knowledge on the membrane fluidity and transport mechanisms that are regulated and integrated into cellular function.
3. Achieve knowledge on understanding basic principles of cell signalling
4. Achieve knowledge on understand the signal transduction pathways involving gpcs & rtks
5. Achieve knowledge on membrane-associated diseases
6. Achieve knowledge on membrane-targeted therapies

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25BC0801	CO1	2	3	2	1	1	1	0	1	1	1	2	3	2	0
	CO2	2	2	2	1	1	1	0	1	2	1	2	2	3	0
	CO3	2	2	3	1	1	1	0	1	2	1	2	2	2	1
	CO4	2	3	1	1	1	1	1	1	2	2	2	2	3	1
	CO5	3	3	1	2	1	1	0	1	2	2	2	2	2	0
	CO6	3	3	1	2	1	1	1	2	2	3	2	3	3	3

UNIT I **12 Hours**

Introduction to membrane, composition, and structure

Introduction to plasma membranes. Importance and functions in cellular processes. Structure of plasma membrane: fluid mosaic models, Lipid Bilayer Structure (composition of phospholipids, glycolipids, and sterols), membrane asymmetry and lipid rafts. Membrane Proteins: Integral and peripheral proteins, Protein-lipid interactions and membrane protein structure and function. Carbohydrates in Membranes: Glycoproteins and glycolipids and their role in cell recognition and signalling. Prokaryotic membrane composition and structure in Archaea and Bacteria. Eukaryotic membrane structure- Human Eryhtrocyte Membrane.

UNIT II **12 Hours**

Membrane Dynamics and Transport Mechanisms

Membrane fluidity and factors affecting fluidity (Temperature, cholesterol, fatty acid composition).Passive Transport Mechanisms: Simple diffusion, facilitated diffusion, Channel proteins and carrier proteins, Osmosis and aquaporins.Active Transport Mechanisms: Primary and secondary active transport, ATPases (Na+/K+ pump, Ca2+ pump), Co-transporters and antiporters. Membrane Potential and Electrochemical Gradient. Nernst equation, Generation and maintenance of membrane potential and role of ion channels in membrane potential.

UNIT III **12 Hours**

Signal Transduction and Membrane Receptors

Introduction to Signal Transduction: Basic principles of cell signalling, Types of signalling molecules. G-Protein Coupled Receptors (GPCRs): Structure and function, Signal transduction pathways involving GPCRs (Adrenaline and serotonin receptors), Receptor Tyrosine Kinases (RTKs): Structure and activation mechanisms, downstream signalling pathways (e.g., MAPK/ERK pathway), Examples of RTKs: Insulin receptor, EGF receptor. Other Membrane

Receptors: Ion channel-linked receptors, Enzyme-linked receptors, and Intracellular receptors

UNIT IV **12 Hours**

Membrane Biochemistry in Health and Disease

Membrane-associated Diseases: Genetic disorders affecting membrane proteins (e.g., cystic fibrosis, familial hypercholesterolemia) and Lipid storage diseases. Pathogens and Membranes: Viral entry and membrane fusion (e.g., HIV, influenza), Bacterial toxins targeting membranes (e.g., diphtheria toxin, cholera toxin), Membrane-targeted Therapies (Pharmacological agents affecting membranes (e.g., statins, ion channel blockers), Drug delivery systems utilizing liposomes and nano particles.

Suggested Text Books and References

1. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). *Molecular Cell Biology* (9th ed.). W.H. Freeman and Company.
2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level* (5th ed.). Wiley.
4. Nicolson, G. L. (2012). *The Fluid-Mosaic Model of Membrane Structure: Still relevant to understanding the structure, function and dynamics of biological membranes after more than 40 years*. Biochimica et Biophysica Acta (BBA) - Biomembranes, 1818(6), 1451-1466.
5. Hancock, J. T. (2010). *Cell Signalling* (3rd ed.). Oxford University Press.
6. Sezgin, E., Levental, I., Mayor, S., & Eggeling, C. (2017). *The mystery of membrane organization: composition, regulation and roles of lipid rafts*. Nature Reviews Molecular Cell Biology, 18(6), 361-374.
7. Simons, K., & Gerl, M. J. (2010). *Revitalizing membrane rafts: new tools and insights*. Nature Reviews Molecular Cell Biology, 11(10), 688-699.
8. van Meer, G., Voelker, D. R., & Feigenson, G. W. (2008). *Membrane lipids: where they are and how they behave*. Nature Reviews Molecular Cell Biology, 9(2), 112-124.
9. Sorkin, A., & von Zastrow, M. (2009). *Endocytosis and signalling: intertwining molecular networks*. Nature Reviews Molecular Cell Biology, 10(9), 609-622.

Course Code	Biochemistry of Diseases.	Course Type	L	T	P	C	CH
B25BC0802		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stake holders have a basic knowledge of biochemistry of diseases.

Course Objectives:

1. Understand the communicable diseases and non-communicable diseases.
2. Understand the inflammation and repair/wound healing and cancer biology .
3. Understand lifestyle diseases
4. Understand neuronal diseases, nephritis and metabolic diseases

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on the communicable diseases and non-communicable diseases.
2. Achieve knowledge on the inflammation and repair/wound healing and cancer biology.
3. Achieve knowledge on Hypertension and Stroke
4. Achieve knowledge on characteristics and causes of atherosclerosis
5. Achieve knowledge on the cellular basis of neurodegeneration.
6. Achieve knowledge on Nephritis and Metabolic Diseases

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO1 1	PSO	PSO	PSO
B25BC 0802	CO 1	1	2	2	1	0	0	0	0	0	0	2	2	2	0
	CO 2	2	0	1	2	2	1	0	0	0	0	2	2	2	0
	CO 3	2	0	2	0	0	0	0	0	0	0	2	2	2	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	2	1	0
	CO 6	2	2	1	0	0	0	0	0	0	0	2	3	1	0

UNIT I

Communicable diseases and non-communicable diseases -12hrs

Tuberculosis, Cholera, Typhoid, Conjunctivitis. Sexually transmitted diseases (STD): Information, statistics, and treatment guidelines for STD, Prevention: Syphilis, Gonorrhea, AIDS, etc. Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma. **Genetic disorders**: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia.

UNIT II.

Inflammation and repair/wound healing 12hrs

Chronic inflammation, acute inflammation-Vascular changes-cellular events - chemical mechanism of inflammation- effects of inflammation-wound healing-mechanism, autoimmune disorder. **hepatic disorders:** Liver disease, Function of liver, liver disease (viral hepatitis, alcoholic liver disease, and cirrhosis), symptoms, causes, diagnosis (liver function test- brief outline of serum bilirubin, serum albumin, serum alkaline phosphatase, ALT, AST and LDH), treatment and management. Hepatic injury- Alcohol liver disease-Drug and toxin induced liver, disease- cirrhosis- pregnancy associated-transplantation associated adenomas and primary carcinoma.

UNIT III.

Lifestyle diseases 12 hrs

Hypertension and Stroke Atherosclerosis: characteristics, causes (confirmed & indirect risk factors – brief description only), ischemia, myocardial infarction (definition), diagnosis (electrocardiography, exercise stress test, echocardiography, coronary angiography, intravascular ultrasound, magnetic resonance imaging – brief description only), prevention (lifestyle, diet, drugs), management (drugs, angioplasty, stenting, bypass surgery- brief description only) Hypertension: characteristics, Causes, Diagnosis, Prevention and Management (brief description only) Stroke: characteristics (ischemic and hemorrhagic), causes, diagnosis (neurological examination, scanning - brief description only).

UNIT IV.

Neuronal diseases, nephritis and metabolic diseases 12 HRS

Cellular basis of neuro degeneration. Alzheimer's, Parkinson's, and other neurodegenerative diseases. Nephritis: Function of kidney (brief outline), GFR, nephritis (definition), causes, symptoms, diagnosis (kidney function test - brief outline of serum and urine creatinine, blood and urine urea, BUN, clearance test creatinine and urea), treatment, management (dialysis- peritoneal and hemodialysis) Metabolic Diseases: Diabetes mellitus and Obesity Diabetes mellitus: classification (type 1, type 2, gestational- brief description only), symptoms (polyuria, polydypsia, polyphagia), causes, diagnosis (GTT, glycated haemoglobin- brief description only), management (diet, exercise, drugs). Obesity: classification according to BMI (brief description), symptoms, causes, diagnosis, treatment and management

REFERENCES

1. Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. (2018). *Harrison's Principles of Internal Medicine* (20th ed.). McGraw-Hill Education. ISBN: 978-1259644030
2. Kumar, V., Abbas, A. K., Aster, J. C., & Perkins, J. A. (2020). *Robbins and Cotran Pathologic Basis of Disease* (10th ed.). Elsevier. ISBN: 978-0323531139
3. Kliegman, R. M., St. Geme, J. W., Blum, N. J., Shah, S. S., Tasker, R. C., & Wilson, K. M. (2019). *Nelson Textbook of Pediatrics* (21st ed.). Elsevier. ISBN: 978-0323529501
4. Ralston, S. H., Penman, I. D., Strachan, M. W. J., & Hobson, R. P. (2018). *Davidson's Principles and Practice of Medicine* (23rd ed.). Elsevier. ISBN: 978-0702070273
5. Hall, J. E. (2020). *Guyton and Hall Textbook of Medical Physiology* (14th ed.). Elsevier. ISBN: 978-0323597128
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7. Rowley, J., Vander Hoorn, S., Korenromp, E., Low, N., Unemo, M., Abu-Raddad, L. J., & Newman, L. (2022). Global strategies for the prevention and control of sexually transmitted infections. *The Lancet Global Health*, 10(1), e40-e48.
8. Croft, M., Siegel, R. M., & Zhang, Y. (2022). Inflammation and chronic disease: A focus on autoimmune disorders. *Nature Reviews Immunology*, 22(10), 617-632.
9. Bluher, M., & Smith, S. R. (2023). Metabolic diseases and obesity: Current perspectives and future directions. *Nature Reviews Endocrinology*, 19(1), 27-42.

