10 YEARS OF UNIVERSITY RECOGNITION

20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY

Bengaluru, India

SCHOOL OF APPLIED SCIENCES

B.Sc. – BIOINFORMATICS, STATISTICS, COMPUTER SCIENCE

HANDBOOK: 2021-24

Rukmini Educational
Charitable Trust

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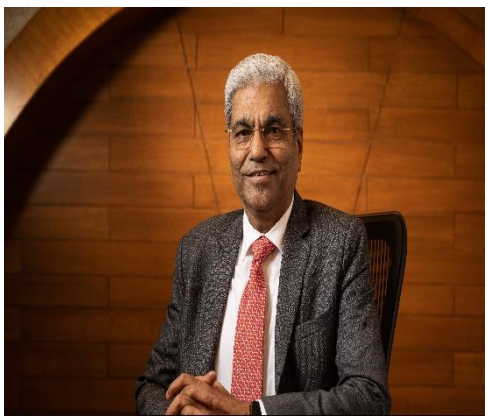

"Education is the most powerful weapon which you can use to change the world."

- 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. 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

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

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 - many 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 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. M. Dhanamjaya,
Vice-Chancellor, REVA University

Director Message

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

Indian economy is experiencing an upward growth right from the beginning of 21st century necessitating well qualified science graduates to work as scientists, teachers, algorithm developers, computer programmers, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating a greater number of teachers and professors to work in schools and colleges. Research has also been given equal importance. Private sector and Corporates are also looking for smart science graduates in a big way. The B.Sc. (BBG) degree program of REVA University is designed to prepare biotechnologist, biochemists, Microbiologist, genetics, Bioinformatician, genomic data scientists, teachers, professionals & administrators to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth.

The program has been developed with an emphasis on knowledge assimilation, application, national and international job market and its social relevance. 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.

The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. 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 handy document containing brief information about B.Sc. (BBG) program, scheme of instruction and detailed course content will serve as a guiding path to you to move forward in a right direction.

I am sure you will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers' involvement and guidance. We will strive to provide all needed comfort and congenial environment for your studies. I wish you and all students' pleasant stay in REVA and grand success in your career.

Prof. Shilpa B.R
Deputy Director, SoAS

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 fulfill 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 13,000 students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and connective 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 7th 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 Kempegowda 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 center, 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 Genetics, Molecular Biology, Biotechnology, Biochemistry, Chemical Sciences, Synthetic chemistry, Nano chemistry, Nanotechnology, bioinformatics, Plant and Agricultural Research, 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, Counselors 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 recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. 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, EMC2, 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.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers, and such others who have contributed richly for the development of the society and progress of the country. One of such awards instituted by REVA University is **'Lifetime Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the "**Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first **"REVA Lifetime Achievement Award"** for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "REVA Award of Excellence" in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes 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 at 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 recognized 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 is every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honored with many more such honors and recognitions.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development.
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

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

ABOUT 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, Bioinformatics, Microbial Technology, Genetics, Chemistry, Physics, Mathematics and B Sc with various combinations viz, Physics Chemistry and Mathematics (PCM), Physics, Mathematics, and Statistics (PMSt), Mathematics, Statistics and Computer Science (MStCs), and Biology (Bioinformatics), Mathematics & Computer Science (BMCs) and Post Graduate Diploma in Clinical Research Management. The school also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics, 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, and professionalism among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that is socially relevant and transforms them to become global citizens.

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 and nation.

Board of Studies in Bioinformatics (B.Sc. Bioinformatics)

S. No.	Name, Designation & Affiliation	External/ Internal Member
	BIOINFORMATICS	
1	**Prof.Shilpa B R** Associate Director, School of Applied Sciences REVA University, Bengaluru-560064	Chairman
2	**Dr. Jagadeesh Kumar D** Assistant Professor, Sir MVIT, Bangalore-64	External Member
3	**Mr. Vivek Chandra Mohan** Assistant Professor, Department of Biotechnology Siddaganga Institute of Technology, Tumkur, Karnataka, India	External Member
4	**Prof.Prashantha C N** Assistant Professor, Department of Biotechnology School of Applied Sciences, REVA University, Bengaluru-560064	Internal Member
	COMPUTER SCIENCE	
5	**Mr. Sudheendra Rao.K.** Data Scientist. Director and Co-Founder Datalore Labs, Bengaluru, Karnataka, India.	Industry Member
6	**Mr. Rajib Lochan Nandi.** Senior software Developer Analyst NTT Data Solution, Bangalore, Karnataka, India.	Industry Member
7	**Prof. PRAVEEN KUMAR V** Assistant Professor, Program coordinator, Department of Computer Science, Acharya Bangalore B School, Bengaluru, Karnataka, India.	External Member
8	**Prof. S. Satheesh Kumar.** Assistant Professor, Coordinator, Department of Computer Science School of Applied Sciences, REVA University, Bengaluru-560064	Internal Member
	STATISTICS	
9	**Dr.R. Sumitra** PG Coordinator & Head, Department of UG, PG Studies & Research in Mathematics, Government Science College, Autonomous, Bengaluru	External Member
10	**Dr. Biradar Kashinath** Principal, Department of Mathematics, Govt. First Grade College for Women, Jewaragi Colony, Kalburgi, Karnataka, India	External Member
11	**Dr. Subramanyam T** Assistant Professor, Department of Mathematics, M.S. Ramaiah University of Applied Sciences, Bengaluru	External Member
12	**Dr. Uday Kumar K N** Associate Professor, Department of Mathematics, School of Applied Sciences, REVA University, Bengaluru-560064	Internal Member
13	**Dr. Madhusudhan Zalki** Professor (Statistics), Department of Mathematics, School of Applied Sciences, REVA University, Bengaluru-560064	Internal Member

B.Sc. Bioinformatics Program Overview
(Bioinformatics, Statistics, Computer Science)

Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data. As an interdisciplinary field of science, bioinformatics, statistics, and computer science to analyze and interpret biological data. The primary goal of bioinformatics is to increase the understanding of biological processes. What sets it apart from other approaches, however, is its focus on developing and applying computationally intensive techniques to achieve this goal. Examples include pattern recognition, data mining, machine learning algorithms, and visualization. Major research efforts in the field include sequence alignment, gene finding, genome assembly, drug design, drug discovery, protein structure alignment, protein structure prediction, prediction of gene expression and protein–protein interactions, genome-wide association studies, the modeling of evolution and cell division/mitosis.

Bioinformatics now entails the creation and advancement of databases, algorithms, computational and statistical techniques, and theory to solve formal and practical problems arising from the management and analysis of biological data. Over the past few decades, rapid developments in genomic and other molecular research technologies and developments in information technologies have combined to produce a tremendous amount of information related to molecular biology. Bioinformatics is the name given to these mathematical and computing approaches used to glean understanding of biological processes. Common activities in bioinformatics include mapping and analyzing DNA and protein sequences, aligning DNA and protein sequences to compare them, and creating and viewing 3-D models of protein structures.

The School of Applied Sciences at REVA UNIVERSITY has designed to offer B.Sc. Bioinformatics as an undergraduate degree Programme to create motivated, enthusiastic, creative, and thinking graduates to fill the roles bioinformatics professionals. Indian economy is experiencing an upward growth right from the beginning of 21st century except for a short stint during the mid of present decade necessitating well qualified science graduates to work as teachers, professors, scientists, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020 thus there will be too many youths with varied educational aspirations. The B.Sc. –Bioinformatics Programme designed will act as a foundation and first degree to prepare bioinformatics analysts who could assist biotech industries in gene finding, genome assembly, drug design, drug discovery, protein structure alignment, protein structure prediction, prediction of gene expression and protein–protein interactions, genome-wide association studies, the modeling of evolution and cell division/mitosis.

The B.Sc. Bioinformatics Programme at the School of Applied Sciences has been developed by the members of the faculty based on interactions with various universities, research establishments and industries in India and abroad. The curriculum is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in communication skills and interdisciplinary topics to enhance their scope. The above-mentioned features of the programme, advanced teaching and learning

resources, and experience of the faculty members with their strong connections with industry and research organizations makes this programme unique.

Program Educational Objectives (PEOs)

After 3 years of graduation, the graduate will:

PEO1	Adopt conceptual as well as applied knowledge and skills in the field of bioinformatics and data science for sustainable approach to solve scientific problems.
PEO2	Express oral and Written skills to understand, learn and advance their careers through entrepreneurial orientation, research, and higher education.
PEO3	Understand the professional, ethical, and social responsibilities through lifelong learning skills with continuous improvement.

Program Outcomes (POs)

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

PO1: Science knowledge: Apply the knowledge of bioinformatics for the solution of complex biological problems in various domains including healthcare considering public health & safety and the cultural societal & environmental concerns.

PO2: Problem analysis: Identify, formulate & analyze biological problems related to life sciences, mathematical and computer science to produce some solutions based on statistical interpretations.

PO3: Conduct investigations of relevant problems: Use research-based skills and knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions and to carry out the research procedures..

PO4: Modern tool usage: Bioinformatics always uses to create, select and apply tools, software's, or algorithms and apply advanced algorithms for product/process development which in turn benefit the society.

PO5: Environment and sustainability: Understand and implement environmentally friendly approaches in life science industries to support sustainable development.

PO6: Ethics: Apply ethical principles and commit to professional ethics, responsibilities, and norms in Life Sciences.

PO7: Individual and teamwork: Function effectively as an individual or team work to demonstrate and understand biological problems and manage projects in multidisciplinary and interdisciplinary settings.

PO8: Communication: Communicate effectively with the scientific community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and deduce clear instructions.

PO9: 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.

PO10: 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.

Program Specific Outcomes (PSOs)

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

PSO-1: Develop a strong conceptual foundation in bioinformatics, computer science and mathematics using latest tools and software's, algorithms, and programming languages along with analytical and managerial skills to arrive at cost effective and optimum solutions.

PSO-2: Explain, design, and analyze domain specific fields for the use of databases and software packages for analysis and interpretation of biological data as required by researchers in Biotechnology and Life Science.

REVA University Regulations for bachelor's degree program Academic Year 2021-22 Batch

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1. These Regulations shall be called **"REVA University Academic Regulations – bachelor's degree programs 2021-22 batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management".**

1.2. These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following bachelor's degree programs of REVA University offered during 2021-22:

B.Sc. in:

- Biotechnology, Biochemistry, and Genetics
- Bioinformatics, Statistics, and Computer Science
- Microbiology, Chemistry, and Genetics
- Physics, Chemistry, and Mathematics
- Mathematics, Statistics, and Computer Science
- Physics, Mathematics, and Computer Science
- Biochemistry, Microbiology, Medical Laboratory Technology
- Nutrition and Dietetics
- Medical Radiology and Diagnostic imaging
- Cloud computing & Big data
- Honors in Computer Science with specialization in Multimedia and Animation
- Computer Science with specialization in Cyber Security
- Honors in Computer Science specialization in Cloud Computing and Big Data

B.A in

- Journalism and Mass Communication
- Journalism, English, Psychology
- Tourism, History & Journalism
- Political Science, Economics & Journalism
- Performing Arts, English Psychology
- Tourism, Journalism and History

B. Com in

- Industry Integrated
- Honors in Accounting and Taxation

- Honors in Banking and Finance
- Honors in Statistics and Accounting
- Honors in Economics and Finance

BBA in

- Honors in Business Analytics and Design Thinking
- Honors in Strategy and Leadership
- Honors in Banking and Finance
- Honors in Hospital and Health Care Management
- Honors in Talent Management and Marketing
- Bachelor of Business Administration
- Bachelor of Business Administration (Honors)
- Bachelor of Business Administration (Entrepreneurship)
- BCA

3. Duration and Medium of Instructions:

3.1. Duration: The bachelor's degree program is of 6 Semesters duration. A candidate can avail a maximum of 12 semesters - 6 years as per double duration norm, in one stretch to complete the bachelor's degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he must study the prevailing courses offered by the school when s/he resumes his/her studies.

3.2. The medium of instruction shall be English.

4. Definitions:

4.1. Course: "Course" means a subject, either theory or practical or both, listed under a program; Example: "Cell Biology" in B.Sc. (BBG) program is an example of course to be studied under respective program.

Every course offered will have three components associated with the teaching learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
P	**Practical**

Where:

- **L** stands for **Lecture session** consisting of classroom instruction.
- **T** stands for **Tutorial session** consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.
- **P** stands for **Practice session,** and it consists of Hands-on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much-required skill component.

4.2. Classification of Courses

Courses offered are classified as: Foundation Courses, Core Courses, Hard Core Courses, Soft Core Courses, Open Elective Courses, SEC, Project work/Dissertation

4.2.1. Foundation Course: The foundation Course is a compulsory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

4.2.2. Hard Core Course (HC) simply core course: The Hard-Core Course is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates must complete compulsorily

4.2.3. Soft Core Course (SC) (also known as Professional Elective Course): A Core course may be a Soft Core if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

4.2.4. Mandatory Course (MC): The Mandatory course is non credited but must be passed in order to complete the Graduate Degree Program.

4.2.5. Open Elective Course (OE): An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an Open Elective Course

4.2.6. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits, and a major project carries double the number of credits of a minor project.

4.2.7. "Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma, or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to Three Years bachelor's degree Programs (6 Semesters) is given below:

S. No	Program	Duration	Eligibility
1	Bachelor of Commerce (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
2	Bachelor of Commerce (Honors)		Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
3	Bachelor of Business Administration (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
4	Bachelor of Business Administration (Honors)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
5	Bachelor of Business Administration (Entrepreneurship)	6 Semesters (3 years)	
6	Bachelor of Arts in a) Journalism, English & Psychology (JEP) b) Political Science, Economics, Journalism c) Tourism, Journalism	6 Semesters (3 years)	Pass in PUC /10+2 of any recognized Board / Council or any other qualification recognized as equivalent there to.

	& History (TJH)		
7	Bachelor of Arts in Performing Arts, English & Psychology	6 Semesters (3 years)	
8	Bachelor of Computer Applications	6 Semesters (3 years)	Pass in PUC/10+2 with at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council of any other qualification recognized as equivalent there to.
9	Bachelor of Science (Hons.) in Computer Science (with specialization in Cloud Computing & Big Data)	6 Semesters (3 years)	Pass in PUC/10+2 examination with Mathematics / Computer Science / Statistics as compulsory subject along with other subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC/ST category) in the above subjects taken together from any Board recognized by the respective State Government /Central Government/Union Territories or any other qualification recognized as equivalent.
10	B Sc in a) Physics, Chemistry and Mathematics (PCM) b) Mathematics, Statistics and Computer Science (MStCs) c) Physics, Mathematics and Computer Science	6 Semesters (3 years)	Pass in PUC/10+2 with Mathematics as compulsory subjects and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.
11	B Sc in a). Bioinformatics, Statistics & Computer Science b) Biotechnology, Biochemistry, Genetics c) Microbiology, Chemistry & Genetics	6 Semesters (3 years)	Pass in PUC/10+2 with Biology as compulsory subject and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.

5.2. Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, University from time to time.

6. Courses of Study and Credits

6.1. Each course of study is assigned with certain credit value

6.2. Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IAs and final examination, evaluation and announcement of results.

6.3. The credit hours defined as below

In terms of credits, every one-hour session of L amounts to 1 credit per Semester and a minimum of two-hour session of T or P amounts to 1 credit per Semester or a three-hour session of T/P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

For Example: The following table describes credit pattern

Credit Pattern					
Lectures (L)	**Tutorials (T)**	**Practice (P)**	**Credits (L: T: P)**	**Total Credits**	**Total contact hours**
4	2	0	4: 1: 0	5	6
3	2	0	3: 1: 0	4	5
3	0	2	3: 0: 1	4	5
2	2	2	2: 1: 1	4	6
0	0	6	0: 0: 3	3	6
4	0	0	4: 0: 0	4	4
2	0	0	2: 0: 0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different Courses of Study:

Different **Courses of Study** are labeled as follows:

a. Foundation Course (FC)
b. Hard Core Course (HC)
c. Soft Core Course (SC)
d. Mandatory Course (MC)
e. Open Elective Course (OE)
f. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits, and a major project carries double the number of credits of a minor project.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

8.1. Registered candidates are required to earn the credits stated in the scheme:

Credits	**Programs**
120	BSc in Physics, Chemistry, Maths, BSc in Maths, Statistics, Comp Sci., BSc in Bioinformatics, Statistics and Computer Science, BSc in Biotechnology, Biochemistry, Genetics, BSc in Microbiology, Chemistry and Genetics, and BSc in Physics, Maths, Computer Science

The following courses are foundation courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Communicative English
2. Languages K / H / Additional English

The following courses are Mandatory Courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Indian constitution.
2. Environmental Science

8.2. The concerned BOS shall prescribe the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical

work, field work, self-study elective, as **Foundation Course (FC), Hard Core (HC), Soft Core (SC), Mandatory Course (MC) and Open Elective (OE).**

8.3. The concerned BoS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program. However, following shall be the

8.4. A candidate can enroll during each semester for credits as prescribed in the scheme of the program.

8.5. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully prescribed number of credits for the award of the degree for three year program in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8.6. Add on Proficiency Diploma / Minor degree/ Honor Degree

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree, a candidate can opt to complete a minimum of 18-20 extra credits either in the same discipline /subject or in different discipline / subject based on the eligibility criteria and in excess to prescribed number of credits for the award of 3-year degree in the registered program.

9. Assessment and Evaluation

9.1. The Scheme of Assessment will have two parts, namely.

i. Internal Assessment (IA); and

ii. Semester End Examination (SEE)

9.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of for 3-year undergraduate degree programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3. The 50 marks of internal assessment shall comprise:

Internal Test	30 marks
Assignments/ Seminars/ Quizzes/ Presentations/ case studies etc.	20 Marks

9.4. The assessment and evaluation procedure for integrated course with theory 3 credits and practical 1.5 credits that has been designed.

Theory: L: T: P: C - 3-0-0 (Total Contact Hours 4hrs)

Practical's: L: T: P: C - 0-0-1.5 (Total Contact Hours 3hrs)

Total semester end theory examination and practical examination marks will be scaled down to 50 The marks distribution is - IA1 +IA2 + SEE (Theory and practical) = 25+25+50=100.

9.5. There shall **be two Internal Tests** conducted as per the schedule announced below**. The students shall attend both the Tests compulsorily.**

- ✓ 1st test is conducted for 15 marks during 8th week of the Semester.
- ✓ 2nd test is conducted for 15 marks during 16th week of the of the Semester.

- ✓ Suitable number of Assignments/quizzes/presentations are set to assess the remaining 20 marks of IA at appropriate times during the semester.

9.6. The coverage of syllabus for the said tests shall be as under:

i. Question paper of the **1st test should be based on first 50% of the total syllabus.**

ii. Question paper of the **2nd test should be based on second 50% of the total syllabus.**

9.7. The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

9.8. A test paper is set for a maximum of 30 marks to be answered as per the pre-set time duration (1 hr / 1 hr. 15 minutes / 1 hr. 30 minutes). Test paper must be designed with School faculty members agreed pattern and students are assessed as per the instructions provided in the question paper. Questions must be set using Bloom's verbs. The questions must be set to assess the student's outcomes described in the course document.

9.9. The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by School specific Question Paper Scrutiny Committee formed by the respective School Head /Director to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

9.10. The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.11. Assignment/seminar/ Project based learning/ simulation-based problem solving/ field work should be set in such a way, students be able to apply the concepts learnt to a real-life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarize the answer from web or any other resources. An IA1 and IA2 assignment / Quiz can be set each for a maximum of 5 marks, totals to 10 marks. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and self-study.

9.12. Internal assessment marks must be decided well before the commencement of Semester End examinations.

9.13. Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 19th and 20th week of the semester and the entire course syllabus must be covered while setting the question paper.

9.14. Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Question paper must be prepared as per the respective School set format.

9.15. Each question is set using Bloom's verbs. The questions must be set to assess the student's outcomes described in the course document. (Please note question papers must be set to test the course outcomes)

9.16. There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where enough external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

9.17. Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.18. There shall also be a **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. Program Assessment Committee (PAC) shall also review the question papers of both Internal Tests as well as Semester End Examinations and submit to the Director of the respective School about the scope of curriculum covered and quality of the questions.

9.19. The report provided by the **Program Assessment committee (PAC)** shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program.

9.20. During unforeseen situation, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC.

9.21. University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper.

9.22. Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor.

9.23. Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the school can accept the marks awarded by the course provider and assign the grade as per REVA University norms.
2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply
3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits.

9.24. The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.25. Utilization of one or two credit online courses would be:

4-week online course – 1 credit – 15 hours

8-week online course / MOOC – 2 credits – 30 hours

12-week online course / MOOC – 3 credits – 45 hours

9.26. Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

S. No	**Type of Assessment**	**when**	**Syllabus Covered**	**Max Marks**	**Reduced to**	**Date by which the process must be completed**
1	Test-1	During 8th week	First 50%	30	15	8th week
2	Assignment- 1	On or before 8th week (10 marks)				
3	Presentations 1	On or before 8th week (5 marks)				
4	Test -2	During 16th Week	Second 50%	30	15	16th Week

5	Assignment 2	On or before 16th Week (5 marks)				
6	Presentations 2	On or before 16th Week (5 marks)				
7	SEE	19/20th Week	100%	100	50	20th Week

Note: 1. Examination and Evaluation shall take place concurrently and Final Grades shall be announced as per notification from the Controller of Examination.

2. Practical examination wherever applicable shall be conducted after 2nd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Controller of Examination who will notify the same immediately.

10. Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes.

b) Skills and operations involved.

c) Results / products including calculation and reporting.

10.1. The 50 marks meant for Internal Assessment (IA) of the performance in carrying out Practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test include performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

10.2. The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board**.**

10.3. For MOOC and other Online Courses assessment shall be decided by the BOS of the School.

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate must submit the progress reports periodically and present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation for final evaluation. The components of evaluation are as follows:

Component – I	Progress Report 1 (25%)
Component – II	Progress Report 2 (25%)
Component – III	Evaluation of Report and final viva voce (50%)

All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

12. Requirements to Pass a Course:

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 40% in the SEE and an overall 40% (IA1+IA2+SEE) in a course is said to be successful.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average. C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P= [IA + SEE]) secured by a candidate in a course which is rounded to nearest integer. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following examples describe to compute the Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e.: **SGPA (Si) = ∑ (Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Examples on how SGPA and CGPA are computed.

Example No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
	20			**129**

Thus, **SGPA = 129 ÷ 16 = 8.06**

Example No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32

Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
	20			**141**

Thus, **SGPA = 141 ÷ 20 = 7.05**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits for the respective programs are calculated considering all the courses undergone by a student over all the semesters of a program, i.e**.: CGPA = ∑ (Ci x Si) / ∑Ci** Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	20	6.83	20 x 6.83 = 136.6
2	19	7.29	19 x 7.29 = 138.51
3	21	8.11	21 x 8.11 = 170.31
4	20	7.40	20 x 7.40 = 148.00
5	22	8.29	22 x 8.29 = 182.38
6	18	8.58	18 x 8.58 = 154.44
Cumulative	**120**		**930.54**

Thus, CGPA = 930.24/120 = 7.75

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Example: CGPA Earned 7.75 x 10=77.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass

< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. **Provisional Grade Card:** The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides Semester Grade Point Average (SGPA).

b. **Final Grade Card:** Upon successful completion of two-year Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial, and practical classes.

14.2 In case a student is on approved leave of absence (e g: - representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc., during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission.

15. Re-Registration and Re-Admission:

15.1. In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and s/he shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2. In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and s/he shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal test due to the illness or other contingencies s/he may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), s/he can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. S/he can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her

submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if s/he is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC.

For every program there will be one grievance committee. The composition of the grievance committee is as follows: -

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 40% (20 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in each course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, s/he shall have to clear all courses of all semesters within the double duration, i.e., with four years of admission of the first semester failing which the student has to re-register to the entire program.

22. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photocopy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. S/he can challenge the grade awarded to him/her by surrendering the grade card and by applying along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Mapping of PEOs with Respect to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
PEO1	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√

Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHK101	**CO1**	0	0	0	0	2	3	0	0	0	3	0	0
	CO2	0	0	0	0	2	3	0	0	0	3	0	0
	CO3	0	0	0	0	0	3	0	0	0	3	0	0
	CO4	0	0	0	0	0	0	3	2	0	3	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHH101	**CO1**	0	0	0	0	2	3	2	0	0	3	0	0
	CO2	0	0	0	0	2	2	3	0	0	3	0	0
	CO3	0	0	0	0	3	3	3	0	0	3	0	0
	CO4	0	0	0	0	3	2	3	0	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHA101	**CO1**	0	0	0	0	3	3	3	2	0	3	0	0
	CO2	0	0	0	0	3	3	3	3	0	3	0	0
	CO3	0	0	0	0	3	3	3	2	0	3	0	0
	CO4	0	0	0	0	3	3	3	3	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHE101	**CO1**	0	0	0	0	3	3	3	2	3	3	0	0
	CO2	0	0	0	0	3	3	3	2	3	3	0	0
	CO3	0	0	0	0	3	3	3	3	3	3	0	0
	CO4	0	0	0	0	3	3	3	3	2	2	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0101	**CO1**	2	3	2	3	3	2	0	0	1	1	1	1
	CO2	2	3	2	3	3	3	3	2	3	3	1	2
	CO3	2	3	2	3	3	3	3	3	3	3	2	2
	CO4	2	3	2	3	3	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0103	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0101	**CO1**	3	2	2	1	1	1	1	1		1	1	2
	CO2	3	2	2	1	1	2	1	1		1	1	3
	CO3	3	2	2	2	1	2	1	1		1	1	2
	CO4	3	2	2	1	2	1	1	1		1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21STS111	**CO1**	3	3	2	2					2	3	2	3
	CO2	3	2	2	3					3	2	3	2
	CO3	3	2	3	2					3	2	3	2
	CO4	3	3	3	2					3	3	3	3
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21STS112	**CO1**	3	2	2	1	1	1			1	1	1	3
	CO2	3	2	2	1	1				1	1	1	2
	CO3	3	2	2	1	1				1	1	1	2
	CO4	3	3	3	2					1	1	1	3

Course code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
B21BI0102	**CO1**	3	2	2	1	3	2	0	0	1	1	1	1
	CO2	3	2	2	1	3	3	3	2	3	3	1	2
	CO3	3	2	2	1	3	3	3	3	3	3	2	2
	CO4	3	2	2	1	3	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0104	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1	1				1	1	3
	CO3	3	2	2	1	1	1	1			1	1	2
	CO4	3	2	2	1	1	1	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0102	**CO1**	3	2	2	1	1	1	2	2	1	1	1	2
	CO2	3	2	2	2	2	1	1	2	1	1	1	3
	CO3	3	2	2	2	2	1	1	1	1	1	1	2
	CO4	3	2	2	1	2	2	1	2	1	1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHK201	**CO1**	0	0	0	0	2	3	0	0	0	3	0	0
	CO2	0	0	0	0	2	3	0	0	0	3	0	0
	CO3	0	0	0	0	0	3	0	0	0	3	0	0
	CO4	0	0	0	0	0	0	3	2	0	3	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHH201	**CO1**	0	0	0	0	2	3	2	0	0	3	0	0
	CO2	0	0	0	0	2	2	3	0	0	3	0	0
	CO3	0	0	0	0	3	3	3	0	0	3	0	0
	CO4	0	0	0	0	3	2	3	0	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHA201	**CO1**	0	0	0	0	3	3	3	2	0	3	0	0
	CO2	0	0	0	0	3	3	3	3	0	3	0	0
	CO3	0	0	0	0	3	3	3	2	0	3	0	0
	CO4	0	0	0	0	3	3	3	3	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHE201	**CO1**	0	0	0	0	3	3	3	2	0	3	3	2
	CO2	0	0	0	0	3	3	3	2	0	3	3	2
	CO3	0	0	0	0	3	3	3	3	0	3	3	2
	CO4	0	0	0	0	3	3	3	3	0	3	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0201	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0203	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	1	0	1	1	1	1	2
	CO3	2	3	1	1	1	1	0	1	1	1	2	2
	CO4	2	3	2	2	2	1	0	1	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0201	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1	1				1	1	3
	CO3	3	2	2	1	1	1				1	1	2
	CO4	3	2	2	1	1	1	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CPS211	**CO1**	3	2	2	2	2	1	1			1	1	2
	CO2	3	2	2	2	2	1	1			1	1	3
	CO3	3	2	2	2	2	1	1			1	1	2
	CO4	3	2	2	2	2	1	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CPS212	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ASM201	**CO1**	1	2	1	1	1	2	3	1	1	1	1	2
	CO2	1	3	1	1	1	3	3	1	1	1	1	3

	CO3	2	3	2	1	3	3	3	1	1	1	2	3
	CO4	1	2	1	1	1	2	3	1	1	1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0202	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0204	**CO1**	3	2	2	2	2	1	1			1	1	2
	CO2	3	2	2	2	2	1	1			1	1	3
	CO3	3	2	2	2	2	1	1			1	1	2
	CO4	3	2	2	2	2	1	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0202	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1	1		1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHK301	**CO1**	0	0	0	0	2	3	0	0	0	3	0	0
	CO2	0	0	0	0	2	3	0	0	0	3	0	0
	CO3	0	0	0	0	0	3	0	0	0	3	0	0
	CO4	0	0	0	0	0	0	3	2	0	3	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHH301	**CO1**	0	0	0	0	2	3	2	0	0	3	0	0
	CO2	0	0	0	0	2	2	3	0	0	3	0	0
	CO3	0	0	0	0	3	3	3	0	0	3	0	0
	CO4	0	0	0	0	3	2	3	0	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHA301	**CO1**	0	0	0	0	3	3	3	2	0	3	0	0
	CO2	0	0	0	0	3	3	3	3	0	3	0	0
	CO3	0	0	0	0	3	3	3	2	0	3	0	0
	CO4	0	0	0	0	3	3	3	3	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0301	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0303	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1	1				1	1	3
	CO3	3	2	2	1	1	1				1	1	2
	CO4	3	2	2	1	1	1	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0301	**CO1**	3	2	2	2	2	2	2			1	1	2
	CO2	3	2	2	2	2	2	2			1	1	3
	CO3	3	2	2	2	2	2	2			1	1	2
	CO4	3	2	2	2	2	2	2			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BIS311	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BIS312	**CO1**	1	2	2	2	2	2	0	0	1	1	1	1
	CO2	1	2	2	1	0	3	3	2	3	3	1	2
	CO3	1	2	2	1	1	3	3	3	3	3	2	2
	CO4	1	2	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B2ASO302	**CO1**	2	3	3	2	2	2	2	3	1	3	2	3
	CO2	2	3	3	2	2	1	2	1	1	3	2	2
	CO3	2	3	3	2	1	1	2	1	1	3	2	2
	CO4	2	3	3	2	1	1	2	1	1	3	2	3
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**

B21BI0302	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0304	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0302	**CO1**	3	2	2	2	2	1				1	2	2
	CO2	3	2	2	2	2					1	2	3
	CO3	3	2	2	2	2					1	2	2
	CO4	3	2	2	2	2		1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHK401	**CO1**	0	0	0	0	2	3	0	0	0	3	0	0
	CO2	0	0	0	0	2	3	0	0	0	3	0	0
	CO3	0	0	0	0	0	3	0	0	0	3	0	0
	CO4	0	0	0	0	0	0	3	2	0	3	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHH401	**CO1**	0	0	0	0	2	3	2	0	0	3	0	0
	CO2	0	0	0	0	2	2	3	0	0	3	0	0
	CO3	0	0	0	0	3	3	3	0	0	3	0	0
	CO4	0	0	0	0	3	2	3	0	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21AHA401	**CO1**	0	0	0	0	3	3	3	2	0	3	0	0
	CO2	0	0	0	0	3	3	3	3	0	3	0	0
	CO3	0	0	0	0	3	3	3	2	0	3	0	0
	CO4	0	0	0	0	3	3	3	3	0	0	0	0
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0401	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0403	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0401	**CO1**	3	2	2	2	2	2	2			1	1	2
	CO2	3	2	2	2	2	2	2			1	1	3
	CO3	3	2	2	2	2	2	2			1	1	2
	CO4	3	2	2	2	2	2	2			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21STS411	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21STS412	**CO1**	2	2	2	1	1	1				1	2	2
	CO2	2	2	2	1	2					1	2	3
	CO3	2	2	2	1	2					1	2	2
	CO4	2	2	2	1	2		1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	2	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0402	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0404	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1	1				1	3	3
	CO3	3	2	2	1	1	1				1	3	2