Course Code	**Advanced Enzymology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0803		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stakeholders have a basic knowledge ofAdvanced Enzymology and its clinical importance.

Course Objectives:

1. To understand the Enzyme kinetics
2. To understand Enzyme specificity, Zymogens, Isozymes, Allosteric and their regulations. regulation
3. To understand Co-enzymes structure and function in metabolism

4. To understand theprinciples of diagnostic enzymology; definition of functional and non-functional plasma enzymes.

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on Basic Enzyme kinetics
2. Achieve knowledge Enzyme specificity, Zymogens, Isozymes, Allosteric and their regulations. Regulation
3. Achieve knowledge on Coenzymes in Metabolism
4. Achieve knowledge on enzymes and methods for their extraction.
5. Achieve knowledge on the factors that influence enzyme levels in plasma or serum.
6. Achieve knowledge on significance of enzymes and their patterns in health and disease

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PSO	PSO	PSO
B25B C 0803	CO 1	3	2	3	1	0	0	0	0	1	1	2	3	2	1
	CO 2	3	3	2	1	2	0	0	2	1	0	2	2	2	0
	CO 3	3	1	3	2	3	0	2	1	2	1	2	2	1	0
	CO 4	3	3	2	3	3	0	2	2	2	2	2	1	1	3
	CO 5	3	1	3	0	1	0	0	1	2	1	2	2	2	0
	CO 6	3	1	2	0	0	1	0	0	2	2	2	2	2	1

Unit I: 12 hours

Enzyme kinetics: Introduction to catalysis and kinetics, Kinetics of single substrate enzyme-catalyzed reactions, Significance of kinetic constants. Experimental measurement of kinetic parameters. Enzyme inhibition (competitive, non-competitive, uncompetitive and mixed inhibition), Kinetics of multi-substrate enzyme-catalyzed reactions. Plant/ bacterial cell wall degrading enzymes.

Unit II: 12 hours

Enzyme specificity and regulation: Enzyme specificity, Zymogens, Isozymes, Allosteric regulation, Hemoglobin and Myoglobin, Feedback inhibition. Mechanism of enzyme action: Mechanisms of catalysis, Investigation of active site structure, Mechanisms of reactions catalyzed by enzymes without cofactors, Metal activated enzymes and metallo enzymes, Coenzymes in enzyme catalyzed reactions. Michaelis-Menten and Lineweaver Burk plots. Graphical analysis of kinetic data. Determination of Vmax and Km-Experimental aspects.

Unit III: **12 hours**

Coenzymes: Coenzyme's structure and function in metabolism. Enzyme isolation and purification: Origin of enzymes, Extraction of enzymes, Enzyme assay methods, Protein assay methods, Enzyme purification, Chromatographic methods. Immobilized enzymes - Methods of immobilization. Comparison of kinetics of immobilized and free enzymes. Properties and industrial applications of immobilized enzymes.

Unit IV: **12 hours**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, problems of enzyme assay in clinical biochemistry laboratory; factors affecting enzyme levels in plasma or serum; selection of enzyme tests; enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase; alkaline and acid phosphates, SGOT, SGPT, LDH & CPK.

Reference Books:

1. Palmer, T., & Bonner, P. L. (2007). *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry* (2nd ed.). Woodhead Publishing. ISBN: 978-1904275275
2. Price, N. C., & Stevens, L. (1999). *Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins* (3rd ed.). Oxford University Press. ISBN: 978- 0198502296
3. Cornish-Bowden, A. (2012). *Principles of Enzyme Kinetics* (4th ed.). Elsevier. ISBN: 978-0444594361
4. Segel, I. H. (1975). *Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems*. Wiley-Interscience. ISBN: 978-0471303091
5. Smith, J. R., & Jones, A. L. (2022). Recent advances in enzyme kinetics and inhibition mechanisms. *Journal of Enzyme Inhibition and Medicinal Chemistry, 37*(1), 10-25.
6. Patel, S. K. S., & Kalia, V. C. (2023). Enzyme immobilization: Advances and applications in biotechnology. *Biotechnology Advances, 61*(1), 107-122.
7. Williams, P. A., & Wong, L. L. (2023). Mechanistic insights into enzyme specificity and regulation. *Chemical Reviews, 123*(4), 254-279.
8. Kim, Y. J., & Park, J. H. (2022). Trends in diagnostic enzymology: From biomarker discovery to clinical applications. *Clinical Biochemistry, 103*(5), 435-450.

Course Code	**Laboratory Course–X Cell and membrane biochemistry**	Course Type	L	T	P	C	CH
B25BC0804		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Need the basic concept of Cell and membrane biochemistry

Course Objective:

1. To experience and connect the theoretical concepts related to membrane biochemistry
   1. 2 To learn to Isolate membranes from red blood cells (RBC)
   2. To learn to Evaluate the disrupting effect of detergent like molecules on bio membranes by dissolving the phospholipid component

Course outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on isolate membranes from red blood cells (RBC)
2. Achieve knowledge on evaluate the disrupting effect of detergent like molecules on bio membranes by dissolving the phospholipids component.
3. Achieve knowledge on to prove that during photosynthesis oxygen is evolved due to presence of grana thylakoids membranes.
4. Achieve knowledge on isolate and estimate the photosynthetic pigments
5. Achieve knowledge on Understand Membrane Biology
6. Achieve knowledge on Photosynthetic Pigments Characterization

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
B25B C 0804	CO1	2	2	1	0	1	1	0	0	2	2	2	2	3	1
	CO2	2	2	1	1	1	1	0	0	2	2	2	2	2	2
	CO3	2	1	1	1	1	1	0	0	2	2	2	2	1	0
	CO4	2	3	2	0	1	1	0	0	2	2	2	2	2	0
	CO5	2	2	2	2	1	1	0	0	2	2	2	2	1	1
	CO6	2	2	2	0	1	1	0	0	1	2	2	2	2	1

Contents:

1. Preparation of RBC ghost membrane.
2. Estimation of % of Hemolysis induced by free-radical (hydrogen peroxide)
3. Study the Photosynthetic Oxygen (O2) Evolution in Hydrilla Plant
4. Isolation of chloroplast from spinach leaves,
5. Estimation of chlorophyll and photosynthetic activity.

6. Extraction and Separation of Photosynthetic Pigments by Partition Chromatography.
7. Determination of Critical Micelle Concentration of detergents.
8. Study of Active transport of Glucose in Intestine and Determination by Anthrone Method

Reference:

1. Boyer, R. (2012). *Modern Experimental Biochemistry* (4th ed.). Pearson. ISBN: 978-0321644907
2. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level* (5th ed.). Wiley. ISBN: 978-1118918401
3. Wilson, K., & Walker, J. (2018). *Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press. ISBN: 978-1107162273
4. Heldt, H. W., & Piechulla, B. (2021). *Plant Biochemistry* (5th ed.). Academic Press. ISBN: 978-0128186374
5. Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). W.H. Freeman. ISBN: 978-1464187952
6. Berg, J. M., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman. ISBN: 978-1319114671
7. Mathews, C. K., van Holde, K. E., Appling, D. R., & Anthony-Cahill, S. J. (2018). *Biochemistry* (4th ed.). Pearson. ISBN: 978-0138004644

Course Code	**Laboratory Course –XI**	**Course Typ**	**L**	**T**	**P**	**C**	**CH**
B25BC0805	**Biochemistry of Diseases.**	**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Needthe basic concept of Biochemistry of Diseases

Course Objective:

1.To identify the abnormal form of Hemoglobin and its variants.

2 To learn to Isolate membranes from red blood cells (RBC)

3. To learn haemostatic mechanism and theories of blood coagulation

.**Course outcomes:**

After completing the course, the student shall be able to

1. Achieve knowledge on analysis of haemoglobin analysis
2. Achieve knowledge on Isolate membranes from red blood cells (RBC) clearly.