	CO4	3	2	2	1	1	1	1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0402	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	3	3
	CO3	3	2	2	1	1					1	3	2
	CO4	3	2	2	1			1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0501	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0503	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0501	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1	2				1	1	3
	CO3	3	2	2	1	1	2				1	1	2
	CO4	3	2	2	1	2	2	1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CPS511	**CO1**	3	2	2	1	1	1				1	2	2
	CO2	3	2	2	1	1					1	3	3
	CO3	3	2	2	1	1					1	2	2
	CO4	3	2	2	1			1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CPS512	**CO1**	3	2	2	1	1	1				1	2	2
	CO2	3	2	2	1	1					1	3	3
	CO3	3	2	2	1	1					1	2	2
	CO4	3	2	2	1			1			1	2	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0502	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0504	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0502	**CO1**	3	2	2	2	2	2	2			1	1	2
	CO2	3	2	2	2	2	2	2			1	1	3
	CO3	3	2	2	2	2	2	2			1	1	2
	CO4	3	2	2	2	2	2	2			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0601	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21ST0601	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0601	**CO1**	2	2	2	2	1	1				1	1	2
	CO2	3	3	3	3	1					1	1	3
	CO3	2	2	2	2	1					1	1	2
	CO4	2	2	2	2			1			1	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BIS611	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1

	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BIS612	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0602	**CO1**	2	3		3							3	2
	CO2	2	2	3	3	3	3					2	3
	CO3	2	2	3	3	3	3		3	3	3	3	3
	CO4	3	3	3	3	3	3	3	3	3	3	3	3
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21BI0603	**CO1**	1	2	1	0	1	1	0	0	1	1	1	1
	CO2	1	2	1	1	0	3	3	2	3	3	1	2
	CO3	2	3	1	1	1	3	3	3	3	3	2	2
	CO4	2	3	2	2	2	3	3	3	2	2	1	2
Course code	**PO/ CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
B21CP0602	**CO1**	3	2	2	1	1	1				1	1	2
	CO2	3	2	2	1	1					1	1	3
	CO3	3	2	2	1	1					1	1	2
	CO4	3	2	2	1			1			1	1	2

B.Sc. (Bioinformatics) Program
(Bioinformatics, Statistics, Computer Science)

Scheme of Instruction and Detailed Syllabus
(Effective from Academic Year 2021-24)

Scheme of Instruction **Duration: 6 Semesters (3 years)**

S. No	Course code	Title of the Course	HC / SC/	Credit Pattern				Hours/ week
				L	T	P	Total	
		FIRST SEMESTER						
1	B21AHK101	Language-I: Kannada-I	FC	1	1	0	2	3
	B21AHH101	Language-I: Hindi-I						
	B21AHA101	Language-I: Additional English-I						
2	B21AHE101	Communication English -I	FC	1	1	0	2	3
3	B21BI0101	Biochemistry & Microbiology	HC	3	0	0	3	4
4	B21ST0103	Fundamental Mathematics-I	HC	3	0	0	3	4
5	B21CP0101	Programming in C	HC	3	0	0	3	4
6	B21STS111	Discrete Mathematics & Algebra	SC	3	0	0	3	4
	B21STS112	Logic and Graph Theory						
7	B21LSM101	Constitution of India and Professional Ethics	MC	0	0	0	0	2
8	B21BI0102	Lab- Biochemistry & Microbiology	HC	0	0	1.5	1.5	3
9	B21ST0104	Lab- Fundamental Mathematics-I	HC	0	0	1.5	1.5	3
10	B21CP0102	C Programming Lab	HC	0	0	1.5	1.5	3
	Total Credits			**14**	**2**	**4.5**	**20.5**	**33**
		SECOND SEMESTER						
11	B21AHK201	Language-II: Kannada-II	FC	1	1	0	2	3
	B21AHH201	Language-II: Hindi-II						
	B21AHA201	Language-II: Additional English-II						
12	B21AHE201	Communicative English-II	FC	1	1	0	2	3
13	B21BI0201	Cell & Molecular Biology	HC	3	0	0	3	4
14	B21ST0203	Fundamental Mathematics-II	HC	3	0	0	3	4
15	B21CP0201	Programming in Python	HC	3	0	0	3	4
16	B21CPS211	Data communication and Networks	SC	3	0	0	3	4
	B21CPS212	Multimedia computing						
17	B21ASM201	Environmental Science	MC	0	0	0	0	2
18	B21BI0202	Lab- Cell & Molecular Biology	HC	0	0	1.5	1.5	3
19	B21ST0204	Lab- Fundamental Mathematics-II	HC	0	0	1.5	1.5	3
20	B21CP0202	Programming in Python Lab-II	HC	0	0	1.5	1.5	3
	Total credits			**14**	**02**	**4.5**	**20.5**	**33**
		THIRD SEMESTER						
21	B21AHK301	Language-III: Kannada-III	FC	1	1	0	2	3
	B21AHH301	Language-III: Hindi-III						
	B21AHA301	Language-III: Additional English-III						
22	B21BI0301	Applied Bioinformatics	HC	3	0	0	3	4

23	B21ST0303	Basic Biostatistics	HC	3	0	0	3	4
24	B21CP0301	Relational Database Management Systems	HC	3	0	0	3	4
25	B21BIS311	Bioinformatics Algorithms	SC	3	0	0	3	4
	B21BIS312	Systems Biology						
26	B2ASO302	Open Elective-Health & Hygiene	OE	3	0	0	3	4
27	B21BIM301	Skill Enhancement Course	MC	0	0	0	0	2
28	B21BI0302	Lab- Applied Bioinformatics	HC	0	0	1.5	1.5	3
29	B21ST0304	Lab- Biostatistics	HC	0	0	1.5	1.5	3
30	B21CP0302	RDBMS Lab-III	HC	0	0	1.5	1.5	3
	Total Credits			**16**	**01**	**4.5**	**21.5**	**34**
Note: Open elective offered by School of Biotechnology, Health & Hygiene shall be opted by other schools. B. Sc Bioinformatics students shall have to opt Open Elective course offered by other schools.								
		FOURTH SEMESTER						
31	B21AHK401	Language-IV: Kannada-IV	FC	1	1	0	2	3
	B21AHH401	Language-IV: Hindi-IV						
	B21AHA401	Language-IV: Additional English-IV						
32	B21BI0401	Bioperl & Biopython	HC	3	0	0	3	4
33	B21ST0403	Statistical Inference	HC	3	0	0	3	4
34	B21CP0401	Unix and Shell Programming	HC	3	0	0	3	4
35	B21STS411	Industrial Statistics	SC	3	0	0	3	4
	B21STS412	Sampling methods & official statistics						
36	B21PTM401	Soft skill training (Mandatory)	MC	0	0	0	0	2
37	B21BIM401	Skill development program	MC	0	0	0	0	2
38	B21BI0402	Lab- Bioperl & Biopython	HC	0	0	1.5	1.5	3
39	B21ST0404	Lab- Biostatistics inference	HC	0	0	1.5	1.5	3
40	B21CP0402	Unix & shell programming Lab	HC	0	0	1.5	1.5	3
	Total Credits			**13**	**01**	**4.5**	**18.5**	**32**
		FIFTH SEMESTER						
41	B21BI0501	Computational drug discovery	HC	3	0	0	3	4
42	B21ST0503	Linear models	HC	3	0	0	3	4
43	B21CP0501	Basics of Web programming	HC	3	0	0	3	4
44	B21CPS511	Software engineering	SC	3	0	0	3	4
	B21CPS512	Cryptography & Network security						
45	B21SAON01	MOOC/ SWAYAM	SEC	2	0	0	2	2
46	B21BIM501	Skill Enhancement program	MC	0	0	0	0	2
47	B21BI0502	Lab- Computational drug discovery	HC	0	0	1.5	1.5	3
48	B21ST0504	Lab- Sapling methods & official statistics	HC	0	0	1.5	1.5	3
49	B21CP0502	Basics of Web programming Lab	HC	0	0	1.5	1.5	3
	Total Credits			**14**	**0**	**4.5**	**18.5**	**29**
		SIXTH SEMESTER						
50	B21BI0601	Genomics & Proteomics	HC	3	0	0	3	4
51	B21ST0601	Operation Research	HC	3	0	0	3	4
52	B21CP0601	Data Mining & Data warehousing	HC	3	0	0	3	4
53	B21BIS611	Medical informatics	SC	3	0	0	3	4
	B21BIS612	AI techniques in Biology						
54	B21BI0602	Bioinformatics Project	HC	0	0	5.5	5.5	12
55	B21BI0603	Lab- Genomics & Proteomics	HC	0	0	1.5	1.5	3
56	B21CP0602	Machine learning Lab	HC	0	0	1.5	1.5	3
	Total credits			**12**	**0**	**8.5**	**20.5**	**33**
	Total credits of all semesters			**59**	**30**		**120**	**194**

Semester-wise Summary of Credit Distribution

Semester	**L**	**T**	**P**	**Credits**	**Hours**
First	14	2	4.5	20.5	33
Second	14	2	4.5	20.5	33
Third	16	1	4.5	21.5	34
Fourth	13	1	4.5	18.5	32
Fifth	14	0	4.5	18.5	29
Sixth	12	0	8.5	20.5	33

Total	**59**	**30**	**31**	**120**	**196**

Distribution of Credits Based on Type of Courses

Semester	Foundation Course (FC)	Hard Core (HC)	Soft Core (SC)	Open Elective (OE)	SEC	Total Credits
First	4	13.5	3	-	-	20.5
Second	4	13.5	3			20.5
Third	2	13.5	3	3		21.5
Fourth	2	13.5	3			18.5
Fifth	-	13.5	3		2	18.5
Sixth	-	17.5	3			20.5
Total	**12**	**85**	**18**	**3**	**2**	**120**

B.Sc. (Bioinformatics) Program
(Bioinformatics, Statistics, Computer Science)
Detailed Syllabus
(Effective from Academic Year 2021-22)

FIRST SEMESTER

Course code	Course Title	Course type	L	T	P	C	Hrs./ Wk.
B21AHK101	**Language- I: Kannada**	FC	1	1	0	2	3

Prerequisites/Pre reading for the course:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå.
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: Direct method /ICT and Digital support/ Collaborative and Cooperative learning/ Differentiated Instruction/ Flipped Classroom

Course objectives

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ

4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èèlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	0	0	0	3	0	0
CO2	0	0	0	0	2	3	0	0	0	3	0	0
CO3	0	0	0	0	0	3	0	0	0	3	0	0
CO4	0	0	0	0	0	0	3	2	0	3	0	0

Course Content:

Unit-I. d£À¥ÀzÀ ªÀÄvÀÄÛ ¥ÁæaÃ£À PÁªÀå

7 Hours

1. ¸ÀvÀåªÀAvÉ ºÀqÉzÀªÀé d£À¥ÀzÀ VÃvÉ
2. £É®QjªÉ£ÉAzÀÄ §UÉ«gÉ bÀ®QjªÉA gÀ£Àß
3. avÀæªÀÄ¥ÁvÉæ gÀªÀÄvÉ £Áj d£Àß

Unit-II. ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hours

1. C©ÞAiÀÄÄªÉÆªÉÄð PÁ®ªÀ±À¢A ªÀÄgÁåzÉAiÀÄA zÁAlzÉÃ.... £ÁUÀZÀAzÀæ
2. ªÀZÀ£ÀUÀ¼ÀÄ §¸ÀªÀtÚ
3. wgÀÄ¤Ã®PÀAoÀgÀ gÀUÀ¼É ºÀjºÀgÀ

Unit-III. ¸ÀtÚ PÀxÉUÀ¼ÀÄ 6

Hours

1. PÀ¯ÁärAiÀÄ PÉÆÃt ªÀiÁ¹Û
2. AiÀiÁgÀÆ CjAiÀÄzÀ «ÃgÀ PÀÄªÉA¥ÀÄ
3. ¸ÀªÀÄ¸ÉåAiÀÄ ªÀÄUÀÄ wæªÉÃtÂ

Hours

1. mÉÆ¼ÀÄîUÀnÖ n.¦. PÉÊ¯Á¸ÀA

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ:

1. ªÀÄÄUÀ½ gÀA. ²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., ZÁjwæPÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2008
3. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
4. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2007
5. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
6. £ÁgÁAiÀÄt ¦. «, ZÀA¥ÀÆ PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
7. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
8. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
9. qÁ. azÁ£ÀAzÀ ªÀÄÆwð, ªÀZÀ£À ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
10. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. ¸ÀªÀðdÕ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2012
11. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. CPÀÌ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 1997
12. ¸ÀA ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, £ÁUÀgÁd Q.gÀA. ªÀZÀ£À PÀªÀÄäl, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
13. £ÀgÀ¹AºÁZÁgï. r.J¯ï., ¥ÀA¥À ¨sÁgÀvÀ ¢Ã¦PÉ, ¥ÀæPÁ±ÀPÀgÀÄ r.«.PÉ ªÀÄÆwð ¥ÀæPÁ±À£À, ªÉÄÊ¸ÀÆgÀÄ. 2012
14. gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ ¸ÀªÀÄUÀæ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. ¯ÉÆÃ»AiÀiÁ ¥ÀæPÁ±À£À, §¼Áîj. 2015
15. zÉÃ±À¥ÁAqÉ J¸ï.J¯ï. ¨ÉÃAzÉæ ±ÀjÃ¥sÀgÀ PÁªÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
16. ¸ÀA. ©.J¸ï. PÉÃ±À ªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
17. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
18. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHH101	**Language-I: Hindi**	FC	1	1	0	2	3

Course description: अध्ययन वर्णन :

यह पाठ्यक्रम नौसिखिया, अपनी भाषा की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक प्रक्रियाओं द्वारा समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है |

Prerequisites/Pre reading for the course: पूर्वापेक्षा:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है |

c) Pedagogy: सिक्षशास्त्र:

- Direct method/ ICT and Digital support/ Collaborative and Cooperative learning/ Differentiated Instruction/ Flipped Classroom

Objectives: पाठ्यक्रम उद्देश्य:

- संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
- साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
- छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
- अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes: अधिगम परिणाम:

अध्ययन की समाप्ति पर अध्येता –

- सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |
- साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |
- समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करसकता है |

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	2	0	0	3	0	0
CO2	0	0	0	0	2	2	3	0	0	3	0	0
CO3	0	0	0	0	3	3	3	0	0	3	0	0
CO4	0	0	0	0	3	2	3	0	0	0	0	0

Course content: <u>अध्ययन विषय सूची /पाठ्यक्रम</u>

इकाई –1 :कहानी, संस्मरण **7 hours**

1.कहानी – नशा – प्रेमचंद

2.कहानी – सुखमय जीवन – चंद्रधर शर्मा गुलेरी

3.संस्मरण – शरत के साथ बिताया कुछ समय–अमृतलाल नागर

इकाई –2:कहानी, आत्मकथा **6 hours**

4.कहानी – मरने से पहले – भीष्म साहनी

5.कहानी – लाल हवेली – शिवानी

6. रेखाचित्र – घीसा – महादेवी वर्मा

इकाई –3:एकांकी, व्यंग्य रचना **7 hours**

7. एकांकी – आवाज का नीलाम – धर्मवीर भारती

8.व्यंग्य रचना – भेड़े और भेडियें – हरिशंकर परसाई

इकाई –4:अनुवाद **6 hours**

अनुवाद : अंग्रेज़ी – हिन्दी(शब्द एवं अनुच्छेद)

सूचना : प्रत्येक इकाई 25 अंक के लिए निर्धारित है |

d) Suggested Textbooks and References

Textbook/s: पाठ्य पुस्तक:

1. हिन्दी पाठ्य पुस्तक – रेवा विश्वविद्यालय |

References: सन्दर्भ ग्रन्थ:

1. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
2. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. कार्यालय अनुवाद निदेशिका
8. संक्षेपण और पल्लवन - के.सी.भाटिया&तुमन सिंग

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHA101	**Language-I: Additional English**	FC	1	1	0	2	3

Course Description:

This is a 2-credit course designed to help the learner gain competency in language through the introduction of various genres of literature. The course aims to inculcate a critical view among learners while sensitizing them to the contemporary issues around. It facilitates creative learning and helps to appreciate, assimilate, and research on the various dimensions of society, culture, and life.