3. Achieve knowledge on Mechanism and theories of blood coagulation
4. Achieve knowledge on Gain the knowledge about Leishman's, May Grunwald Giesma and Perl's stain
5. Achieve knowledge on Laboratory Diagnosis of Fungal Infection
6. Achieve knowledge on Comprehensive Urine Analysis

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC 0805	CO 1	2	2	2	1	1	0	0	0	0	0	2	2	2	0
	CO 2	2	1	1	2	2	1	0	0	0	0	2	2	2	0
	CO 3	2	1	2	0	0	0	0	0	0	0	2	2	1	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	2	1	0
	CO 6	2	2	1	1	0	0	0	0	0	0	2	2	1	0

Course Contents:

1. Tube agglutination test: WIDAL test.
2. Haemoglobin pigments and their measurement.
3. Abnormal haemoglobins, their identification and estimation.
4. Normal haemostatic mechanism and theories of blood coagulation.
5. Screening coagulation tests such as Bleeding and clotting Time, Hess test, prothrombin time(PT) and Activated Partial Thromboplastin time (APTT)
6. VDRL.
7. To process clinical samples for laboratory diagnosis of fungal infections i.e. a) Skin b) Nail c) Hair d) Body fluids and secretions.
8. To prepare a bone marrow smear and stain by Leishman's, May GrunwaldGiesma and Perl's stain
9. Physical, Chemical and Microscopic examination of urine

Reference:

1. Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2016). *Dacie and Lewis Practical Haematology* (12th ed.). Elsevier. ISBN: 978-0702066962
2. Hoffbrand, A. V., Higgs, D. R., Keeling, D. M., & Mehta, A. B. (2019). *Postgraduate Haematology* (7th ed.). Wiley-Blackwell. ISBN: 978-1119398940

3. Marshall, W. J., & Bangert, S. K. (2019). *Clinical Chemistry* (9th ed.). Elsevier. ISBN: 978-0702079368
4. Turgeon, M. L. (2020). *Clinical Hematology: Theory and Procedures* (6th ed.). Jones & Bartlett Learning. ISBN: 978-1284180149
5. Nussbaum, R. L., McInnes, R. R., & Willard, H. F. (2015). *Thompson & Thompson Genetics in Medicine* (8th ed.). Elsevier. ISBN: 978-1437706963
6. Chessbrough, M. (2019). *District Laboratory Practice in Tropical Countries* (3rd ed.). Cambridge University Press. ISBN: 978-1108725521
7. Pincus, M. R., & McPherson, R. A. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (23rd ed.). Elsevier. ISBN: 978-0323413150.

Course Code	Laboratory Course –XII Advanced Enzymology lab .	Course Typ	L	T	P	C	CH
B25BC0806		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Needthe basic concept of Advanced Enzymology lab

Course Objective:

1. To learn the characteristics of ALP
2. To learn the effect of ALP.

Course outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on purification of ALP in biological samples
2. Achieve knowledge on physical properties of ALP
3. Achieve knowledge on Various factors affects the Enzyme activity
4. Achieve knowledge on the Effect of Temp on ALP activity.
5. Achieve knowledge on purification of Acid phosphatase.
6. Achieve knowledge on factors affecting the ACP activity.

Mapping of Course Outcomes with programme Outcomes

Cours Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PSO1	PSO2	PSO3
	CO1	3	2	1	1	2	0	1	0	2	1		2	3	3

B25B C 0806	CO2	3	2	3	1	0	0	0	1	2	0		2	2	1
	CO3	2	2	2	0	3	0	0	1	2	0		0	2	3
	CO4	3	2	2	2	2	0	0	2	3	2		2	1	3
	CO5	2	2	2	2	3	2	1	2	3	2		3	3	3
	CO6	3	2	3	1	2	0	1	2	2	0		1	2	1

Course Contents.

1. Partial purification of alkaline phosphatase from *E. coli*.
2. Assay of alkaline phosphatase from *E. coli* using p-nitrophenyl phosphate as substrate
3. Characterization of alkaline phosphatase.
    a) Effect of pH
    b) Effect of substrate concentration (Calculation of Km)
    c) Effect of Temperature
4. Partial purification of acid phosphatase from *E.coli*
5. Assay of acid phosphatase from *E.coli* using p-nitrophenyl phosphate as substrate
6. Characterization of acid phosphatase.
7. Determination of optimum pH and Temperature of Acid Phosphatase.
8. Determination of Km Value (substrate concentration) of Acid Phosphatase.

Reference;

1. Boyer, R. (2012). Modern Experimental Biochemistry (4th ed.). Pearson. ISBN: 978-0321644907
2. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley. ISBN: 978-1118918401
3. Nelson, D. L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry (7th ed.). W.H. Freeman. ISBN: 978-1464187952
4. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press.ISBN: 978-1107162273
5. Berg, J. M., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2019). Biochemistry (9th ed.). W.H. Freeman. ISBN: 978-1319114671
6. Mathews, C. K., van Holde, K. E., Appling, D. R., & Anthony-Cahill, S. J. (2018). Biochemistry (4th ed.). Pearson. ISBN: 978-0138004644

Course Code	Biochemistry aspect of Forensic Sciences	Course Type	L	T	P	C	CH
B25BCS811		**DSE**	**3**	**0**	**0**	**3**	**2**

Pre request; Need the basic knowledge about Biochemistry aspect of Forensic Sciences

Course Objective:

1. To learn Basics of Forensic Science
2. To learn DNA Profiling and Forensic Biology
3. To understand Forensic significance of body fluids
4. To learn Tools and techniques in Forensic

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on Basics of Forensic Science

2. Achieve knowledge onDNA Profiling and Forensic Biology

3. Achieve knowledge on. Forensic significance of body fluids

4. Achieve knowledge on Tools and techniques in Forensic

5. Achieve knowledge on the determination of Ag-Ab interaction in the biological sample.

6. Achieve knowledge on the determination of Hair and their location by forenscic methods.

Cours Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BCS811	CO 1	3	1	2	2	1	1	0	0	0	0	2	1	0
	CO 2	2	2	3	1	2	1	0	0	0	0	2	1	0
	CO 3	1	1	3	1	1	1	0	0	0	0	1	1	0
	CO 4	1	1	3	1	1	1	0	0	0	0	2	2	0
	CO 5	1	2	3	1	1	0	0	0	0	0	1	1	0
	CO 6	2	1	1	1	1	0	0	0	0	0	1	1	0

Course Contents:

Unit I:

Basics of Forensic Science **6hrs**

Definition of Forensic Science, The Role of the Forensic Laboratory, History and Development of Forensic Science in India & Abroad, Pioneers in Forensic Science, Multidisciplinary nature, Forensic Technology solving crimes with advanced technology, Forensic intelligence and Interviews. Forensic Evidences: Concise of Forensic Physical, Biological, Chemical and Psychological evidences, Medico-Legal Cases. Laws and Principles of Forensic Science: Law of Exchange (Locard), Law of Individuality, Law of Comparison, Law of Progressive Changes and Law of Probability, Branches of Forensic Science

Unit II:

DNA Profiling **6hrs**

DNA Profiling: Introduction, History of DNA Typing, molecular biology of DNA, variations, polymorphism, DNA Extraction-Organic and Inorganic extraction, Comparison of Extraction methods, Commercial kits DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism. Analysis of SNP, YSTR, Mitochondrial DNA, Ancient DNA typing, Evaluation of results

Unit III:

Forensic significance of body fluids **6hrs**

Blood: Chemistry and properties, Presumptive and Confirmatory tests, Individualization (Blood Grouping, Polymorphic enzyme typing). Forensic Characterization of Semen. Forensic Characterization of Bloodstains, Stain Patterns of Blood. Semen: Composition, functions and morphology of spermatozoa, Forensic significance, location, collection, evaluation. Body fluids: Forensic significance of other body fluids as Saliva, Sweat and fecal matters, their collection and identification. Hair: Introduction, types, location, collection evaluation and forensic significance of Hair.

Unit- IV

Tools and techniques in Forensic **6hrs**

Meaning and Terminology of Instrumentation: Definition, Need of Instrumentation in Forensic Sciences.Microscopy: Theory and basic principles, setup and Forensic applications of Compound, Fluorescence, Polarized, Stereo-zoom microscope. Electron Microscopy- Theory and basic principles of Electron Microscopy, Structure and Forensic applications of Scanning Electron microscope (SEM), Transmission Electron Microscope (TEM).Schematic analysis of Chemical, Biological and Physical samples, Preliminary and Confirmatory methods of analysis, Colour spot tests in Forensic Biological, Chemical and Physical analysis, Microcrystalline test. Centrifuge Techniques: Centrifugation Techniques: Basic principles of sedimentation, Various types of centrifuges and centrifugation.

REFERENCES:

1. Saferstein, R. (2020). *Criminalistics: An Introduction to Forensic Science* (12th ed.). Pearson. ISBN: 978-0134803722
2. Jackson, A. R. W., & Jackson, J. M. (2011). *Forensic Science* (3rd ed.). Pearson. ISBN: 978-0131998803
3. James, S. H., Nordby, J. J., & Bell, S. (2014). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (4th ed.). CRC Press. ISBN: 978-1439853832
4. Butler, J. M. (2015). *Advanced Topics in Forensic DNA Typing: Interpretation* (1st ed.). Elsevier Academic Press. ISBN: 978-0124052130
5. Lee, H. C., & Pagliaro, E. M. (2013). *Forensic Evidence and Crime Scene Investigation* (1st ed.). Cambridge University Press. ISBN: 978-0521768627
6. Houck, M. M., & Siegel, J. A. (2015). *Fundamentals of Forensic Science* (3rd ed.). Elsevier. ISBN: 978-0128000373
7. Ballantyne, K. N., & Kayser, M. (2017). *Forensic DNA Typing Protocols* (2nd ed.). Humana Press. ISBN: 978-1493967513
8. Verma, S., & Dahiya, R. (2018). DNA profiling: Past, present, and future. *Indian Journal of Medical Research, 148*(3), 325-332.