Prerequisites: The student must possess fundamentals of language skills and be aware of social issues.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives

1. To develop linguistic prowess of the students.
2. To appraise different genres of literature.
3. To illustrate the fundamentals of creative language.
4. To enhance consistent reading habits.

Course Outcome

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

1. Demonstrate a thorough understanding of sensitive and critical social issues.
2. Develop reading skills and a wide range of vocabulary.
3. Critically analyze a piece of prose or poetry.
4. Explain their opinion in a coherent and communicable manner.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	0	3	0	0
CO2	0	0	0	0	3	3	3	3	0	3	0	0
CO3	0	0	0	0	3	3	3	2	0	3	0	0
CO4	0	0	0	0	3	3	3	3	0	0	0	0

Course content

Unit-I: Values & Ethics **7 hours**

Literature: Rabindranath Tagore - Where the Mind is Without Fear

Saki – The Lumber-room

William Shakespeare – Extract from Julius Caesar (Mark Antony's Speech)

Language: Vocabulary Building

Unit-II: Natural & Supernatural **6 hours**

Literature: John Keats – La Belle Dame Sans Merci

Charles Dickens – The Signal Man

Hans Christian Anderson - The Fir Tree

Language: Collective Nouns

Unit-III: Travel & Adventure **7 hours**

Literature: R.L. Stevenson – Travel

H.G. Wells – The Magic Shop

Jonathan Swift – Excerpt from Gulliver's Travels Book – I

Writing Skills: Travelogue

Unit-IV: Success Stories **6 hours**

Literature: Emily Dickinson – Success is Counted Sweetest

Dr. Martin Luther King - I Have a Dream

Helen Keller – Expert from The Story of My Life

Writing Skills: Brochure & Leaflet

Reference Books:

1. Tagore, Rabindranath. Gitanjali. Rupa Publications, 2002.
2. Wordsworth, William. The Complete Works of William Wordsworth. Andesite Press, 2017.
3. Munro, Hector Hugh. The Complete Works of Saki. Rupa Publications, 2000.
4. Shakespeare, William. The Complete Works of William Shakespeare. Sagwan Press, 2015.
5. Chindhade, Shirish. Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, Arun Kolatkar, Dilip Chitre, R. Parthasarathy. Atlantic Publications, 2011.
6. Dickens, Charles. The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2. Createspace Independent Publications, 2015.
7. Anderson, Hans Christian. The Fir Tree. Dreamland Publications, 2011.
8. Colvin, Sidney (ed). The Works of R. L. Stevenson. (Edinburgh Edition). British Library, Historical Prints Edition, 2011.
9. Bishop, Elizabeth. Poems. Farrar, Straus and Giroux, 2011.
10. Swift, Jonathan. Gulliver's Travels. Penguin, 2003.
11. Dickinson, Emily. The Complete Poems of Emily Dickinson. Createspace Independent Publications, 2016.
12. Brooke, Rupert. The Complete Poems of Rupert Brooke. Andesite Press, 2017.
13. King, Martin Luther Jr. &James M. Washington. I Have a Dream: Writings and Speeches That Changed the World. Harper Collins, 1992.
14. Keller, Helen. The Story of My Life. Fingerprint Publishing, 2016.
15. Green, David. Contemporary English Grammar Structures and Composition. New Delhi: MacMillan Publishers, 2010.
16. Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, 2012.
17. Leech, Geoffrey, and Jan Svartvik. A Communicative Grammar of English. Longman, 2003.
18. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHE101	**Communicative English-I**	FC	1	1	0	2	3

Prerequisites: 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

After the completion of the course, students 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

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	3	3	0	0
CO2	0	0	0	0	3	3	3	2	3	3	0	0
CO3	0	0	0	0	3	3	3	3	3	3	0	0
CO4	0	0	0	0	3	3	3	3	2	2	0	0

Course content

Unit-I: Functional English **7 Hours**

Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs

Writing Skills: Paragraph Writing

Activities: Conversations; Leaving Phone Messages

Literature: Chief Seattle – The End of Leaving and Beginning of Survival

Unit-II: Interpersonal Skills **6 Hours**

Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs

Writing Skills: Official Letters

Activities: Making Apologies; Invitations & Making Arrangements

Literature: Ruskin Bond – Tiger in the Tunnel

Unit-III: Multitasking Skills **7 Hours**

Remedial Grammar: Present Perfect; For, Since & How Long; -ed & -ing adjectives; Prefix & Opposites of Adjectives

Writing Skills: Note Making

Activities: Agreeing & Disagreeing with Opinions

Literature: Jesse Owens - My Greatest Olympic Prize

Unit-IV: Communication Skills **6 Hours**

Remedial Grammar: Collocations; Prepositions

Writing Skills: Precise Writing

Activities: Offers, Suggestions & Requests

Literature: Avijit Pathak – Onscreen Magic

Reference Books:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 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*. New Delhi: 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	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0101	**Biochemistry & Microbiology**	HC	2	1	0	3	4

Prerequisites: The student must have knowledge of biology to understand the biological activity of organisms.

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

Course Objectives

1. The course aims to understand the biochemicals present in the living organisms.
2. It also aims to provide the advanced analytical techniques to identify the biomolecules from living organisms.
3. The students can learn the overview of microorganisms and their biological functions.
4. Students will learn microbial techniques to identify and classify microorganisms from different sources.

Course outcomes

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

1. Understand the concepts of biochemicals and their functions from different organisms.
2. Adapt and apply analytical techniques to identify biomolecules of different organisms.
3. Understand the types and classifications of microorganisms present in different organisms.
4. Apply and analyze microbial identification techniques for the benefit of living organisms.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	3	2	3	3	2	0	0	1	1	1	1
CO2	2	3	2	3	3	3	3	2	3	3	1	2
CO3	2	3	2	3	3	3	3	3	3	3	2	2
CO4	2	3	2	3	3	3	3	3	2	2	1	2

Course content

Unit-I: Introduction to Biochemistry **12 hours**

Scope of Biochemistry, Biomolecules, Nature and Nomenclature, Stereoisomers, Naturally occurring derivates of carbohydrates, Functions of carbohydrates, characteristics, classification of carbohydrates; Monosaccharaides, Disaccharides, Polysaccharides, storage polysaccharides, structural polysaccharides, Homo & Heteropolysaccharides – Peptidoglycan, hyaluronic acid, Anomers, Epimers, Enantiomers, Optical isomers, Stereoisomers, Structure and role of proteoglycans, Glycosides, Glycoproteins, Glycolipids (gangliosides and lipopolysaccharides). Techniques used for carbohydrates identification.

Unit-II: Proteins, Lipids & Vitamins **12 hours**

Introduction to Amino acids, General Classification, structure and physiochemical properties of Amino acids, Peptide bond- Nature and conformation, General properties of proteins, Outlines of structural organization of proteins: primary, secondary, tertiary, and quaternary structures (ex. hemoglobin & myoglobin)**.** Introduction to lipids; occurrence and properties, classification of lipid- simple lipids, complex lipids & derived lipids, Introduction to Vitamins and minerals; **sources,** classification, structure, and biochemical roles**.** Deficiency disorders of water- and fat-soluble vitamins. Minerals: classification, sources, functions, recommended daily allowances and Deficiencies and toxicity. Techniques used for Proteins, lipids, and vitamins identification.

Unit-III: Introduction to Microbiology **12 hours**

Origin, Historical Development and Scope of Microbiology. Prokaryotic and Eukaryotic microorganisms-general characteristics, classification, and importance. Virology- General Properties, of viruses, morphology and ultra-structure of viruses**,** classification of viruses: DNA & RNA viruses, Plant and animal Viruses, Mode of reproduction, classification and importance of Mycoplasma, viral related agents - viroids, virions, and prions. Introduction to Vaccines.

Unit-IV: Microbial Techniques **12 hours**

Sterilization principles & operations, Different methods of Sterilization and disinfection with examples. Microbial medium, Isolation and enumeration techniques used in Microbiology. Stains and Differential staining methods used in microbiology. Microbial taxonomy-methods and its importance. Microbial diversity and its importance Metabolism-bacterial photosynthesis, aerobic and anaerobic respiration.

Reference Books

1. M J Pelzer Jr, ECS Chan, NR Krieg, **"Microbiology",** Tata McGraw-Hill Publishing Co Ltd, 5th Edition, 2007.
2. Starrier, Ingraham and Wheeler, **"General Microbiology",** McMillan Publisher, 5th Edition, 1998.
3. Atlas R.M. **"Microbiology: Fundamentals and applications 4th Edition",** Singapore: Pearson Education Asia, 2000.
4. Prescott L.M, Harley T.P and Klein D.A. **"Microbiology, 9th Edition",** WMC. Brown publishers, 2012.
5. Dr. U. Satyanarayana, **"Biochemistry",** Books and Allied (P) Ltd, 1999.
6. David Nelson, Leininger "**Principles of Biochemistry 8th edition"** Michael M.cox 2018.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0103	**FUNDAMENTAL MATHEMATICS-I**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Basic knowledge on Mathematics and Algebra.

Course objectives

1. Explain the consistency of the given system of equations.

2. Recognize and use basic properties of subspaces and vector spaces.
3. Identify the given vectors are linearly independent or not and find the matrix of the given linear transformation with respect to the standard basis.
4. Describe the concepts of partial differentiation and analytic geometry in 3D.

Course outcomes

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

1. Make use of Gauss elimination and Gauss Jordon method for solving the system of equations, if the given system of equations is consistent.
2. Identify and evaluate the radius of curvature of the given curve. Also evaluate the given indeterminate form using L' Hospital rule.
3. Determine the matrix of the given linear transformation with respect to the standard basis.
4. Develop competency in applying the idea of partial derivatives

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

Unit-I: Linear Algebra **12 hours**

Introduction, Recapitulation of basic matrix theory, Elementary transformations, Rank of a matrix-Echelon form and normal form, Consistency of system of linear equations (homogeneous and non-homogeneous), solution of system of equations-Gauss elimination and Gauss Jordon, Eigen values and Eigen vectors of a square matrix (only for matrix).

Unit-II: Vector space **12 hours**

Introduction, Recapitulation of basic set theory, matrix theory and a field theory, Definitions-vector space and subspaces, illustrative examples, and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations-definition, properties, and problems.

Unit-III: Calculus **12 hours**

Successive differentiation, derivative of standard functions, Leibnitz theorem (without proof) and simple examples. Vector calculus: Addition, subtraction, dot product, cross product, scalar triple product, Vector differentiation and vector integration, gradient, divergence, curl of a vector, equation of normal

Unit-IV: Partial differentiation **12 hours**

Introduction, partial derives, homogeneous function and Euler's theorem, Total differentiation, a partial differentiation of composite functions. Analytical geometry in 3-D: Different forms of equations of straight line and plane (Recap). Angle between two planes - Line of intersection of two planes - Plane coaxial with

given planes - Planes bisecting the angle between two planes - Angle between a line and a plane, Co-planarity of two lines - shortest distance between two lines.

Reference Books

1. B. S. Grewal – **Higher Engineering Mathematics**, 42th edition, Khanna Publishers, 2012.
2. E. Kreyszig – **Advanced Engineering Mathematics",** 10th edition, Wiley publications**,** 2011
3. G B Thomas and R L Finney, **"Calculus and Analytical geometry",** 10th ed.: Addison – Wesley, 2000.
4. S. Narayanan & T. K. Manicavachogam Pillay, **"Calculus"** S. Viswanathan Pvt. Ltd., vol. I & II. 1996,
5. S. Narayanan and T.K. Manicavachogam Pillay, **"Calculus (I & II)".** Chennai, India: S. Viswanathan Pvt. Ltd., 1996.
6. Joseph Edwards, **"An elementary treatise on the differential calculus: with applications and numerous examples",** Reprint. Charleston, USA: BiblioBazaar, 2010.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0101	**PROGRAMMING IN C**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Basic knowledge on computer operating and Microsoft skills.

Course Objectives

1. To develop enough familiarity with the specific environment.
2. To develop an understanding of fundamental programming logic and programming techniques.
3. To develop programming language of different numerical methods which are used to solve scientific and engineering problems.
4. To emphasize on developing the student's ability to analyze and solve problems by using high level programming language.

Course outcomes

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

1. To understand the Syntax and Structure of the C Programming.
2. Design C Programs for Problems.
3. Write and Execute C Programs for simple applications.
4. Develop algorithms based on C programming for simple application development.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1	1	1		1	1	2
CO2	3	2	2	1	1	2	1	1		1	1	3
CO3	3	2	2	2	1	2	1	1		1	1	2
CO4	3	2	2	1	2	1	1	1		1	1	2

Course content

Unit-I: Introduction to C **12 hours**

Fundamentals in C, Programming Languages, Types of software's, Compilers, Operating Systems, Program execution phases, Character set , Number systems, Format specifiers, Identifiers, Keywords ,Variables, Data Types, Declaration of Variable , Assigning Values to Variables , Initialization, Constants, Comments, Basic Structure of a 'C' program , Header files, Pre Processor, Programming Examples, Arithmetic, Logical & Relational operator, Increment & Decrement operators, Conditional operator, Assignment operator, Unary, Binary, Bitwise, Ternary Operators, Expressions, Type conversions, Operator precedence, Basic Console I/O functions- Formatted Console I/O, Unformatted Console I/O.

Unit-II: Control statements, Arrays and Pointers **12 hours**

Conditional Branching if statement, if-else statement, Nested if statement, switch statement, Un-Conditional Branching, looping- while loop, do-while loop, for loop, Break and continue statements. Introduction to Arrays, one dimensional array, Array Initialization, Array indexing, Reading, and displaying elements, Two dimensional arrays, Programming Examples. Pointers: Declaration of Pointer Variables, Assigning Address to Pointer Variables, pointer to pointer, Programming Examples.

Unit-III: Functions and Structures **12 hours**

Functions: Advantages of using functions, Function Prototype, defining a function, calling a function, return statement, Types of functions, Recursion, Nested functions, main () function, Library Function, Local and global variables, call by value and call by references, programming Examples. Structures: Definition, Declaration, Initialization of a Structure, Structure Variables, typedef statement, Programming Examples.

Unit-IV: Unions, Strings and Files **12 hours**

Unions: Definition, Declaration, Initialization, Accessing union members. Strings: Definition, Declaring and Initializing String variables, Reading and Writing Strings, String manipulation functions, Array of Strings. The %s format specifier –The gets () and puts () functions. Files – declaration of file, File modes, opening and closing a file, reading, and writing a file. Programming examples & exercises.

Reference Books

1. Anita Goel and Ajay Mittal, **"Computer Fundamentals and Programming in C",** Dorling Kindersley (India) Pvt Ltd, Pearson Education in South Asia, 2011.
2. Yeshvant Kanetkar **"Let Us C"** BPB Publications,2011.
3. E Balaguruswamy, **"Computing Fundamentals & C Programming",** McGraw Hill Education India, 2017.
4. Byron Gottfried, Fourth Edition, **"PROGRAMMING WITH C",** Schaum's Outlines, 2018.
5. Kernighan B.W and Ritchie D.M, **"The C Programming language",** Second Edition, Pearson Education,2006.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21STS111	**DISCRETE MATHEMATICS AND ALGEBRA**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Basic knowledge on Mathematics and Algebra

Course Objectives

1. Study the basic concept of set theory and Extended addition principle
2. Understand the concepts of relation its property, and digraph of binary relation.
3. Learn the basic counting techniques like permutation, and combination with repletion and multinomial.
4. Study the concepts of algebraic structure with one and two variables.

Course outcomes

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

1. Simplify the given compound set using the law of set theory and solve the given problem using addition rule by representing the data through Venn diagram.
2. Examine the given relation whether equivalence relation or not.
3. Find the coefficient of certain powers of the variables in the binomial and multinomial expansion.
4. Verify the given set with the binary operation(s) is group are ring.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2					2	3	2	3
CO2	3	2	2	3					3	2	3	2
CO3	3	2	3	2					3	2	3	2
CO4	3	3	3	2					3	3	3	3

Course content

Unit-I: Set theory **9 hours**

Fundamentals of sets, Subsets, Venn diagrams, Operations on sets, Laws of set theory, Countable and uncountable sets, Addition- principle, and Extended Addition Principle.

Unit-II: Relations **9 hours**

Cartesian product of Sets (illustrative example), Matrices and Digraphs of relations, Operations on relations, Properties of relations, Equivalence relations, partitions of a set. Partial ordered relations, Posets, Hasse diagrams.

Unit-III: Counting Techniques **9 hours**

Counting Techniques: The rules of sum and product, Permutation, Combination, Binomial and Multinomial theorem (without proof), and Combination with repetition,

Unit-IV: Groups and Rings **9 hours**

Groups with one binary operation, Semi groups, monoids, Product and quotient of groups, Isomorphism, Homomorphism, Cyclic groups, Algebraic structure with two binary operations, Lagrange's theorem, Coset decomposition of groups, and Rings.

REFERENCE BOOKS

1. C.L. Liu, **"Elements of Discrete Mathematics 3rdedition"** Tata McGraw Hill Publishers. 2008.
2. J.P. Trembley and R. Manohar, **"Discrete Mathematical Structures with Applications to Computer Science"** Tata McGraw Hill Publishers. 2012.
3. Kenneth H. Rosen, **"Discrete Mathematics, and its Application, Fifth edition",** Tata McGraw-Hill Publishing company Pvt.Ltd., New Delhi, 2003.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21STS112	**LOGIC AND GRAPH THEORY**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Basic knowledge on Mathematics and Sets

Course objectives

1. Study the basic concept of set theory, laws of logic and Extended addition principle
2. Understand the concepts of relation its property, and digraph of binary relation.
3. Learn the basic concepts of graph theory walk their classification and application of graphs.
4. Study standard theorem on Euler graph and Hamilton graphs and dual of a graph.

Course outcomes

1. Verity the given argument is valid are not using laws of logic and rules of inference.
2. Determine the relation and construct the relation matrix for the given Hasse diagram for the posset defined on the set.
3. Define the graph and walk and their classifications
4. Construct the dual of graph and Examine planarity of a graph by Euler formula.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1			1	1	1	3
CO2	3	2	2	1	1				1	1	1	2
CO3	3	2	2	1	1				1	1	1	2
CO4	3	3	3	2					1	1	1	3

Course Content

Unit-I: Set theory and Logic **12 hours**

Fundamentals of sets, Subsets, Venn diagrams, Operations on sets, Laws of set theory, Propositions, Logical connectives, and truth tables (illustrative example), Logical equivalence, Laws of logic, Converse, Inverse and Contra positive and Rules of inference.

Unit-II: Cartesian product of Sets **12 hours**

Cartesian product of Sets (illustrative example), Matrices and Digraphs of relations, Operations on relations, Properties of relations, Equivalence relations, Partial ordered relations, Posets, Hasse diagrams, and Extremal elements in Posets.

Unit-III: Introduction to graph theory **12 hours**

Introduction to graph theory: graphs, Representation of graphs, regular graphs, complete graphs, Null graphs, Bipartite graphs, Isomorphism, Sub graphs, Walk, Trail, Path, Cycle, Connected and Disconnected graphs. Applications: Konigsberg's Bridge problem, Utilities problem, and Seating Problems.

Unit-IV: Operation on graphs **12 hours**

Operation on graphs, Definition of Euler Trail, Euler graph, Standard theorems on Euler graphs Hamiltonian Path, Hamiltonian Cycle and Hamiltonian Graph, Standard theorems on Hamiltonian Graph, Planar graph, Detection of Planarity, Geometric dual, and Euler formula.

Reference Books

1. Jonathan L. Gross, Jay Yellen, Mark Anderson, **"Graph Theory & Applications",** 3rd Edition Taylor & Francis Group, 2019.
2. Frank Harrary: **Graph Theory Narosa Publications,** Narosa Publishing house. 2013.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21LSM101	**CONSTITUTION OF INDIA & PROFESSIONAL ETHICS**	FC	2	0	0	2	2

Prerequisites/Pre reading for the course:

Basic knowledge on science and social studies.

Course objectives

1. To provide and gain knowledge on Constitution of India.
2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law.
3. To prepare students in the understanding of Constitution perspective and make them face the world as a bonafide citizen.
4. To attain knowledge about ethics and know about professional ethics.

Course outcomes

1. Strengthen the knowledge on Indian constitutional law and make the practical implementation.
2. Understand the fundamental rights and human rights.
3. Get the knowledge to explain the duties and more importantly practice it in a right way.
4. Adopt the habit of raising their voice against a unconstitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity.

Course content

UNIT -I: Constitution of India **6 hours**

Constitution of India: Making of Indian Constitution, features of Indian Constitution Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional

Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

UNIT -II: Legislature and Executive **6 hours**

Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission.

UNIT -III: Judiciary **6 hours**

Supreme Court of Indian, High Court, Right to Information Act 2005, Consumer Protection- Consumer Rights- Caveat Emptor and Caveat Venditor.

UNIT-IV: Professional Ethics **6 hours**

Definition Scope and need of ethics for professional, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees. Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Reference Books

1. M V Pylee, **"An introduction to Constitution of India".**
2. M Govindarajan, S Natarajan, V S Senthil Kumar, **"Engineering Ethics".**
3. Dr. Durga Das Basu, **"Introduction to constitution of India"**

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0102	**BIOCHEMISTRY AND MICROBIOLOGY LAB**	HC	0	0	1.5	1.5	3

Prerequisites: The student must have knowledge of biology to understand the biological activity of organisms.

Course Objectives

1. The course aims to understand the biochemicals present in the living organisms.
2. It also aims to provide the advanced analytical techniques to identify the biomolecules from living organisms.
3. The students can learn the overview of microorganisms and their biological functions.
4. Students will learn microbial techniques to identify and classify microorganisms from different sources.

Course outcomes

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

1. Understand the concepts of biochemicals and their functions from different organisms.
2. Adapt and apply analytical techniques to identify biomolecules of different organisms.
3. Understand the types and classifications of microorganisms present in different organisms.

4. Apply and analyze microbial identification techniques for the benefit of living organisms.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	3	2	0	0	1	1	1	1
CO2	3	2	2	1	3	3	3	2	3	3	1	2
CO3	3	2	2	1	3	3	3	3	3	3	2	2
CO4	3	2	2	1	3	3	3	3	2	2	1	2

Course content

1. Preparation of buffers.
2. Estimation of glucose using DNS method.
3. Estimation of proteins and determination of amino acids
5. Determination of Iodine number, Iodine value.
6. Preparation of Medium-MRBA, NA and NB
7. Basics and handling of microscopes
8. Isolation of micro flora from air, soil, and water samples. Establishment of pure culture
9. Staining Methods-simple, negative, gram and endospore staining techniques
10. Estimation of microbes by turbidometry and hemocytometer
11. Biochemical Test-Starch and cellulose hydrolysis, Gelatin hydrolysis, Oxidase test.

References

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.
5. David Plummer, **"An introduction to practical Biochemistry"** 7th edition, 2013
6. Manicam and Sadasivam, **"Biochemical methods"** 4th edition, 2006
7. David Nelson, **"Leininger Principles of Biochemistry"** 8th edition Michael M.cox 2018
8. Donald Voet, Judith G. Voet **"Biochemistry"**, Wiley Publishing house. 2008.
9. U. Satyanarayana U. Chakrapani **"Biochemistry" (with Clinical Concepts & Case Studies)"** Elsevier India Pvt. Ltd. 2013.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0104	**FUNDAMENTALS OF MATHEMATICS-1 LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Basic knowledge on Mathematics and Algebra.

Course objectives

1. Explain the consistency of the given system of equations.
2. Recognize and use basic properties of subspaces and vector spaces.
3. Identify the given vectors are linearly independent or not and find the matrix of the given linear transformation with respect to the standard basis.
4. Describe the concepts of partial differentiation and analytic geometry in 3D.

Course outcomes

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

1. Make use of Gauss elimination and Gauss Jordon method for solving the system of equations, if the given system of equations is consistent.
2. Identify and evaluate the radius of curvature of the given curve. Also evaluate the given indeterminate form using L' Hospital rule.
3. Determine the matrix of the given linear transformation with respect to the standard basis.
4. Develop competency in applying the idea of partial derivatives

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1	1				1	1	3
CO3	3	2	2	1	1	1	1			1	1	2
CO4	3	2	2	1	1	1	1			1	1	2

Course content

1. Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions, and input/output statements.
2. Some simple programs to understand the relational, conditional, and logical operators.
    i. Compare two numbers (less than, greater than) using if statement
    ii. Sum of natural numbers using while loop
    iii. Finding the factors of a number using for loop.
    iv. To check the given number is prime or not (use if... else statement).
    v. Find the factorial of a number (use if...if...else). vi) Simple programs to illustrate logical operators (and, or, not)
3. Python commands to reduce given matrix to echelon form and normal form with examples.
4. Python program/command to establish the consistency or otherwise and solving system of linear equations.
5. Using Python, Expressing a vector as a linear combination of given set of vectors.
6. Using Python, Illustration of linear dependence and independence of vectors.
7. Basis and Dimension – illustrative examples by Python.
8. Verifying whether a given transformation is linear by Python.
9. Python command to find the nth derivatives.
10. Python program to find nth derivative with and without Leibnitz rule.
12. Obtaining partial derivative of some standard functions
13. Verification of Euler's theorem.

Reference Books

1. Seymour Lipschutz., **"Data Structures"** Tata Mc-Graw-Hill publication. 2007
2. T.H. Cormen, C. E. Leiserson, R.L. Rivest., **"Introduction to Algorithms (3rd Ed.)".** The MIT Press. 2007
3. Wayne W. Daniel, **"Biostatistics"** (9 Ed.) Wiley 2004
4. Seymour Lipschutz and John Schiller. **"Introduction to Probability and Statistics"** TATA McGraw-Hill edition. 1998
5. Bernard Lo, **"Resolving Ethical Dilemmas: A Guide for Clinicians",** Fifth Edition. 2013.
6. Helga Kuhse; Peter Singer, **"Second edition of A Companion to Bioethics",** 2009.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0102	**C PROGRAMMING LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Basic knowledge on computer operating and Microsoft skills.

Course Objectives

1. To develop enough familiarity with the specific environment.
2. To develop an understanding of fundamental programming logic and programming techniques.
3. To develop programming language of different numerical methods which are used to solve scientific and engineering problems.
4. To emphasize on developing the student's ability to analyze and solve problems by using high level programming language.

Course outcomes

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

1. To understand the Syntax and Structure of the C Programming.
2. Design C Programs for Problems.
3. Write and Execute C Programs for simple applications.
4. Develop algorithms based on C programming for simple application development.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1	2	2	1	1	1	2
CO2	3	2	2	2	2	1	1	2	1	1	1	3
CO3	3	2	2	2	2	1	1	1	1	1	1	2
CO4	3	2	2	1	2	2	1	2	1	1	1	2

Course content

1. Write a C Program to find area and circumference of circle.
2. Write a C program to display the size of every data type using "size of" operator.
3. Write a C Program to Make a Simple Calculator Using switch…case.
4. Write a C program to add two numbers using Call by value.
5. Write a C program to find the Fibonacci series using recursion

6. Write a C program to find number of occurrences of vowels, Consonants, word, space, and the special characters in the given statement
7. Write a C program to read and print the student information using structure.
8. Write a C Program to open, read and close the File.

Reference Books

1. Anita Goel and Ajay Mittal, **"Computer Fundamentals and Programming in C"**, Dorling Kindersley (India) Pvt Ltd, Pearson Education in South Asia, 2011.
2. Yeshvant Kanetkar **"Let Us C"** BPB Publications,2011.
3. E Balaguruswamy, **"Computing Fundamentals & C Programming",** McGraw Hill Education India.
4. Byron Gottfried, Fourth Edition, "Programming With C", Schaum's Outlines, 2012.
5. Kernighan B.W and Ritchie D.M, **"The C Programming language",** Second Edition, Pearson Education,2006.

SECOND SEMESTER

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHK201	**LANGUAGE – II: KANNADA**	FC	1	1	0	2	3

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå.
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives: £Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤n Ö£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

1. d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.
2. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
3. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
4. ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨sÁªÀ ªÀÄvÀÄÛ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	0	0	0	3	0	0
CO2	0	0	0	0	2	3	0	0	0	3	0	0
CO3	0	0	0	0	0	3	0	0	0	3	0	0
CO4	0	0	0	0	0	0	3	2	0	3	0	0

Course content

Unit-I: ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hours

1. ZÀAzÀæªÀÄw «¯Á¥À gÁWÀªÁAPÀ
2. ºÀUÉUÀ¼À£ÀÄ »ArzÀ£ÀÄ ªÀÄ£ÀzÉÆ¼ÀUÉ PÀÄªÀiÁgÀªÁå¸À
3. UÉÆÃgÀPÀë ¥Àæ¸ÀAUÀ ZÁªÀÄgÀ¸À

Unit-II: ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hours

1. wæ¥À¢UÀ¼ÀÄ ¸ÀªÀðdÕ
2. V½AiÀÄÄ ¥ÀAdgÀzÉÆ½®è ¥ÀÄgÀAzÀgÀzÁ¸ÀgÀÄ
3. PÀgÉzÀÄ PÉÆlÖ£ÀÄ ±Á¥ÀªÀ£ÀÄ PÀ£ÀPÀzÁ¸ÀgÀÄ

Unit-III: ¯ÉÃR£ÀUÀ¼ÀÄ **6**

Hours

1. DvÀä²æÃUÁV ¤gÀAPÀÄ±ÀªÀÄwUÀ¼ÁV PÀÄªÉA¥ÀÄ
2. ªÀiÁ£À«ÃAiÀÄvÉ CAvÁgÀ¯Áè zÉÃªÀ£ÀÆgÀÄ ªÀÄºÁzÉÃªÀ
3. ¨sÀÆvÁ¬Ä ªÀÄÄ¤zÁ¼ÀÄ ªÀÄÄgÁj §¯Á è¼À

Unit-IV: ¥À æªÁ¸À PÀxÀ£À **6**

Hours

1. £À£ÉÆß¼ÀV£À ºÁqÀÄ PÀÆå¨Á (¸ÀAUÀæºÀ) f. J£ï. ªÉÆÃºÀ£ï

Reference Books:

1. ªÀÄÄUÀ½ gÀA. ²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., ZÁjwæPÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2008
3. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
5. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2007
6. £ÁgÁAiÀÄt ¦. «, ZÀA¥ÀÆ PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
7. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010 7. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
8. qÁ. azÁ£ÀAzÀ ªÀÄÆwð, ªÀZÀ£À ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
9. ¸ÀA ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, £ÁUÀgÁd Q. gÀA. ªÀZÀ£À PÀªÀÄäl, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
10. ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, µÀlà¢ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
11. ¸ÀA. ¸ÉÃvÀÄgÁªÀÄ gÁªï C.gÁ., ²æÃ ®Qëöä±À£À eÉÊ«Ä¤ ¨ sÁgÀvÀ(ªÀÄÆ®-vÁvÀàAiÀÄð-¸ÀavÀæ), ¥ÀæPÁ±ÀPÀgÀÄ PÁªÀÄzsÉÃ£ÀÄ ¥ÀÄ¸ÀÛPÀ ¨sÀªÀ£À, ¨ÉAUÀ¼ÀÆgÀÄ. 2010

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHH201	**LANGUAGE – II: HINDI**	FC	1	1	0	2	2

Prerequisites/Pre reading for the course:

1. अध्येता,पी.यु.सीकेस्तरपरद्वितीयभाषाकेरूपमेंहिन्दीकाअध्ययनकरनाचाहिए|
2. हिन्दीसाहित्यकेइतिहासकासंक्षिप्तज्ञानकीआवश्यकताहै|
3. हिन्दीव्याकरणकाअवबोधनआवश्यकहै|
4. हिन्दी-अंग्रेजीअनुवादसेसंबंधितजानकारीजरुरीहै|

Pedagogy: सिक्षशास्त्र:

1. Direct method
2. ICT and Digital support
3. Collaborative and Cooperative learning
4. Differentiated Instruction
5. Flipped Classroom

Course Objectives: पाठ्यक्रम उद्देश्य:

1. **संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना**|

2. **साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना**|
3. **छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना**|
4. **अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना**|

Course outcomes: अधिगम परिणाम:

अध्ययनकीसमाप्तिपरअध्येता –

1. **सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै**|
2. **साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै**|
3. **समाजमेंअंतर्निहितपद्दतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै**|
4. **साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै**|

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	2	0	0	3	0	0
CO2	0	0	0	0	2	2	3	0	0	3	0	0
CO3	0	0	0	0	3	3	3	0	0	3	0	0
CO4	0	0	0	0	3	2	3	0	0	0	0	0

Course content: अध्ययन विषय सूची /पाठ्यक्रम

इकाई- 1: कविता: प्राचीन एवं आधुनिक **7 hours**

1. कबीर के दोहे
2. कविता –जलियाँवाला बाग में बसंत- सुभद्राकुमारी चौहान
3. कविता –सुभाष की मृत्यु पर - धर्मवीर भारती

इकाई-2: कविता: प्राचीन एवं आधुनिक **6 hours**

1. तुलसीदस के पद
2. कविता – पाषाणी – नागार्जुन
3. कविता –चलना हमारा काम है- शिवमंगल सिंह सुमन

इकाई-3: कविता: प्राचीन एवं आधुनिक **7 hours**

1. मीराबाई के पद
2. कविता –मेरे सपने बहुत नहीं हैं-गिरिराज कुमार माथुर
3. कविता – अभी न होगा मेरा अंत – निराला

इकाई-4: **6 hours**

अनुवाद : शब्द एवं अनुच्छेद (हिन्दी से अंग्रेज़ी)

सूचना : प्रत्येक इकाई 25 अंक के लिए निर्धारित है |

Suggested Textbooks and References

Textbook/s: पाठ्य पुस्तक:

1. हिन्दी पाठ्य पुस्तक – रेवा विश्वविद्यालय।

References: सन्दर्भ ग्रन्थ:

1. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त

2. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त

3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र

4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह

5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह

6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे

7. संक्षेपण एवं पल्लवन

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHA201	**LANGUAGE II: ADDITIONAL ENGLISH**	FC	1	1	0	2	2

Prerequisites/Pre reading for the course:

The student must possess fair knowledge of language and literature.