Course Code	**Cancer biology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BCS812		**DSE**	**3**	**0**	**0**	**3**	**2**

Pre requisites

Need the basic knowledge about Cancer biology.

Course Objective:

1. To learn Cancer cell and its characteristics.
2. To learn Cancer Diagnosis and Treatments
3. To understand Classification of Cancer by tissue types
4. To learn Cancer classification

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on Cancer cell and normal cells.

2. Achieve knowledge on Cancer Diagnosis and Treatments

3. Achieve knowledge on Classification of Cancer by tissue types

4. Achieve knowledge on Cancer classification with techniques.

5. Achieve knowledge on Tumor suppressor Genes (P53) and its role in cancer.

6. Achieve knowledge on the conversion of Proto-oncogenes in to oncogenes with effects.

Cours Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BC S812	**CO 1**	1	2	3	2	1	1	1	1	2	1	2	1	3
	CO 2	2	2	2	3	1	2	1	0	3	1	2	2	2
	CO 3	1	2	3	1	2	2	2	1	2	2	2	2	2
	CO 4	1	2	2	2	1	1	2	1	1	2	2	2	2
	CO 5	1	1	2	1	1	1	0	0	2	1	2	2	2
	CO 6	2	2	2	1	1	1	0	1	2	3	2	1	2

Course Contents:

Unit-1 **6 hrs**

Cancer cell: Common properties of normal cell, Properties of Cancer cells, Definition of cancer, Normal vs Benign cancer vs Malignant Tumor, Types of cancer ,common symptoms. Definition of Primary and secondary cancer with examples. Examples of cancer susceptibility syndromes. Transplantation related malignancies.

Unit-II- **6hrs**

Classification of Cancer

Cancer classification: TNM Classification, Purpose, Types of staging, TNM System, Stage grouping ,other factors that can affect the stage, with other staging system.Genes involved in cancer ;the concept of Oncogenes and Tumor suppressor genes, conversion of Proto-oncogenes in to oncogenes.Brief information about the role of p53 in cancer.

Unit-III

Diagnosis:

Histopathological diagnosis, immunohistochemistry in differential diagnosis, Hematological malignancies. Morphological diagnosis, Flow cytometric diagnosis. Molecular classification of cancer. Clinical examination, Radiological examination. Biopsy

Unit-IV **6hrs.**

Cancer Treatments:

Biopsy Analysis, Surgery and its types. Radiation, Chemotherapy, Biological therapy, Hormone therapy, Transplantation, Targeted therapies, Gene therapy, Other treatment. Methods(Cryosurgery,Laser therapyphotodynamic therapy, Hyperthermia)

References.

1. Weinberg, R. A. (2023). *The Biology of Cancer* (3rd ed.). Garland Science.ISBN: 978-0815345282
2. King, R. J. B., & Robins, M. W. (2021). *Cancer Biology* (5th ed.). Pearson.ISBN: 978-1292132957
3. Hanahan, D., & Weinberg, R. A. (2022). *Hallmarks of Cancer: The Next Generation*. Cell Press. ISBN: 978-0123864604
4. Alison, M. R. (2020). *The Cancer Handbook* (3rd ed.). Wiley-Blackwell. ISBN: 978-1119308828
5. Vogelstein, B., & Kinzler, K. W. (2020). *The Genetic Basis of Human Cancer* (3rd ed.). McGraw-Hill Medical. ISBN: 978-1259644143
6. Perry, M. C. (2021). The *Chemotherapy Source Book* (6th ed.). Wolters Kluwer Health. ISBN: 978-1975140833
7. DeVita, V. T., Lawrence, T. S., & Rosenberg, S. A. (2022). *Cancer: Principles and Practice of Oncology* (11th ed.). Wolters Kluwer Health. ISBN: 978-1975144114
8. Hanahan, D., & Weinberg, R. A. (2021). Hallmarks of cancer: The next generation. *Cell, 184*(10), 253-264.

Course code		Course type	L	T	P	C	CH
B25BC0807	**Research Project/ Internship**	**DSE**	**0**	**0**	**6**	**6**	**12**

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and methodology.
6. Describe the statistical procedures in the interpretation of results.

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BC0807	CO1	2	2	3	3	3	2	2	1	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. Hons. By Research (Biotechnology)

Eighth Semester

Course code	Enzyme Technology	Course type	L	T	P	C	CH
B25BT0801		**DSC**	**2**	**0**	**0**	**2**	**2**

Prerequisite for the course:

- The student should have the basic knowledge of Enzyme properties and applications
- The student should have the basic knowledge of Physiology and pathophysiology of enzymes

Course objectives:

1. To acquire fundamental knowledge on enzymes and their importance in biological reactions.
2. To understand ability to difference between a chemical catalyst and biocatalyst.
3. Exposure to the nature of non-protein enzymes.

Course outcomes:

After the end of the Course students will be able to:

1. Explain the key structural and energetic factors which give rise to increased enzyme stability
2. Conceptulize the importance of enzymes for industrial application,
3. Summarize current processes involved in industrial enzyme production
4. Describe methods for selection of industrial enzymes using genetic and biochemical techniques.
5. Describe methods for optimisation of industrial enzymes using genetic and biochemical techniques.
6. Compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Mapping of course and program outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B25BT0801	CO1	3	2	3	1	1	3	0	2	2	0	3	2	2
	CO2	1	1	2	1	1	0	0	2	2	2	3	3	3
	CO3	2	3	3	2	2	0	0	3	2	2	3	3	3
	CO4	2	3	3	2	2	0	0	3	2	2	3	3	3
	CO5	2	3	3	2	1	0	0	2	2	2	3	3	3
	CO6	3	3	3	3	3	1	0	3	2	2	3	3	2

Syllabus:

UNIT I Introduction to Enzymology 6 Hrs

History of Enzymology; General characteristics of enzymes; advantages of enzymes over chemical catalysts, Nomenclature and classification of enzymes, Significance of Enzyme Commission number; Denaturation and renaturation; enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apo-enzyme, Isoenzymes, cofactor, coenzyme, prosthetic group; enzyme activity unit, turn over number and specific activity.

UNIT II: Regulation of Enzyme activities 6 hrs

Enzyme action; effect of enzyme on the rate and equilibrium of a reaction; principles that explain catalytic power and substrate specificity of enzymes; enzyme substrate complex (Lock & Key Model, Induced Fit Theory, Substrate Strain Theory), factors responsible for catalytic efficiency of enzyme; proximity and orientation effect, acid-base catalysis, covalent catalysis, strain and distortion theory; Nature of active site, identification of functional groups at active sites; regulatory enzymes- covalently modulated enzymes, allosteric enzymes and their mode of action; regulation of enzyme activity in the living system

UNIT III: Enzyme kinetics 6 hrs

An introduction to enzyme kinetics and its importance, Methods used for investigating the kinetics of enzyme catalysed reactions; factors that influence the velocity of enzyme catalysed reaction(effect of substrate concentration, enzyme concentration, pH, temperature, presence of activator/inhibitor etc.); Michaelis-Menten equation, Vmax, Km and its significance; enzyme inhibition, types of enzyme inhibitions- competitive, uncompetitive, non-competitive, mixed type inhibition and determination of Ki, Determination of Km and Vmax in the presence and absence of inhibitor; feed- back inhibition.

UNIT IV: Enzyme production **6 hrs**

Strategies used for enzyme production, isolation and purification at laboratory and industrial scale from plant, animal and microbial sources, method of calculating the purification fold; estimation of enzyme activity; characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight (MW) and the number of sub-units of an enzyme; enzyme immobilization and its importance; enzyme therapy, enzyme inhibitors and drug design; Applications of enzymes in medicine, textile, paper, dairy industry, beverage and fruit processing, food processing and preservation, clinical applications of enzyme estimation.

Reference Books:

1. Martin F. Chaplin, C. Bucke. (1990). Enzyme technology. Cambridge university press, UK
2. KHAN, FARHA. (2000). Principles of Enzyme technology. PHI Publications, UK
3. Karl-Erich Jaeger, Andreas Liese, Christoph Syldatk, Karl-Erich Jaeger, Andreas Liese, Christoph Syldatk. (2024). Introduction to Enzyme Technology. Springer Publications, USA
4. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche. (2010). Enzyme technology. Springer Publications, USA.
5. Ram Sarup Singh, Reeta Rani Singhania, Christian Larroche. (2019). Advances in Enzyme Technology. A volume in Biomass, Biofuels, Biochemicals. Springer Publications, USA

Course code	System	Course type	L	T	P	C	CH
B25BT0802	Biology	DSC	2	0	0	2	2

Prerequisite for the course:

- The student should have the basic knowledge of biology
- The student should have the basic knowledge of bioinformatics

Course objectives:

1. To acquire fundamental knowledge on importance in biological reactions.
2. To understand ability to understand the concept of genes through computational approach.
3. Exposure to the nature of biological pathways and its correlation to living system.

Course outcomes:

After the end of the Course students will be able to:

1. Construct computational models of biological systems
2. Analyse computational models of biological systems
3. Understand common mathematical approaches to study biological problems
4. Apply computational analyses to explore the behavior of biological systems
5. Summarize and critique papers from the literature describing systems biology approaches and analysis
6. Apply the concept of system biology in life science research.

Mapping of course and program outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B25BT0802	CO1	3	2	3	1	1	3	0	2	2	0	3	2	2
	CO2	1	1	2	1	1	0	0	2	2	2	3	3	3
	CO3	2	3	3	2	2	0	0	3	2	2	3	3	3
	CO4	2	3	3	2	2	0	0	3	2	2	3	3	3
	CO5	2	3	3	2	1	0	0	2	2	2	3	3	3
	CO6	3	3	3	3	3	1	0	3	2	2	3	3	2

Syllabus:

Unit I: Introduction to Primary Databases 6 Hrs

Lectures Introduction to Primary Databases: Types of Biological data- Genomic DNA, cDNA, rDNA, ESTs, GSSs; Primary Databases -Nucleotide sequence databases-GenBank, EMBL, DDBJ, Protein Sequence Databases- UniProtKB, UniProt, TrEMBL, Swiss-Prot, UniProt Archive-UniParc, UniProt Reference Clusters-UniRef, UniProt Metagenomic and Environmental Sequences-UniMES. Literature Databases- PubMed, PLos, BioMed Central.

Unit II: File formats, sequence patterns and profiles: 6 Hrs

Sequence file formats – GenBank, FASTA, ALN/ClustalW2, PIR; Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations viz. consensus, regular expression (Prositetype) and sequence profiles; Sequence similarity-based search engines (BLAST and FASTA); Pattern based search using MeMe and PRATT); Motif-based search using ScanProsite and eMOTIF; Profile-based database searches using PSI- BLAST and HMMer.

Unit III: **Sequence Analysis and predictions** **6 Hrs**

Sequence Analysis and predictions: Nucleic acid sequence analysis- Reading frames; Codon Usage analysis; Translational and transcriptional signals, Splice site identification, Gene prediction methods and RNA fold analysis; Protein sequence analysis- Compositional analysis, Hydrophobicity profiles, Amphiphilicity detection, Moment analysis, Transmembrane prediction methods, Secondary structure prediction methods.

Unit IV: **Machine learning, systems biology** **6 Hrs**

Machine learning techniques: Artificial Neural Networks and Hidden Markov Models: Applications in Protein Secondary Structure Prediction and Gene Finding, Introduction to Systems Biology and its applications in whole cell modelling, Microarrays and Clustering techniques for microarray data analysis, informatics in Genomics and Proteomics, DNA computing.

Reference Books

5. Klipp, Edda, Wolfram Liebermeister, Christoph Wierling, and Axel Kowald. *Systems biology: a textbook*. John Wiley & Sons, 2016.
6. Palsson, B., 2015. *Systems biology*. Cambridge university press.
7. Alon, U., 2019. *An introduction to systems biology: design principles of biological circuits*. Chapman and Hall/CRC.
8. Voit, E., 2017. *A first course in systems biology*. Garland Science.

Course Code	**Enzyme technology Lab**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BT0804		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites/Pre reading for the course:

The student should have basic knowledge of Enzyme properties and function.

Course Objectives:

The objective of this Course is to:

1. To understand the working conditions in Enzymologist lab.

2. To explore the production of enzymes techniques.
3. To handle the protein samples and their maintenance.
4. To exploit enzyme assay for the benefit of mankind.

Course Outcomes:

After the end of the Course students will be able to:

1. Explain the key structural and energetic factors which give rise to increased enzyme stability
2. Conceptulize the importance of enzymes for industrial application,
3. Summarize current processes involved in industrial enzyme production
4. Describe methods for selection of industrial enzymes using genetic and biochemical techniques.
5. Describe methods for optimisation of industrial enzymes using genetic and biochemical techniques.
6. Compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Mapping of Course Outcomes with programme Outcomes

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B25BT0804	CO1	3	3	3	2	2	3	2	1	2	2	3	3	3
	CO2	3	2	3	2	1	3	2	1	2	2	3	3	2
	CO3	3	3	3	3	3	3	2	2	2	3	3	3	3
	CO4	3	3	3	3	3	3	2	0	2	2	3	3	3
	CO5	2	2	3	3	2	3	2	1	2	3	3	3	2
	CO6	3	3	3	3	3	3	1	2	3	3	2	3	3

Course Contents:

1. Identification of enzymes in different sources
2. Isolation of Amylase from different sources
3. Positive and negative controls of enzyme (Catalase) activity
4. Effect of temperature on enzyme (Catalase) activity
5. Effect of concentration on enzyme (Catalase) activity
6. Effect of pH on enzyme (Catalase) activity
7. Effect of enzyme (Catalase) inhibitor
8. Estimation of Protease activity in commercially available detergent
9. Determination of alkalinity in the given water sample.

Reference Books:

1. Jack Kyte, Thomas E. Crowley. (2014). Experiments in the Purification and Characterization of Enzymes: A Laboratory Manual. Academic press, UK
2. Thomas E. Crowley, Jack Kyte. (2019). Experiments in the Purification and Characterization of Enzymes. A Laboratory Manual. Elsevier publications. USA
3. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche. (2010). Enzyme technology. Springer Publications, USA.
4. Ram Sarup Singh, Reeta Rani Singhania, Christian Larroche. (2019). Advances in Enzyme Technology. A volume in Biomass, Biofuels, Biochemicals. Springer Publications, USA

Course code	**System Biology Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BT0805		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisite for the course:

- The student should have the basic knowledge of biology
- The student should have the basic knowledge of bioinformatics

Course objectives:

1. To acquire fundamental knowledge on importance in biological reactions.
2. To understand ability to understand the concept of genes through computational approach.
3. Exposure to the nature of biological pathways and its correlation to living system.

Course outcomes:

After the end of the Course students will be able to:

1. Construct computational models of biological systems

2. Analyse computational models of biological systems
3. Understand common mathematical approaches to study biological problems
4. Apply computational analyses to explore the behavior of biological systems
5. Summarize and critique papers from the literature describing systems biology approaches and analysis
6. Apply the knowledge of systems biology for life science research.

Mapping of course and program outcomes

Course Code	**POS / COS**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B25BT0805	CO1	3	3	3	2	2	3	2	1	2	2	3	3	3
	CO2	3	2	3	2	1	3	2	1	2	2	3	3	2
	CO3	3	3	3	3	3	3	2	2	2	3	3	3	3
	CO4	3	3	3	3	3	3	2	0	2	2	3	3	3
	CO5	2	2	3	3	2	3	2	1	2	3	3	3	2
	CO6	3	3	3	3	3	3	1	2	3	3	2	3	3

Course Contents

1. Sequence Analysis and predictions: Nucleic acid sequence analysis- Reading frames;
2. Codon Usage analysis; Translational and transcriptional signals, Splice site identification,
3. Gene prediction methods
4. RNA fold analysis.
5. Protein sequence analysis-Compositional analysis,
6. Hydrophobicity profiles,
7. Amphiphilicity detection, Moment analysis,
8. Transmembrane prediction methods,
9. Secondary structure prediction methods.

Reference Books

1. Klipp, Edda, Wolfram Liebermeister, Christoph Wierling, and Axel Kowald. Systems biology: a textbook. John Wiley & Sons, 2016.
2. Palsson, B., 2015. Systems biology. Cambridge university press.
3. Alon, U., 2019. An introduction to systems biology: design principles of biological circuits. Chapman and Hall/CRC.
4. Voit, E., 2017. A first course in systems biology. Garland Science.

Course code	RESEARCH PROJECT / INTERNSHIP	Course type	L	T	P	C	CH
B25BT0808		DSE	0	0	12	12	24

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and methodology.
6. Describe the statistical procedures in the interpretation of results.

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BT0808	CO1	2	2	3	3	3	2	2	1	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	1	1

Hons. By Research (Genetics)

Eighth Semester

Course code	Recombinant DNA Technology	Course type	L	T	P	C	CH
B25GN0801		DSC	2	0	0	2	2

Prerequisites:

1. Students should be knowing the basic gene transfer concepts.
2. They should be aware of genome organization of the organisms.

Course Objective:

The objective of the course is to:

1. Understand the fundamentals of genetic engineering.
2. Study the protocol of PCR and DNA sequencing.
3. Study the types and significance of molecular markers
4. Learn the applications of r-DNA technology.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the methods of genetic engineering.
2. Elucidate the mechanism and applications of PCR and DNA sequencing.
3. Enlist the types and significance of molecular markers.
4. Illustrate the mechanism of blotting and fingerprinting.
5. Deduce the protocol for production of recombinant proteins.
6. Converse the significance of Genetically modified organisms.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25GN0801	CO1	3	3	3	3	2	2	2	3	2	2	2	1	3
	CO2	3	3	2	2	3	2	2	2	2	2	3	3	2
	CO3	3	2	1	2	3	2	2	2	2	2	3	2	3
	CO4	1	2	2	2	2	2	2	2	3	2	3	3	2
	CO5	3	2	1	2	2	3	1	1	1	1	3	3	2
	CO6	1	3	2	3	2	2	1	1	1	2	2	3	2

Course contents:

Unit-I **12 hrs**

Genetic Engineering: History, DNA modifying enzymes, Cloning vectors and Cloning hosts, Gene transfer and cloning methods, Gene Screening and isolation - Strategies, DNA libraries, Probe Selection and screening. PCR – Principle, Methodology, Types - RT-PCR, RAPD, AFLP, ISSR, inverse PCR and Real time PCR and their applications

DNA sequencing methods - Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing method, Capillary gel electrophoresis.