Course objectives

1. To assess ecological and environmental concerns through literature.
2. To identify the inequal structures of power in society.
3. To compare and relate the position of men and women in society.
4. To interpret the representation of society in popular culture.

Course outcomes

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

1. Demonstrate a thorough understanding of sensitive and critical ecological and environmental issues.
2. Analyze the rigid structure of center and margin in our society.
3. Criticize the subordinate position of women in society.
4. Justify the depiction of society in popular culture.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	0	3	0	0
CO2	0	0	0	0	3	3	3	3	0	3	0	0
CO3	0	0	0	0	3	3	3	2	0	3	0	0
CO4	0	0	0	0	3	3	3	3	0	0	0	0

Course content

Unit-I: Ecology & Environment **7 hours**

1. Literature: Toru Dutt - Casuarina Tree
2. Gordon J.L. Ramen – Daffodils No More
3. C.V. Raman – Water – The Elixir of Life

4. Language: Degrees of Comparison

Unit-II: Voices from the Margin **6 hours**

1. Literature: Tadeusz Rozewicz – Pigtail
2. Jyoti Lanjewar – Mother
3. Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl
4. Language: Prefix and Suffix

Unit-III: Women & Society **7 hours**

1. Literature: Kamala Das – An Introduction
2. Rabindranath Tagore – The Exercise Book
3. Jamaica Kincaid – Girl
4. Writing Skills: Dialogue Writing

Unit-IV: Popular Culture **6 hours**

1. Literature: Rudyard Kipling – The Absent-minded Beggar
2. Sir Arthur Conan Doyle – The Adventure of Lion's Mane
3. Aldous Huxley – The Beauty Industry
4. Writing Skills: Story Writing

Reference Books:

1. Agrawal, K.A. Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study. Atlantic Publications, 2009.
2. Latham, Edward Connery (ed). The Poetry of Robert Frost. Holt Paperbacks, 2002.
3. Gale, Cengage Learning. A Study Guide for Tomas Rivera's The Harvest. Gale, Study Guides, 2017.
4. Basu, Tejan Kumar. The Life and Times of C.V. Raman. Prabhat Prakashan, 2016.
5. Rozewicz, Tadeusz. New Poems. Archipelago, 2007.
6. Manohar, Murli. Critical Essays on Dalit Literature. Atlantic Publishers, 2013.
7. Hansda, Sowvendra Shekhar. The Adivasi Will Not Dance: Stories. Speaking Tiger Publishing Private Limited, 2017.
8. Jacobs, Harriet. Incidents in the Life of a Slave Girl. Createspace Independent Publication, 2014.
9. Das, Kamala. Selected Poems. Penguin Books India, 2014.
10. Tagore, Rabindranath. Selected Short Stories of Rabindranath Tagore. Maple Press, 2012.
11. Gale, Cengage Learning. A Study Guide for Jamaica Kincaid's Girl. Gale, Study Guides, 2017.
12. Kipling, Rudyard. The Absent-Minded Beggar. Hardpress Publishing, 2013.
13. Doyle, Arthur Conan. The Hound of the Baskervilles. General Press, 2017.
14. Dixson, Robert J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd., 1988.
15. Turton, Nigel D. ABC of Common Errors. Mac Millan Publishers, 1995.
16. Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.
17. Kumar, E Suresh, J. Savitri and P Sreehari (ed). Effective English. Pearson Education, 2009.

Course code	Course Title	HC/	L	T	P	C	Hrs./

		SC/ OE					Wk.
B21AHE201	**COMMUNICATIVE ENGLISH – II**	FC	1	1	0	2	3

Prerequisites/Pre reading for the course:

The student must possess functional knowledge of LSRW skills.

Course Objectives

1. To build skills essential for corporate communication.
2. To enhance context specific language skills.
3. To discover the creative linguistic potential through language and literature.
4. To develop communication skills necessary for employability.

Course outcomes

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

1. Apply acquired skills to communicate effectively in a corporate scenario.
2. Demonstrate command over rhetoric of language.
3. Develop critical and creative thinking through assimilated language skills.
4. Utilize the communication skills learnt to match industry standards.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	0	3	3	2
CO2	0	0	0	0	3	3	3	2	0	3	3	2
CO3	0	0	0	0	3	3	3	3	0	3	3	2
CO4	0	0	0	0	3	3	3	3	0	3	0	0

Course content

Unit-I: Language Acquisition **7 Hours**

1. Remedial Grammar: Questions& Negatives; Questions Tags
2. Writing Skills: Email Writing
3. Activities: Group Discussions
4. Literature: Alphonse Daudet - The Last Lesson

Unit-II: Persuasive Skills **6 Hours**

1. Remedial Grammar: Past Simple & Past Perfect
2. Writing Skills: Report Writing
3. Activities: Book & Movie Reviews
4. Literature: Lord Alfred Tennyson – Ulysses

Unit-III: Cognitive Skills **7 Hours**

1. Remedial Grammar: Present & Past Passive; Conditionals
2. Writing Skills: Creative Writing
3. Activities: Role Plays
4. Literature: O. Henry – The Gift of the Magi

Unit-IV: Employability Skills **6 Hours**

1. Remedial Grammar: Reported Speech; Idioms
2. Writing Skills: Cover Letter & CV
3. Activities: Exchanging Information
4. Literature: Saki – The Open Window

Reference Books:

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.
8. Goodale, Malcolm. Professional Presentation. Cambridge University Press, 2013.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0201	**CELL & MOLECULAR BIOLOGY**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic biology, microbiology, and biochemistry.

Course objectives

1. Understand the basic concepts of cell and molecular biology to predict the prokaryotic and eukaryotic genetic material.
2. Explore the concepts on DNA replication, transcription, and translation.
3. To understand the concepts of gene regulations of prokaryotic and eukaryotic organisms.
4. To understand the genetic mutations and progression towards diseases.

Course outcomes

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

1. Understand and appreciate the diversity of life as it evolved over time by processes of mutation, selection, and genetic change.
2. Illustrate that fundamental structural units define the function of all living things.
3. Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context.
4. Construct and utilize predictive models to study and describe complex biological systems.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

Unit-1: Basics of Cell Biology (structure & function) 12 hours

Discovery of cell and Cell Theory; Cell Structure and components, Comparison between prokaryotes and eukaryotic cells; Chromosomes and Genes and Structural organization of prokaryotic and Eukaryotic organisms. Structure and functions of DNA and RNA, major forms of DNA (A-DNA, B-DNA and Z-DNA), Central dogma, DNA replication, (Prokaryotes and eukaryotes): Semi–conservative replication, DNA as Genetic material (classical experiments).

Unit-II Transcription and Translation 12 hours

Transcription: Transcription initiation, post-transcriptional modifications, Enzymes involved in transcriptions, DNA mismatch, DNA Repair mechanism, Elongation factors, Termination: Rho dependent and Rho-independent termination; Translation: Structure and Function of rRNA, Initiations, elongation and termination in Prokaryotes and Eukaryotes, Post-translations modifications: Heat shock proteins and methylation, protein folding. Inhibitors and Modifiers of protein synthesis Genetic Code

Unit-III: Gene Regulation 12 hours

Regulatory strategies in Eukaryotes, Cell differentiation and gene regulation in prokaryotes and eukaryotes; Operon concept-Lac operon, Trp-operon, galactose-operon, Epigenetics: Epigenetic mechanisms of Transcriptional regulation, Translational control, DNA variations: SNP, InDel, SNV.

Unit-IV 12 hours

Mutation: Occurrence, Types of mutations: Germline and Somatic mutations, kinds of Mutation: spontaneous & induced Mutation, Mutagens – Physical and chemical, detection of Mutation. Molecular basis of gene mutations and transposable elements in prokaryotes and eukaryotes.

REFERENCE BOOKS

1. Cooper, G.M., Hausman, R.E. **"The Cell: A molecular approach".** ASM Press and Sinauer Associates 5th Edition 2009.
2. De Robertis. **"Cell and Molecular Biology".** Lippincott Williams and Williams 6th Edition 2008.
3. Klug, W.S., Cummings, Spencer, Benjamin Cummings, **"Concepts of Genetics"** 11th Edition 2009.
4. Russell, P. J. iGenetics- **"A Molecular Approach".** Benjamin Cummings, 3rd Edition, 2009
5. Simmons, **"Principles of genetics",** John Wiley & Sons (Asia) Pte Ltd. New Jersey, 4th Edition, 2006.
6. Brown T. **"A Genomes 3",** Garland Science Publishing, New York, 2007.
7. Griffiths, AJF, Wessler SR, Lewontin RC, Gelbart WM and JH Miller, **"Introduction to genetic analysis"** W.H. Freeman and Company, New York. 2005.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0203	**FUNDAMENTAL MATHEMATICS-II**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic mathematics and concepts of mathematical techniques to understand biological samples.

Course objectives

1. Evaluate some definite integral using reduction formulas and multiple integrals.
2. Understand various method for solving first order and first degree D.E.
3. Study various method for solving homogeneous and non-homogeneous D.E with constant coefficients.
4. Form the partial differential equation from for the relation and solve by direct integration or Lagrange's linear form.

Course outcomes

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

1. Evaluate the given definite integral (s) using an appropriate reduction formula or method.
2. Identify the first order and first-degree D. E and can use suitable method for solving it.
3. Solve the given D.E with constant coefficients using suitable technique for finding integral.
4. Construct the PDE by eliminating arbitrary constants and functions from the relation and can also solve PDE by using suitable method.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	1	0	1	1	1	1	2
CO3	2	3	1	1	1	1	0	1	1	1	2	2
CO4	2	3	2	2	2	1	0	1	2	2	1	2

Course content

Unit-I: Integral Calculus **12 hours**

Reduction formulae for $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, and $\int sin^m x\, cos^n x\, dx$, (without proof) Evaluation of theses integrals with standard limits and simple problems**.**

Multiple integrals: Definition of a line integral and basic properties – Examples on evaluation of line integrals –Double integrals, Change of order of integration, evaluation of triple integrals.

Unit-2: Differential equation of First order **12 hours**

Introduction, Solution of First order and first degree, Initial value problem, Liner equations, Bernoulli's differential equations, exact differential equations, Equations reducible to the exact form, , Applications of differential equations-Laws of decay and growth.

Unit-3: Linear ordinary Differential equations **12 hours**

Introduction**,** linear differential equations with constant coefficients, Solution of homogeneous and non-homogeneous linear D.E, Method of finding the complimentary functions and particular integral

$(e^{ax} / f(D), \sin ax / f(D), \cos ax / f(D), \phi(x) / f(D))$.

Unit-4: Partial differential Equations (PDEs) **12 hours**

Formation of a partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$.

Reference Books:

1. G B Thomas and R L Finney, **Calculus and Analytical geometry**, 10th ed.: Addison – Wesley, 2000.
2. S. Narayanan & T. K. Manicavachogam Pillay, **Calculus:** S. Viswanathan Pvt. Ltd., vol. I & II. 1996
3. S. Narayanan and T.K. Manicavachogam Pillay, **Calculus (I & II).** Chennai, India: S. Viswanathan Pvt. Ltd., 1996.
4. Joseph Edwards, **An elementary treatise on the differential calculus: with applications and numerous examples,** Charleston, USA: BiblioBazaar, 2010.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0201	**PROGRAMMING IN PYTHON**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic c-programing objectives, arrays, conditional statements.

Course objectives

1. To know the basics of algorithmic problem solving to do input/output with files in Python
2. To use Python data structures –- lists, tuples, dictionaries.
3. To develop Python programs with conditionals and loops.
4. To read and write simple Python programs using files.

Course outcomes

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

1. Develop algorithmic solutions to simple computational problems, simple Python programs for solving problems.
2. Read, write & execute simple Python programs.
3. Read and write data from/to files in Python Programs.
4. Represent compound data using Python lists, tuples, and dictionaries.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1	1				1	1	3
CO3	3	2	2	1	1	1				1	1	2
CO4	3	2	2	1	1	1	1			1	1	2

Course content

UNIT- I: Introduction to Python **12 Hours**

Introduction to Python, Installing Python, Expression and values, Variable, Keywords, Basic operators. Conditional Statements, Looping, Control statements, Arrays

UNIT-II: Strings and Functions **12Hours**

Strings and Functions: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, String Methods, in Operator, String Operations. Function Calls, Type Conversion Functions, Math Functions, Composition, Adding New Functions, Directories Expressions: Concept of regular expression, various types of regular expressions, using match function.

UNIT-III: List **12 Hours**

List: Values and Accessing Elements, traversing a List, Deleting elements from List, Built-in List Operators, Concatenation, Repetition, Built-in List functions and methods. Dictionaries: Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods. Tuples: Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in Tuple Functions. Exceptions: Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions Regular

UNIT-IV: Files **12 Hours**

Files: Text Files, The File Object Attributes, Classes and Objects: Overview of OOP (Object Oriented Programming), Class Definition, Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes, Inheritance, Method Overriding, Data Encapsulation, Data Hiding.

Textbooks:

1. Wesley J. Chun, **"Core Python Applications Programming",** 3rd Edition, Pearson Education, 2016
2. Charles Dierbach, **"Introduction to Computer Science using Python",** Wiley, 2015
3. Downey, A. et al., **"How to think like a Computer Scientist: Learning with Python",** John Wiley, 2015
4. John Zelle, **"Python Programming: An Introduction to Computer Science",** Second edition, Course Technology Cengage Learning Publications, 2013.
5. Michel Dawson**, "Python Programming for Absolute Beginners",** Third Edition, Course Technology Cengage Learning Publications, 2013.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CPS211	**DATA COMMUNICATION AND NETWORKS**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Basics on Networks, Simple Waveforms

Course objectives

1. Outline the theory behind the basic design of networks and approaches to design networks.
2. Get the idea of representation of digital information and digital transmission and could be able to understand and design reliable transmission.
3. Able to determine type of transmission and technology required for transmission.

4. Outline the theory behind the various protocol used in transmission and could design new protocols.

Course outcomes

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

1. Explain the basics of networking, Network Models.
2. Identify the data & signals, the channel rate and conversion techniques, the error detection and correction techniques.
3. Demonstrate handling of multiple channels and transmission.
4. Determine how to transmit data over the channels reliably.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	1	1			1	1	2
CO2	3	2	2	2	2	1	1			1	1	3
CO3	3	2	2	2	2	1	1			1	1	2
CO4	3	2	2	2	2	1	1			1	1	2

Course content

Unit-I: Data Communications **12 Hours**

Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet. Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.