UNIT II **12 hrs**

Fluorescence *in-situ* hybridization (FISH), Genome *in-situ* hybridization (GISH), Gel electrophoresis for nucleic acids, Methods of labeling of DNA, Blotting of macromolecules and hybridization, Oligonucleotide synthesis, Promoter characterization, DNA fingerprinting, Microarray technology. Production of recombinant proteins, Vaccine and pharmaceutical compounds; application in agriculture, GMO crops and transgenic animals. Ethical concerns and issues in GMOs.

References:

1. Primrose SB and Old. (2013). *Principles of Gene manipulation.* 7th edition. Wiley-Blackwell Scientific Publications,
2. Terence A. Brown. (2020). *Gene cloning and DNA analysis: an introduction*, 8th edition. Wiley- Blackwell.
3. M. R. Green, J. Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*. 4th edition. Cold Spring Harbor.
4. M. Wink.(2011). *An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology. 2nd edition.* Wiley.
5. Monika Jain. (2011). *Recombinant DNA Techniques – A textbook.* 1st edition. Narosa Publishing House.
6. Vance Hunter and Franky Strickland. (2018). *Applications of recombinant DNA technology*. 1st edition. ED-Tech Press.

Course code	**Expression of Eukaryotic genes**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0802		**DSC**	2	0	0	2	2

Prerequisites:

1. Students should be aware of central dogma.
2. They should know the basics of cell cycle.

Course Objective:

The objective of the course is to:

1. Understand the various modes of regulation.
2. Study the factors of regulation.
3. Learn the interactions of proteins and DNA.
4. Know the transcriptional and translational gene regulation.

Course outcomes:

After completing the course, the student shall be able to:

1. Comprehend the different modes of gene regulation.
2. Elucidate the role of enzymes in gene regulation.
3. Diagram the structure of transcription factors.

4. Deduce the role of transcription factors.
5. Explain the molecular control of transcription.
6. Extrapolate the protein-DNA interactions in gene expression.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	CO1	2	2	2	2	2	2	2	2	2	2	2	3	2
	CO2	2	2	2	1	2	3	2	2	2	2	3	1	1
	CO3	2	2	2	2	2	3	2	1	2	3	3	2	2
B25GN0802	CO4	2	2	2	1	2	2	2	1	2	1	3	3	2
	CO5	1	2	2	2	3	2	2	1	2	2	2	3	2
	CO6	2	2	2	1	2	2	3	2	3	3	2	3	2

Course contents:

UNIT I

Cis-Acting Elements and Trans-Acting Factors **12 hrs**

Eukaryotic RNA polymerases and basal transcription factors Diversity in core promoter elements Diversity in general transcription factors Proximal & Distal Promoter Elements, Enhancers and Silencers, Gene-specific Regulators. Domain Structure of Eukaryotic Transcription Factors Transcription factors – DNA binding domains Transcription factors – transcription activation domain. Protein-DNA interactions in gene expression. The DNA-binding proteins and their recognition motifs

Gene regulation in eukaryotes: 12 hrs

DNA alteration (Gene amplification, programmed DNA rearrangement, DNA methylation); Spatial and temporal control, Tubulin gene in plant, globin genes in animals); Molecular control of transcription in eukaryotes (Enhancer, Silencer, enhancer trap mutagenesis, transcription factors, alternate promoters, alternate splicing, molecular organization of transcriptionally active DNA); Induction of transcriptional activity by environmental and horizontal factors; Translational control. Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

References:

1. Michael F Carey, Craig L Peterson, Stephen P Smale. (2009). *Transcriptional regulation in eukaryotes: Concepts, strategies and techniques*. 2nd edition. CSH Press.
2. Ajit Kumar. (2013). *Eukaryotic gene regulation*. 2nd edition. Springer US.
3. David S Latchman (2008). *Eukaryotic transcription factors*. 5th edition. Elsevier.
4. Gerald M Kolodny. (2021). *Eukaryotic gene regulation*. Volume 2. Taylor & Francis.
5. Gurbachan S Miglani. (2013). *Gene regulation*. 1st edition. Alpha Science International Limited.

Course code	**Recombinant DNA Technology Lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0804		**DSC**	0	0	2	2	3

Prerequisites:

1. Students should be knowing the basic gene transfer concepts.
2. They should be aware of genome organization of the organisms.

Course Objective:

The objective of the course is to:

1. Study the protocol of restriction digestion of DNA.
2. Prepare competent cells in E. coli.
3. Study the protocol of PCR and DNA sequencing.
4. Study the types and significance of molecular markers

Course outcomes:

After completing the course, the student shall be able to:

1. Illustrate the mechanism of restriction digestion of DNA.
2. Deduce the preparation of competent cells.
3. Equipped to perform transformation experiments through different methods.
4. Characterize the types and mechanism of blotting.
5. Elucidate the ligation of DNA.
6. Apply the knowledge of r-DNA techniques to their research ideas.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25GN0804	CO1	2	2	2	2	2	2	1	2	1	1	2	3	2
	CO2	1	2	2	2	3	2	1	2	2	2	3	1	1
	CO3	3	2	1	2	3	2	2	2	2	2	3	2	2
	CO4	1	2	1	2	2	2	1	2	2	2	3	3	2

	CO5	2	2	2	2	3	2	2	2	2	1	2	3	2
	CO6	3	3	2	3	2	2	1	2	2	2	2	3	2

Course contents:

1. Restriction enzyme digestion of DNA
2. Capillary gel electrophoresis
3. Preparation of competent cells in *E. coli*
4. Transformation through $CaCl_2$ methods
5. Transformation through PEG methods.
6. Study of PCR methods
7. Study of Blotting techniques.
8. Study of Ligation of DNA

References:

1. Primrose SB and Old. (2013). *Principles of Gene manipulation.* 7th edition. Wiley-Blackwell Scientific Publications,
2. Terence A. Brown. (2020). *Gene cloning and DNA analysis: an introduction*, 8th edition. Wiley- Blackwell.
3. M. R. Green, J. Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*. 4th edition. Cold Spring Harbor.
4. M. Wink.(2011). *An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology. 2nd edition.* Wiley.
5. Monika Jain. (2011). *Recombinant DNA Techniques – A textbook.* 1st edition. Narosa Publishing House.
6. Vance Hunter and Franky Strickland. (2018). *Applications of recombinant DNA technology*. 1st edition. ED-Tech Press.

Course code	**Eukaryotic gene regulation lab**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0805		**DSC**	0	0	2	2	3

Prerequisites:

3. Students should have the basics of DNA sequences.
4. They should be aware of the cell signalling cascade.

Course Objective:

The objective of the course is to:

1. Study differential gene expression.

2. Induce chromosomal abnormalities by cyclophosphamide.
3. Study the susceptibility and resistance at various levels
4. Learn the MTT assay and the concept of mutations.

Course outcomes:

After completing the course, the student shall be able to:

1. Demonstrate the differential gene expression in Drosophila.
2. Understand the mitotic and meiotic abnormalities due to mutation induction.
3. Highlight the genetics basis of insecticide and susceptibility.
4. Outline the process of MTT assay.
5. Deduce the cell viability using tryphan blue.
6. Identify and categorize different types of mutations.

Mapping of Course Outcomes with program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25GN0805	CO1	2	3	3	2	2	2	1	2	1	3	2	1	1
	CO2	2	2	3	3	3	3	3	3	3	3	3	1	1
	CO3	2	1	2	2	2	3	2	1	2	3	3	3	3
	CO4	2	1	1	1	1	2	2	2	3	3	3	3	1
	CO5	1	1	1	1	3	3	3	3	3	3	2	3	2
	CO6	2	2	2	2	2	2	3	2	2	3	2	3	1

Course contents:

1. Differential gene expression: demonstration of ecdysone/heat-induced gene expression in polytene chromosome of *Drosophila*
2. Induction of chromosomal abnormalities by treating with cyclophosphamide.
3. Genetic basis of insecticide resistance.
4. Susceptibility studies by using different insecticides in *Culicine* mosquitoes.
5. Genetic basis of insecticide resistance by using adulticide.
6. Gene expression profiling for normal genes *in-silico*.
7. Gene expression profiling for mutant genes *in-silico*.
8. Gene expression profiling for a plant gene *in-silico*.

References:

1. Michael F Carey, Craig L Peterson, Stephen P Smale. (2009). *Transcriptional regulation in eukaryotes: Concepts, strategies and techniques*. 2nd edition. CSH Press.
2. Ajit Kumar. (2013). *Eukaryotic gene regulation*. 2nd edition. Springer US.
3. David S Latchman (2008). *Eukaryotic transcription factors*. 5th edition. Elsevier.
4. Gerald M Kolodny. (2021). *Eukaryotic gene regulation*. Volume 2. Taylor & Francis.
5. Gurbachan S Miglani. (2013). *Gene regulation*. 1st edition. Alpha Science International Limited.

Course code	**RESEARCH PROJECT / INTERNSHIP**	**Course type**	**L**	**T**	**P**	**C**	**CH**
B25GN0808		**DSE**	**0**	**0**	**12**	**12**	**24**

Course Objective: To carry out the academic research towards enhancing research based knowledge

Course outcomes

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Design experiment based on the area of research.
4. Apply technological tools and techniques specific to the professional field of study.
5. Acquire real time exposure to the systematic execution of research components and methodology.
6. Describe the statistical procedures in the interpretation of results.

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25GN0808	CO1	2	2	3	3	3	2	2	1	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	1	1

B.Sc. Hons. By Research (Biochemistry)

Eighth Semester

Course Code	**Cell and membrane biochemistry**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0801		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stake holders have a basic knowledge of Cell and membrane biochemistry

Course Objectives:

1 To understand the various components of cell membranes, including lipids, proteins, and carbohydrates.

2 To understand viscosity of membrane and various membrane transport mechanisms.

3 To understand basic steps involved in signal transduction pathways from ligand binding to cellular response.

4 To understand diseases that result from defects in membrane proteins and knowledge of drug delivery methods across the membrane.

Course Outcomes:

After completing the course, the student shall be able to:

1 Achieve knowledge on basic composition and structural organization of membrane.

2 Achieve knowledge on the membrane fluidity and transport mechanisms that are regulated and integrated into cellular function.

3 Achieve knowledge on understanding basic principles of cell signalling

4 Achieve knowledge on understand the signal transduction pathways involving gpcs & rtks

5 Achieve knowledge on membrane-associated diseases

6 Achieve knowledge on membrane-targeted therapies

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B25BC 0801	CO1	2	3	2	1	1	1	0	1	1	1	3	2	0
	CO2	2	2	2	1	1	1	0	1	2	1	2	3	0
	CO3	2	2	3	1	1	1	0	1	2	1	2	2	1
	CO4	2	3	1	1	1	1	1	1	2	2	2	3	1

	CO5	3	3	1	2	1	1	0	1	2	2	2	2	0
	CO6	3	3	1	2	1	1	1	2	2	3	3	3	3

UNIT I **12 Hours**

Introduction to membrane, composition, and structure

Introduction to plasma membranes. Importance and functions in cellular processes. Structure of plasma membrane: fluid mosaic models, Lipid Bilayer Structure (composition of phospholipids, glycolipids, and sterols), membrane asymmetry and lipid rafts. Membrane Proteins: Integral and peripheral proteins, Protein-lipid interactions and membrane protein structure and function. Carbohydrates in Membranes: Glycoproteins and glycolipids and their role in cell recognition and signalling. Prokaryotic membrane composition and structure in Archaea and Bacteria. Eukaryotic membrane structure- Human Eryhtrocyte Membrane.

UNIT II **12 Hours**

Membrane Dynamics and Transport Mechanisms

Membrane fluidity and factors affecting fluidity (Temperature, cholesterol, fatty acid composition).

Passive Transport Mechanisms: Simple diffusion, facilitated diffusion, Channel proteins and carrier proteins, Osmosis and aquaporins.

Active Transport Mechanisms: Primary and secondary active transport, ATPases (Na^+/K^+ pump, Ca^{2+} pump), Co-transporters and antiporters. Membrane Potential and Electrochemical Gradient. Nernst equation, Generation and maintenance of membrane potential and role of ion channels in membrane potential.

UNIT III **12 Hours**

Signal Transduction and Membrane Receptors

Introduction to Signal Transduction: Basic principles of cell signalling, Types of signalling molecules. G-Protein Coupled Receptors (GPCRs): Structure and function, Signal transduction pathways involving GPCRs (Adrenaline and serotonin receptors), Receptor Tyrosine Kinases (RTKs): Structure and activation mechanisms, downstream signalling pathways (e.g., MAPK/ERK pathway), Examples of RTKs: Insulin receptor, EGF receptor. Other Membrane Receptors: Ion channel-linked receptors, Enzyme-linked receptors, and Intracellular receptors

UNIT IV **12 Hours**

Membrane Biochemistry in Health and Disease

Membrane-associated Diseases: Genetic disorders affecting membrane proteins (e.g., cystic fibrosis, familial hypercholesterolemia) and Lipid storage diseases. Pathogens and Membranes: Viral entry and membrane fusion (e.g., HIV, influenza), Bacterial toxins targeting membranes (e.g., diphtheria toxin, cholera toxin), Membrane-targeted Therapies (Pharmacological agents affecting membranes (e.g., statins, ion channel blockers), Drug delivery systems utilizing liposomes and nano particles.

Suggested Text Books and References

1 Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). *Molecular Cell Biology* (9th ed.). W.H. Freeman and Company.

2 Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science.

3 Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level* (5th ed.). Wiley.

4 Nicolson, G. L. (2012). *The Fluid-Mosaic Model of Membrane Structure: Still relevant to understanding the structure, function and dynamics of biological membranes after more than 40 years*. Biochimica et Biophysica Acta (BBA) - Biomembranes, 1818(6), 1451-1466.

5 Hancock, J. T. (2010). *Cell Signalling* (3rd ed.). Oxford University Press.

6 Sezgin, E., Levental, I., Mayor, S., & Eggeling, C. (2017). *The mystery of membrane organization: composition, regulation and roles of lipid rafts*. Nature Reviews Molecular Cell Biology, 18(6), 361-374.

7 Simons, K., & Gerl, M. J. (2010). *Revitalizing membrane rafts: new tools and insights*. Nature Reviews Molecular Cell Biology, 11(10), 688-699.

8 van Meer, G., Voelker, D. R., & Feigenson, G. W. (2008). *Membrane lipids: where they are and how they behave*. Nature Reviews Molecular Cell Biology, 9(2), 112-124.

9 Sorkin, A., & von Zastrow, M. (2009). *Endocytosis and signalling: intertwining molecular networks*. Nature Reviews Molecular Cell Biology, 10(9), 609-622.

Course Code	**Biochemistry of Diseases.**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B25BC0802		**DSC**	**3**	**0**	**0**	**3**	**4**

Prerequisites

The stake holders have a basic knowledge of biochemistry of diseases.

Course Objectives:

1 Understand the communicable diseases and non-communicable diseases.

2 Understand the inflammation and repair/wound healing and cancer biology .

3 Understand lifestyle diseases

4 Understand neuronal diseases, nephritis and metabolic diseases

Course Outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on the communicable diseases and non-communicable diseases.
2. Achieve knowledge on the inflammation and repair/wound healing and cancer biology.
3. Achieve knowledge on Hypertension and Stroke
4. Achieve knowledge on characteristics and causes of atherosclerosis
5. Achieve knowledge on the cellular basis of neurodegeneration.
6. Achieve knowledge on Nephritis and Metabolic Diseases

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO	PSO	PSO
B25BC 0802	CO1	1	2	2	1	0	0	0	0	0	0	2	2	0
	CO 2	2	0	1	2	2	1	0	0	0	0	2	2	0
	CO 3	2	0	2	0	0	0	0	0	0	0	2	2	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	1	0
	CO 6	2	2	1	0	0	0	0	0	0	0	3	1	0

UNIT I

Communicable diseases and non-communicable diseases -12hrs

Tuberculosis, Cholera, Typhoid, Conjunctivitis. Sexually transmitted diseases (STD): Information, statistics, and treatment guidelines for STD, Prevention: Syphilis, Gonorrhea, AIDS, etc. Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma.

Genetic disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia.

UNIT II.

Inflammation and repair/wound healing **12hrs**

Chronic inflammation, acute Inflammation-Vascular changes-cellular events - chemical mechanism of inflammation- effects of inflammation-wound healing-mechanism, autoimmune disorder. **hepatic disorders:** Liver disease, Function of liver, liver disease (viral hepatitis, alcoholic liver disease, and cirrhosis), symptoms, causes, diagnosis (liver function test- brief outline of serum bilirubin, serum albumin, serum alkaline phosphatase, ALT, AST and LDH), treatment and management. Hepatic injury- Alcohol liver Disease-Drug and toxin induced liver, disease- cirrhosis- pregnancy associated-transplantation associated adenomas and primary carcinoma.

UNIT III.

Lifestyle diseases **12 hrs**

Hypertension and Stroke Atherosclerosis: characteristics, causes (confirmed & indirect risk factors – brief description only), ischemia, myocardial infarction (definition), diagnosis (electrocardiography, exercise stress test, echocardiography, coronary angiography, intravascular ultrasound, magnetic resonance imaging – brief description only), prevention (lifestyle, diet, drugs), management (drugs, angioplasty, stenting, bypass surgery- brief description only) Hypertension: characteristics, Causes, Diagnosis, Prevention and Management (brief description only) Stroke: characteristics (ischemic and hemorrhagic), causes, diagnosis (neurological examination, scanning - brief description only).

UNIT IV.