Unit-II: Physical layer **12 Hours**

Physical layer: Analog and digital, Analog signals, Digital signals, Analog versus digital, Data rate limit, Transmission impairments, Line coding, Block coding, Sampling, Transmission mode, Modulation of digital data, Telephone modems, Modulation of analog signal, FDM, WDM, TDM, Guided media, Unguided media, Circuit switching, Telephone networks, DSL technology, Cable modem, SONET.

Unit-III: Data link layer **12 Hours**

Data link layer: Types of errors, Detection, Error correction, Flow, and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, point to point protocol, PPP stack, Random access, Controlled access, Channelization, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Bluetooth, Connecting devices, Backbone network, Virtual LAN, Cellular telephony, Satellite networks.

Unit-IV: Network Layer **12 Hours**

Network layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6. **Transport layer:** User datagram protocol (UDP), Transmission control protocol (TCP). **Application layer:** Name space, Domain name space, Distribution of name space, DNS on the internet, electronic mail, File transfer, HTTP, World wide web (WWW), Digitizing audio and video, Audio, and video compression, streaming stored audio/video, Streaming live audio/video, Real time interactive audio/video, Voice over IP.

Reference books

1. Ferouzan, Behrouz A., **Data Communications and Networking,** TATA McGraw Hill 2002.
2. Stallings William, **Data and Computer Communication,** Pearson Education 7th ed., 2000
3. Black, Ulylers D., **Data Communication and Distributed Networks**, PHI 3rded, 1999
4. Tanenbaum, Andrew S., **Computer Networks, PHI** 2nd ed. 2000.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CPS212	**MULTIMEDIA COMPUTING**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on Genomics and bioinformatics tools and software's.

Course objectives

1. To provide knowledge on different concept of multimedia
2. To understand the different data formats
3. To know the applications of multimedia in different fields
4. To develop the tools to predict the multimedia applications.

Course outcomes

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

1. Understand the concept of Multimedia Technology
2. Learn the concepts of various digital media
3. Know the fundamentals of data compression
4. Understand the distributed multimedia system

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

UNIT-I: Introduction, Media, and Audio Technology **12 Hours**

Multimedia Elements; Multimedia Applications; Multimedia Systems Architecture, Evolving Technologies for Multimedia Systems; Defining Objects for Multimedia Systems; Multimedia Data Interface Standards; The need for Data Compression; Multimedia Databases. Media: Perception Media, Representation Media, Presentation Media, Storage Media, Transmission Media, Information Exchange Media, Presentation Spaces & Values, and Presentation Dimensions; Sound: Frequency, Amplitude, Sound Perception and Psychoacoustics; Audio Representation on Computers; Three-Dimensional Sound Projection; Music and MIDI Standards; Speech Signals; Speech Output; Speech Input; Speech Transmission.

UNIT-II: Graphics and Images, Video Technology, Computer-Based Animation 12 Hours

Capturing Graphics and Images Computer Assisted Graphics and Image Processing, Reconstructing Images, Graphics, and Image Output Options. Basics, Television Systems, Digitalization of Video Signals, Digital Television; Basic Concepts, Specification of Animations, Methods of Controlling Animation, Display of Animation, Transmission of Animation, Virtual Reality Modelling Language.

UNIT-III: Multimedia Data Compression 12 Hours

Types of compression Binary image compression color, gray scale and still video image compression video image compression audio compression fractal compression. Data and file formats: RTF TIFF RIFF, MIDI, JPEG, AVI video file formats, MPEG standards.

UNIT-IV: Multimedia Applications 12 Hours

Media Preparation and composition, Media integration and communication, Media Entertainment, Telemedicine, E-Learning, Digital Video editing and production system, Video Conferencing.

Reference books:

1. Ralf steinmetz, Klara Narstedt: **"Multimedia Fundamentals" Volume 1: Media Coding and Content Processing**, 2nd Edition, Pearson Education,2003
2. Brabhat K Andleigh, Kiran Thakrar: **Multimedia System Design** PHI 2003
3. K R Roa, Zoran S, Bojkovik and dragorad **A: Multimedia communication systems: Techniques, standards, and networks.** Pearson Edition 2002.
4. Nalin K sharid: **Multimedia Information networking** PHI, 2002

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ASM201	**ENVIRONMENTAL SCIENCE**	MC	3	1	0	4	4

Prerequisites/Pre reading for the course:

Basic knowledge of Environmental Science studied at higher secondary & school level.

Course objectives

1. Discuss Foster clear awareness and concern about economic, social, political, and ecological interdependence in urban and rural area
2. Influence the new patterns of behaviors of individuals, groups, and society towards the environment
3. List the knowledge values, attitudes, commitment, and skills needed to protect and improve the environment
4. Elaborate the evaluation of the environmental measures and education programs.

Course outcomes

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

1. Adapt the environmental conditions and protect it
2. Estimate the role of individual, government, and NGO in environmental protection.
3. Interpret the new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	1	1	2	3	1	1	1	1	2
CO2	1	3	1	1	1	3	3	1	1	1	1	3
CO3	2	3	2	1	3	3	3	1	1	1	2	3
CO4	1	2	1	1	1	2	3	1	1	1	1	2

Course content

Unit-I: Multidisciplinary Nature of Environmental Studies 6 hours

Introduction to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment. Environmental protection – Role of Government-Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Initiative and Role of Non-government organizations in India and world. Self-study: Need for public awareness on the environment, Gaia Hypothesis.

Unit-II: Environmental pollution, degradation & Waste management 6 hours

Environmental Pollution – Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures. Self-study: Case studies of London smog, Bhopal gas tragedy, marine pollutions, and study of different wastewater treatment processes. Environmental degradation – Introduction, Global warming and greenhouse effect, Acid rain- formation & effects, Ozone depletion in stratosphere and its effect. Solid Waste management – Municipal solid waste, Biomedical waste, Industrial solid waste and electronic waste (E-Waste). Self-study: Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

Unit-III: Energy & Natural resources 6 hours

Energy – Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy. ***Self-study:*** Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster. Natural resources –water resource (Global water resource distribution, Water conservation methods, Water quality parameters, uses of water and its importance), Mineral resources (Types of minerals, Methods of mining & impacts of mining activities), Forest wealth (Importance's, Deforestation-Causes, effects and controlling measures)

Self-study: Hydrology & modern methods adopted for mining activities.

Unit-IV: Ecology and ecosystem 6 hours

Ecology-Definition, branches, objectives and classification, Concept of an ecosystem- Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological succession and productivity,

Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon, nitrogen and phosphorus cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids. ***Self-study:*** Need for balanced ecosystem and restoration of degraded ecosystems.

Reference Books

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy**, "Environmental Studies",** Willy Publishing house. 2017.
2. Dr. M. S. Reddy & Chandrashekar, **"Environmental Studies",** Wiley India Private Ltd., 2016.
3. R.J. Ranjit Daniels and Jagadish Krishnaswamy, **"Environmental Studies",** Wiley India Private Ltd. 2009.
4. Benny Joseph, **"Environmental Studies"**, Tata McGraw – Hill Publishing Company Limited. 2015.
5. Dr. S. M. Prakash, **"Environmental Studies"**, Elite Publishers Mangalore, 2007

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0202	**CELL AND MOLECULAR BIOLOGY LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Knowledge on basic biology, microbiology, and biochemistry.

Course objectives

1. Understand the basic concepts of cell and molecular biology to predict the prokaryotic and eukaryotic genetic material.
2. Explore the concepts on DNA replication, transcription, and translation.
3. To understand the concepts of gene regulations of prokaryotic and eukaryotic organisms.
4. To understand the genetic mutations and progression towards diseases.

Course outcomes

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

1. Understand and appreciate the diversity of life as it evolved over time by processes of mutation, selection, and genetic change.
2. Illustrate that fundamental structural units define the function of all living things.
3. Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context.
4. Construct and utilize predictive models to study and describe complex biological systems.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

1. Estimation of DNA by Diphenylamine (DPA) method
2. Isolation and purification of Genomic DNA from bacteria
3. Isolation and purification of plant genomic DNA.
4. Agarose gel electrophoresis of DNA
5. Electrophoresis of Proteins by SDS- PAGE
6. Measurements of cells and chromosomes using Micrometry
7. Sex chromatin - Barr body analysis/blood smear analysis
6. Study of Karyotype and image analysis
7. Dissection of salivary gland of Drosophila and preparation of polytene chromosomes

Reference books

1. J Sambrook & D. W. Russell. **"Molecular cloning: a laboratory manual"** Vol 1, 2 & 3, CSHL Press. 2001.
2. Klug, W.S., Cummings, M.R., Spencer, C. A. Benjamin Cummings, **"Concepts of Genetics",** 11th Edition 2009.
3. Russell, P. J. **"iGenetics- A Molecular Approach".** Benjamin Cummings, 3rd Edition, 2009
4. Simmons, **"Principles of genetics",** John Wiley & Sons (Asia) Pte Ltd. New Jersey, 4th Edition, 2006.
5. Brown T**. "A Genomes 3".** Garland Science Publishing, New York, 2007.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0204	**FUNDAMENTAL MATHEMATICS-II**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Knowledge on basic mathematics and concepts of mathematical techniques to understand biological samples.

Course objectives

1. Evaluate some definite integral using reduction formulas and multiple integrals.
2. Understand various method for solving first order and first degree D.E.
3. Study various method for solving homogeneous and non-homogeneous D.E with constant coefficients.
4. Form the partial differential equation from for the relation and solve by direct integration or Lagrange's linear form.

Course outcomes

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

1. Evaluate the given definite integral (s) using an appropriate reduction formula or method.
2. Identify the first order and first-degree D. E and can use suitable method for solving it.
3. Solve the given D.E with constant coefficients using suitable technique for finding integral.
4. Construct the PDE by eliminating arbitrary constants and functions from the relation and can also solve PDE by using suitable method.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2

CO1	3	2	2	2	2	1	1			1	1	2
CO2	3	2	2	2	2	1	1			1	1	3
CO3	3	2	2	2	2	1	1			1	1	2
CO4	3	2	2	2	2	1	1			1	1	2

Course content

1. Python program for reduction formula with or without limits
2. Evaluation of the line integral with constant limits.
3. Evaluation of the double integral with constant limits.
4. Evaluation of the triple integral with constant limits.
5. Evaluation of the line integral with variable limits.
6. Evaluation of the double integral with variable limits.
7. Evaluation of the triple integral with variable limits.
8. Solutions to the problems on Linear differential equations
9. Solutions to the problems on different types of Partial differential equations.
10. Solving second order linear partial differential equations in two variables with constant coefficient.
11. Solving some more second order linear partial differential equations in two variables with constant coefficient.

Reference Books

1. Mitchell L. Model, **"Bioinformatics Programming using Python: Practical Programming for Biological Data",** O'Reilly Media", 1st Edition, 2009.
2. Mark Lutz and David Ascher, **"Learning Python",** O'Reilly Media, 5th Edition, 2013.
3. Jeff Chang, Brad Chapman, Iddo Friedberg, Thomas Hamelryck, **"Biopython Tutorial and Cookbook"**, 2018.
4. Sebastian Bassi. **Python for Bioinformatics**. 2018.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0202	**PROGRAMMING IN PYTHON LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Knowledge on basic C-programming and installing software's.

Course objectives

1. The course is mainly focused basic Python programming and command usage.
2. The course is also aiming to provide bioinformatics applications and data science.
3. The course is also introducing the detailed programming to read sequences and structures.
4. Represent compound data using python lists, Dictionaries

Course outcomes

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

1. The students will have a python commands, objects, and data structures.
2. The students will be able to develop algorithms using python programming to solve biological datasets.

3. The students can use numerical algorithms to analyze big data using python.
4. Students can be able to develop bioinformatic algorithms, tools, and software's.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1	1		1			1	1	2

Course content

1. Write a python program to demonstrate basic data type in python.
2. Write a python program to find factorial of a number.
3. Write a python program to check whether the number is prime or not.
4. Write a python program to find the largest number in an given array
5. Write a Python program to swap first and last element of the list.
6. Write a Python program to check if a string is palindrome or not
7. Write a python program to sort list of dictionaries by values– Using itemgetter
8. Write a Python program to read file word by word.

Reference Books

1. Mitchell L. Model, **"Bioinformatics Programming using Python: Practical Programming for Biological Data",** O'Reilly Media", 1st Edition, 2009.
2. Mark Lutz and David Ascher, **"Learning Python",** O'Reilly Media, 5th Edition, 2013
3. Chapman, **"Mathematical and Computational Biology Series",** Hall/CRC. 2010.

THIRD SEMESTER

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHK301	**LANGUAGE-III: KANNADA-III**	FC	1	1	0	2	3

Prerequisites/Pre reading for the course:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy:

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Flipped Classroom

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ

£ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÄr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤n Ö£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨ sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆEA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.
4. ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨sÁªÀ ªÀÄvÀÄÛ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	0	0	0	3	0	0
CO2	0	0	0	0	2	3	0	0	0	3	0	0
CO3	0	0	0	0	0	3	0	0	0	3	0	0
CO4	0	0	0	0	0	0	3	2	0	3	0	0

Course content

Unit-I: £ÀªÉÇÃzÀAiÀÄ PÀ«vÉUÀ¼ÀÄ

7 hours

1. ¨É¼ÀUÀÄ zÀ.gÁ. ¨ÉÃAzÉæ
2. PÀ°Ì PÀÄªÉA¥ÀÄ
3. PÀ£Àßqï ¥ÀzÀUÉÆ¼ï f. ¦. gÁdgÀvÀßA

Unit II £ÀªÉÇÃzÀAiÀÄ ºÁUÀÄ £ÀªÀå PÀ«vÉUÀ¼ÀÄ

7 Hours

1. CªÀzsÀÆvÀ ¸ÀÄ.gÀA.JPÀÄÌAr
2. ªÀÄ£É¬ÄAzÀ ªÀÄ£ÉUÉ PÉ.J¸ï.£À
3. £À£Àß ºÀtvÉ f. J¸ï. J¸ï.

Unit III ¸ÀtÚ PÀxÉUÀ¼ÀÄ **6 hours**

1. zÁ½ £ÀqÉzÁªÀ CuÁ Ú CªÀÄgÉÃ±À £ÀÄUÀqÉÆÃtÂ
2. PÉÆ£ÉAiÀÄ VgÁQ ¤gÀAd£À
3. ªÀiÁ¤ÃlgÏ vÉÃd¹ é

Unit IV £ÁlPÀ **6 hours**

1. «ÄÃrAiÀiÁ (¸ÀAUÀæºÀ) AiÀÄÄj¦rÃ¸ï C£ÀÄªÁzÀ: PÉ. ªÀÄgÀÄ¼À ¹zÀÞ¥À

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÀå ¸ÀA¸ÀÌøw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
4. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
5. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
6. ¸ÀA. ©.J¸ï. PÉÃ±ÀªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
7. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
8. DzsÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHH301	**LANGUAGE-III: HINDI-III**	FC	1	1	0	2	3

Prerequisites/Pre reading for the course: पूर्वापेक्षा:

- अध्येता को, हिन्दी नाटक साहित्य का संक्षिप्त ज्ञान आवश्यक है |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |

- हिन्दी व्याकरण का अवबोधन आवश्यक है।
- मीडिया लेखन की बुनियादी जानकारी चाहिए।
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है|

Pedagogy: सिक्षशास्त्र:

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives: पाठ्यक्रम उद्देश्य:

1. संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना|
2. साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना|
3. छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना|
4. अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना|

Course Outcomes: अधिगम परिणाम:

अध्ययनकीसमाप्तिपरअध्येता –

1. सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै|
2. साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै|
3. समाजमेंअंतर्निहितपद्दतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै|
4. साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै|

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	2	0	0	3	0	0
CO2	0	0	0	0	2	2	3	0	0	3	0	0
CO3	0	0	0	0	3	3	3	0	0	3	0	0
CO4	0	0	0	0	3	2	3	0	0	0	0	0

Course content

इकाई –1:नाटक : एक और द्रोणाचार्य – डॉ. शंकर शेष **7 hours**

लेखक परिचय

प्रथम दृश्य

द्वितीय दृश्य

इकाई –2 :नाटक : एक और द्रोणाचार्य **7 hours**

तृतीय दृश्य

चतुर्थ दृश्य

इकाई –3:नाटक : एक और द्रोणाचार्य **6 hours**

पंचम दृश्य

छठा दृश्य

इकाई –4: **6 hours**

अनुवाद : अंग्रेजी - हिन्दी-समाचार पत्र संबंध

सूचना : प्रत्येक इकाई 25 अंक के लिए निर्धारित है |

References Textbook/s: पाठ्य पुस्तक:

1. एक और द्रोणाचार्य – डॉ. शंकर शेष

References: सन्दर्भ ग्रन्थ:

1. मीडिया लेखन एवं जनसंचार – डॉ.संजीव कुमार
2. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
3. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
4. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
5. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
6. कार्यालय अनुवाद निदेशिका
7. मीडिया विमर्श – रामशरण जोशी
8. संस्कृति– बाजार और जनसंचार , नन्द भरद्वाज

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHA301	**LANGUAGE-III: ADDITIONAL ENGLISH-III**	FC	1	1	0	2	3

Prerequisites/Pre reading for the course:

The student must possess fair knowledge of language, literature and society

Course objectives

1. To outline the global and local concerns of gender and identity.
2. To identify the complexities of human emotions through literature.
3. To assess the struggles of human survival throughout history.
4. To compare between the various dimensions of childhood.