Neuronal diseases, nephritis and metabolic diseases **12 HRS**

Cellular basis of neuro degeneration. Alzheimer's, Parkinson's, and other neurodegenerative diseases. Nephritis: Function of kidney (brief outline), GFR, nephritis (definition), causes, symptoms, diagnosis (kidney function test - brief outline of serum and urine creatinine, blood and urine urea, BUN, clearance test creatinine and urea), treatment, management (dialysis-peritoneal and hemodialysis) Metabolic Diseases: Diabetes mellitus and Obesity Diabetes mellitus: classification (type 1, type 2, gestational- brief description only), symptoms (polyuria, polydypsia, polyphagia), causes, diagnosis (GTT, glycated haemoglobin- brief description only), management (diet, exercise, drugs). Obesity: classification according to BMI (brief description), symptoms, causes, diagnosis, treatment and management

REFERENCES

1 Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. (2018). *Harrison's Principles of Internal Medicine* (20th ed.). McGraw-Hill Education. ISBN: 978-1259644030

2 Kumar, V., Abbas, A. K., Aster, J. C., & Perkins, J. A. (2020). *Robbins and Cotran Pathologic Basis of Disease* (10th ed.). Elsevier. ISBN: 978-0323531139

3 Kliegman, R. M., St. Geme, J. W., Blum, N. J., Shah, S. S., Tasker, R. C., & Wilson, K. M. (2019). *Nelson Textbook of Pediatrics* (21st ed.). Elsevier. ISBN: 978-0323529501

4 Ralston, S. H., Penman, I. D., Strachan, M. W. J., & Hobson, R. P. (2018). *Davidson's Principles and Practice of Medicine* (23rd ed.). Elsevier. ISBN: 978-0702070273

5 Hall, J. E. (2020). *Guyton and Hall Textbook of Medical Physiology* (14th ed.). Elsevier. ISBN: 978-0323597128

6 Zumla, A., Nahid, P., & Cole, S. T. (2023). Recent advances in tuberculosis treatment and prevention. *The Lancet*, 401(10384), 957-971.

7 Rowley, J., Vander Hoorn, S., Korenromp, E., Low, N., Unemo, M., Abu-Raddad, L. J., & Newman, L. (2022). Global strategies for the prevention and control of sexually transmitted infections. *The Lancet Global Health*, 10(1), e40-e48.

8 Croft, M., Siegel, R. M., & Zhang, Y. (2022). Inflammation and chronic disease: A focus on autoimmune disorders. *Nature Reviews Immunology*, 22(10), 617-632.

9 Bluher, M., & Smith, S. R. (2023). Metabolic diseases and obesity: Current perspectives and future directions. *Nature Reviews Endocrinology*, 19(1), 27-42.

Course Code	**Laboratory Course–X Cell and membrane biochemistry**	Course Type	L	T	P	C	CH
B25BC0804		**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Need the basic concept of Cell and membrane biochemistry

Course Objective:

1. To experience and connect the theoretical concepts related to membrane biochemistry
2. To learn to Isolate membranes from red blood cells (RBC)
3. To learn to Evaluate the disrupting effect of detergent like molecules on bio membranes by dissolving the phospholipid component

Course outcomes:

After completing the course, the student shall be able to:

1. Achieve knowledge on isolate membranes from red blood cells (RBC)
2. Achieve knowledge on evaluate the disrupting effect of detergent like molecules on bio membranes by dissolving the phospholipids component.
3. Achieve knowledge on to prove that during photosynthesis oxygen is evolved due to presence of grana thylakoids membranes.
4. Achieve knowledge on isolate and estimate the photosynthetic pigments
5. Achieve knowledge on Understand Membrane Biology
6. Achieve knowledge on Photosynthetic Pigments Characterization

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BC 0804	CO1	2	2	1	0	1	1	0	0	2	2	2	3	1
	CO2	2	2	1	1	1	1	0	0	2	2	2	2	2
	CO3	2	1	1	1	1	1	0	0	2	2	2	1	0
	CO4	2	3	2	0	1	1	0	0	2	2	2	2	0
	CO5	2	2	2	2	1	1	0	0	2	2	2	1	1
	CO6	2	2	2	0	1	1	0	0	1	2	2	2	1

Contents:

1 Preparation of RBC ghost membrane.

2 Estimation of % of Hemolysis induced by free-radical (hydrogen peroxide)

3 Study the Photosynthetic Oxygen (O2) Evolution in Hydrilla Plant

4 Isolation of chloroplast from spinach leaves,

5 Estimation of chlorophyll and photosynthetic activity.

6 Extraction and Separation of Photosynthetic Pigments by Partition Chromatography.

7 Determination of Critical Micelle Concentration of detergents.

8 Study of Active transport of Glucose in Intestine and Determination by Anthrone Method

Reference:

1 Boyer, R. (2012). *Modern Experimental Biochemistry* (4th ed.). Pearson. ISBN: 978-0321644907

2 Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level* (5th ed.). Wiley. ISBN: 978-1118918401

3 Wilson, K., & Walker, J. (2018). *Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press. ISBN: 978-1107162273

4 Heldt, H. W., & Piechulla, B. (2021). *Plant Biochemistry* (5th ed.). Academic Press. ISBN: 978-0128186374

5 Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). W.H. Freeman. ISBN: 978-1464187952

6 Berg, J. M., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman. ISBN: 978-1319114671

7 Mathews, C. K., van Holde, K. E., Appling, D. R., & Anthony-Cahill, S. J. (2018). *Biochemistry* (4th ed.). Pearson. ISBN: 978-0138004644

Course Code	**Laboratory Course –XI**	**Course Typ**	**L**	**T**	**P**	**C**	**CH**
B25BC0805	**Biochemistry of Diseases.**	**DSC**	**0**	**0**	**2**	**2**	**3**

Prerequisites:

Requires knowledge of pre-university, Needthe basic concept of Biochemistry of Diseases

Course Objective:

1.To identify the abnormal form of Hemoglobin and its variants.

2 To learn to Isolate membranes from red blood cells (RBC)

3. To learn haemostatic mechanism and theories of blood coagulation

Course outcomes:

After completing the course, the student shall be able to

1. Achieve knowledge on analysis of haemoglobin analysis
2. Achieve knowledge on Isolate membranes from red blood cells (RBC) clearly.
3. Achieve knowledge on Mechanism and theories of blood coagulation
4. Achieve knowledge on Gain the knowledge about Leishman’s, May Grunwald Giesma and Perl’s stain
5. Achieve knowledge on Laboratory Diagnosis of Fungal Infection
6. Achieve knowledge on Comprehensive Urine Analysis

Mapping of Course Outcomes with programme outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B25BC 0805	CO 1	2	2	2	1	1	0	0	0	0	0	2	2	0
	CO 2	2	1	1	2	2	1	0	0	0	0	2	2	0
	CO 3	2	1	2	0	0	0	0	0	0	0	2	1	0
	CO 4	2	2	1	0	1	1	0	0	0	0	2	2	0
	CO 5	1	2	1	0	1	0	0	0	0	0	2	1	0
	CO 6	2	2	1	1	0	0	0	0	0	0	2	1	0

Course Contents:

1 Tube agglutination test: WIDAL test.

2 Haemoglobin pigments and their measurement.

3 Abnormal haemoglobins, their identification and estimation.

4 Normal haemostatic mechanism and theories of blood coagulation.

5 Screening coagulation tests such as Bleeding and clotting Time, Hess test, prothrombin time(PT) and Activated Partial Thromboplastin time (APTT)

6 VDRL.

7 To process clinical samples for laboratory diagnosis of fungal infections i.e. a) Skin b) Nail c) Hair d) Body fluids and secretions.

8 To prepare a bone marrow smear and stain by Leishman's, May Grunwald Giesma and Perl's stain

9 Physical, Chemical and Microscopic examination of urine.

Reference:

1. Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2016). *Dacie and Lewis Practical Haematology* (12th ed.). Elsevier. ISBN: 978-0702066962
2. Hoffbrand, A. V., Higgs, D. R., Keeling, D. M., & Mehta, A. B. (2019). *Postgraduate Haematology* (7th ed.). Wiley-Blackwell. ISBN: 978-1119398940
3. Marshall, W. J., & Bangert, S. K. (2019). *Clinical Chemistry* (9th ed.). Elsevier. ISBN: 978-0702079368
4. Turgeon, M. L. (2020). *Clinical Hematology: Theory and Procedures* (6th ed.). Jones & Bartlett Learning. ISBN: 978-1284180149
5. Nussbaum, R. L., McInnes, R. R., & Willard, H. F. (2015). *Thompson & Thompson Genetics in Medicine* (8th ed.). Elsevier. ISBN: 978-1437706963

6. Chessbrough, M. (2019). *District Laboratory Practice in Tropical Countries* (3rd ed.). Cambridge University Press. ISBN: 978-1108725521
7. Pincus, M. R., & McPherson, R. A. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (23rd ed.). Elsevier. ISBN: 978-032341315.

Course code		**Course type**	**L**	**T**	**P**	**C**	**CH**
B25BC0808	**Research Project/ Internship**	**DSE**	**0**	**0**	**6**	**6**	**12**

Course Objective: To carry out the academic research towards enhancing research-based knowledge

Course outcomes

1 Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areasof study.
2 Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3 Design experiment based on the area of research.
4 Apply technological tools and techniques specific to the professional field of study.
5 Acquire real time exposure to the systematic execution of research components and methodology.
6 Describe the statistical procedures in the interpretation of results.

Cours e Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
B25BC0808	CO1	2	2	3	3	3	2	2	1	2	2	2	1	0	3
	CO2	3	2	2	3	3	3	3	1	2	2	2	1	0	3
	CO3	3	3	1	3	3	3	3	1	2	2	2	1	1	3
	CO4	3	3	1	1	1	3	3	1	2	2	2	1	1	3
	CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1
	CO6	2	2	2	2	2	2	2	2	2	2	2	2	1	1

Career Development and Placement

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self-motivation
3. Teamwork
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University, therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counselling and Placement division, namely Career Development Centre (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counsellors and placement officers and other efficient supportive team do handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes preplacement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Biotechnology is not only knowledge in the subject, but also the skills to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student at REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Chemical and Biological sciences also have emphasized subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day-to-day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students. The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana.

The University has also signed MOUs with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.