Course outcomes

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

1. Evaluate the pressing gender issues within our society.
2. Criticize human actions through a humane and tolerant approach.
3. Perceive the human conflicts with an empathetic perspective.
4. Disprove the assumption of a privileged childhood.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	0	3	0	0
CO2	0	0	0	0	3	3	3	3	0	3	0	0
CO3	0	0	0	0	3	3	3	2	0	3	0	0
CO4	0	0	0	0	3	3	3	3	0	0	0	0

Course content

Unit-I: Gender & Identity **7 hours**

1. Anne Sexton – Consorting with Angels
2. Eugene Field – The Doll's Wooing
3. Vijay Dan Detha – Double Life
4. Charlotte Perkins Gilman – The Yellow Wallpaper

Unit-II: Love & Romance **6 hours**

1. Alfred Noyes – The Highway Man
2. William Shakespeare – Sonnet 116
3. Frank Richard Stockton – The Lady or the Tiger?
4. Oscar Wilde – The Nightingale and the Rose

Unit-III: War & Trauma **7 hours**

1. Lord Alfred Tennyson – The Charge of the Light Brigade
2. Taufiq Rafat – The Medal
3. Guy de Maupassant – Two Friends
4. Sadaat Hasan Manto – Toba Tek Singh

Unit-IV: Children's Literature **6 hours**

1. William Blake – The Chimney Sweeper
2. D.H. Lawrence – Discord in Childhood
3. Anna Sewell – The Black Beauty (Extract)
4. Rudyard Kipling – The Jungle Book (Extract)

Reference Books:

1. Sexton, Anne. *The Complete Poems*. Houghton Mifflin, 1999.
2. Namjoshi, Suniti. *Feminist Fables*. Spinifex Press, 1998.
3. Vanita, Ruth & Saleem Kidwai (ed.) *Same Sex Love in India*. Penguin India, 2008.
4. Gilman, Charlotte Perkins. *The Yellow Wallpaper*. Rockland Press, 2017.
5. Gale, Cengage Learning. *A Study Guide for Alfred Noyes's "The Highwayman"*. Gale, Study Guides, 2017. (Kindle Edition Available)
6. Shakespeare, William. *Poems and Sonnets of William Shakespeare*. Cosimo Classics, 2007.
7. Stockton, Frank Richard. *The Lady, or the Tiger?* Createspace Independent Publications, 2017.
8. Wilde, Oscar. *The Collected Works of Oscar Wilde*. Wordsworth Editions Ltd., 1997.
9. Tennyson, Lord Alfred. *The Complete Works of Alfred Tennyson*. Forgotten Books, 2017.
10. Blake, William Erdman, David V. (ed.). *The Complete Poetry and Prose* (Newly revised ed.). Anchor Books, (1988).

11. Maupassant, Guy de. *Guy de Maupassant-The Complete Short Stories*. Projapati, 2015.
12. Manto, Sadaat Hasan. *Manto: Selected Short Stories*. RHI, 2012.
13. Ricks, Christopher. *Metaphysical Poetry*. Penguin, 2006.
14. Sewell, Anna. *The Black Beauty*. Maple Press, 2014.
15. Kipling, Rudyard. *The Jungle Book*. Amazing Reads, 2018.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0301	**APPLIED BIOINFORMATICS**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on biology, computer science and mathematics.

Course objectives

1. The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
2. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
3. The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
4. The students will understand the algorithms to develop bioinformatics tools and software's.

Course outcomes

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

1. Understand the methodologies used for database searching and determining the accuracy of database search.
2. Design and implement the algorithms used in sequence and structure prediction to solve biological problems.
3. Analyze and interpret the sequence and structure to predict the evolutionary relationships.
4. Predict the gene and protein structures using publicly available computational tools.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

Unit-I: Fundamentals of Bioinformatics **12 hours**

Introduction to Bioinformatics, Goal, Scope, Applications, Limitations, Biological Databases: Types of Databases, Literature databases: Open access and open sources, PubMed, PubMed Central, Information Retrieval from Biological Databases; Sequence Formats, Genome Databases: Viral genome database (ICTVdb, VirGen), Bacterial Genomes database (Genomes Online Database –GOLD, Microbial Genome Database-MBGD), Organism specific Genome database (OMIM / OMIA, SGD, Worm Base, PlasmoDB,

Fly Base, TAIR), and Genome Browsers (ENSEMBL, VEGA genome browser, NCBI-NCBI map viewer, UCSC Genome Browser), Metabolic databases: KEGG, Interactome databases, Ligand databases.

Unit-II: Pairwise sequence alignment **12 hours**

Basic concepts of sequence similarity, identity and homology, definitions of homologues, Orthologous, Paralogous and Xenologous, Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles. Measurement of sequence similarity; Pairwise sequence alignment: Basic concepts of sequence alignment, Dot plot, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results. Database similarity search (BLAST, Types of BLAST, analysis of BLAST Results)

Unit-III: Multiple sequence alignments & Phylogenetic Analysis **12 hours**

The need for MSA, basic concepts of MSA. Algorithm of CLUSTAL OMEGA, Use of HMM-based Algorithm for MSA; Phylogenetic Analysis: Definition and description of phylogenetic trees and various types of trees, Phylogenetic analysis algorithms: Alignment, Substitution, tree building methods: Distance based (UPGMA, NJ) and character-based methods (Parsimony, likelihood), Tree evaluation: Bootstrapping methods, use of tools such as Phylip, Mega, PAUP.

Unit-IV: Structure Predictions **12 hours**

Gene structure prediction: Exons, introns, ORFs, Expressed sequence tags (ESTs), regulatory regions, Prokaryotic gene prediction, Eukaryotic gene prediction, Gene structure prediction tools; RNA Structure prediction (RNAFold), Protein structure prediction: Protein structure prediction tools: Physico-chemical properties of proteins (Protparam), Secondary Structure prediction: Chou Fasman, GOR methods, motifs and patterns, protein fold prediction; Tertiary structure prediction: Comparative modelling, fold recognition method, (Swiss modeller, ITASSER). Protein classification using CATH and SCOP.

Reference books

1. Andreas D. Baxevanis, B.F. Francis Ouellette. **"Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins",** 2nd Edition, Willy publishing 2009.
2. David W. Mount., **"Bioinformatics: Sequence and Genome Analysis",** Cold Spring Harbor Laboratory Press, New York. 2004.
5. Andrew R. Leach., **"Molecular Modelling Principles and Applications"** (2nd Ed.), Prentice Hall, USA. 2001.
6. G. E. Schulz., **"Principles of Protein Structure",** Springer 2009
7. Jin Xiong, **"Essential Bioinformatics",** Cambridge University Press, 2006.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0303	**BASIC BIOSTATISTICS**	FC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic mathematics

Course objectives

1. To introduce students about basic concepts of Biostatistics
2. To study the concepts of Measures of Dispersion
3. To study the bivariate data
4. To study the concepts of Different Distributions.

Course outcomes

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

1. Understand the different methods of presentation of statistical data.
2. Solve mathematically and interpret biologically simple problems using Measures of Central Tendency and dispersion
3. Explain and apply the concepts of Bivariate data and interpret the Biological Problems using Correlation and Regression.
4. Mathematical solution and interpretation biologically simple problems using Probability and Distributions.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1	1				1	1	3
CO3	3	2	2	1	1	1				1	1	2
CO4	3	2	2	1	1	1	1			1	1	2

Course content

UNIT-I: Introduction to biostatistics **12 hours**

Introduction to biostatistics, types of data, methods of data collection, classification, and tabulation of data. Diagrammatic and graphical representation of data, frequency distribution, cumulative frequency distribution and their graphical representation, histogram, frequency polygon, frequency curve and ogives.

UNIT-II: Measures of Central tendency **12 hours**

Measures of Central tendency: Mean, Median & Mode. Measures of dispersion Variability: Range, Quartile deviation, Mean deviation, Standard deviation, and Coefficient of variation. Skewness and kurtosis, Karl-Pearson's coefficient of skewness

UNIT-III: Analysis of Bivariate data **12 hours**

Analysis of Bivariate data: correlation, types of correlation, measurement of correlation, regression equations, regression coefficients, properties of correlation coefficient and regression coefficients.

UNIT-IV: Basic concepts of Probability **12 hours**

Basic concepts of Probability – Sample space and events – Addition and Multiplication theorem – Baye's theorem and conditional probability. Random Variables (discrete and continuous), probability mass

function, probability density function, cumulative distribution function. Theoretical distributions: Binomial, Poison and Normal.

Reference Books

1. Palanichamy, S. and Manoharan, M., **"Statistical methods for biologist"**, Paramount publications, 2001.
2. Arora P.N and Malhon.P.K., **"Biostatistics",** Himalaya publishing house, Mumbai, 2009
3. Wayne W. Daniel, **"Biostatistics: A Foundation for analysis in the Health Sciences"** 9th Edition, Wiley Publications. 2009.
4. Douglas S. Shafer, Zhiyi Zhang, **"Beginning Statistics",** prince publications, 2012.
5. Robert R. Sakal and F. James Rohlf, **"Introduction to Biostatistics":** Second Edition, Dover Publications. Inc, 2011.
6. S.C. Gupta, and V.K. Kapoor, **"Fundamentals of mathematical Statistics",** S. Chand and Sons, New Delhi, 2002.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0301	**RELATIONAL DATABASE MANAGEMENT SYSTEMS**	FC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on computer programming and sources of data collection.

Course objectives

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Design and implement a database schema for a given problem-domain
3. Apply normalization techniques to normalize the database
4. Understand the use of Structured Query Language (SQL) and learn SQL syntax.

Course outcomes

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

1. Describe the fundamental elements of relational database management systems
2. Explain the basic concepts of relational data model, entity-relationship model, relational Database design, relational algebra, and SQL.
3. Design ER-models to represent simple database application scenarios
4. Convert the ER-model to relational tables, populate relational database and formulate SQL Queries on data.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	2			1	1	2
CO2	3	2	2	2	2	2	2			1	1	3
CO3	3	2	2	2	2	2	2			1	1	2
CO4	3	2	2	2	2	2	2			1	1	2

Course content

Unit-I: Basic concepts of database management **12 hours**

BASIC CONCEPTS: Database Management System - Characteristics of the Database Approach - Different people behind DBMS- Advantages of DBMS over file-based system - Three level architecture of DBMS or logical DBMS architecture - Physical DBMS Architecture - Database Administrator (DBA) Functions & Role - Types of Databases. The database system Environment, Classification of DBMS.

Unit- II: Relational, ER Models and Normalization **12 hours**

Relational, ER Models and Normalization: Data Models - Relational Model – Domains - Tuple and Relation - Super keys - Candidate keys - Primary keys and foreign keys for the Relations - Relational Constraints - Domain Constraint - Key Constraint - Integrity Constraint - Entity Relationship (ER) Model – Entities – Attributes – Relationships - Defining Relationship for College Database - E-R Diagram - Conversion of E-R Diagram to Relational Database. Functional Dependencies and Normalization for Relational Database: Informal Design Guidelines for Relational schemas, Functional Dependencies, First Normal Form, Second Normal form, Third Normal form, Boyce-Codd Normal Form

Unit-III: Relational Algebra Operations **12 hours**

Relational Algebra Operations: Union, Intersection, Difference, Cartesian product, Selection, Projection, Join, Division, Additional Relational Operations. Structures Query Language (SQL): Meaning – SQL commands - Data Definition Language - Data Manipulation Language - Data Control Language - Transaction Control Language - Queries using Order by – Where –Group by-Nested Queries. Aggregate functions in SQL.

Unit-IV: Distributed and Client Server Databases **12 Hours**

Distributed and Client Server Databases: Need for Distributed Database Systems - Structure of Distributed Database - Advantages and Disadvantages of DDBMS - Advantages of Data Distribution - Disadvantages of Data Distribution - Data Replication - Data Fragmentation. Client Server Databases: Emergence of Client Server Architecture - Need for Client Server Computing - Structure of Client Server Systems & its advantages. PL/SQL Introduction, Language fundamentals, conditional and sequential control, Iterative, Processing and loops.

Reference books

1. Remez Elmasri and Shamkant B. Navathe, **"Fundamentals of Database Systems",** 5th Edition, Pearson Education, 2007.
2. Abrahamsi. Silberschatz, Henry. F. Korth, S. Sudarshan, **"Database System Concepts"** 6th Edition, McGraw Hill, 2012.
3. Ramakrishnan & J. Gehrke, **"Database Management System",** McGraw Hill. 2011.
4. J.A. Hoffer, V. Rames & H. Topi, "Modern Database Management" Pearson, 2011.
5. Silberschatz, Korth & Sudarshan, **"Database System Concepts",** McGraw Hill. 2016.
6. Krishna P. Radha, Das Gupta Pranab Kumar, **"Database Management System Oracle SQL And PL/SQL"** Prentice-Hall of India Pvt. Ltd, 2013.

Course code	Course Title	HC/	L	T	P	C	Hrs./

		SC/ OE					Wk.
B21BIS311	**BIOINFORMATICS ALGORITHMS**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic bioinformatics, sequences, and alignment methods.

Course objectives

1. The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
2. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
3. The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
4. The students can develop their algorithms based on the sequence alignment and structure prediction.

Course outcomes

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

1. Understand the methodologies used for database searching and determining the accuracy of database search.
2. Design and implement the algorithms used in sequence and structure prediction to solve biological problems.
3. Analyze and interpret the sequence and structure to predict the evolutionary relationships.
4. Predict the gene and protein structures using publicly available computational tools.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

Unit-1: Algorithms and Complexity **12 hours**

Algorithm, Biological Algorithms versus Computer Algorithms, correct versus incorrect algorithms, Recursive Algorithms, Iterative versus Recursive Algorithms, fast versus Slow Algorithms, Algorithm Design Techniques: Exhaustive Search, Branch-and-Bound Algorithms, Greedy Algorithms, Dynamic Programming, Divide-and-Conquer Algorithms, Machine Learning, Randomized Algorithms.

Unit-II: Dynamic Programming Algorithms **12 hours**

The Power of DNA Sequence Comparison, Edit Distance and Alignments, Longest Common Subsequences, Global Sequence Alignment, Scoring Alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Alignment (PSSM, HMM), Gene Prediction (Neural Networks), Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment.

Unit-III: Clustering and Trees **12 hours**

Gene Expression Analysis, Hierarchical Clustering, k-Means Clustering, Clustering and Corrupted Cliques, Evolutionary Trees, Distance-Based Tree Reconstruction, Reconstructing Trees from Additive Matrices, Evolutionary Trees and Hierarchical Clustering, Character-Based Tree Reconstruction, Small Parsimony Problem, Large Parsimony Problem.

Unit-IV: Graph Algorithms **12 hours**

Graphs, Graphs and Genetics, DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, DeBurgian graph, SBH as a Hamiltonian Path Problem, SBH as a Eulerian Path Problem, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment.

Reference books

1. Jones, Neil C. **"An introduction to bioinformatics algorithms".** A Bradford books. 2009
2. Pavel Pevzner and Phillip Compeau **"Bioinformatics Algorithms: An Active Learning Approach"** 2014.
3. T.R. Sharma, **"Genome Analysis and Bioinformatics: A Practical Approach**", 1st Edition, IK International publishing house Pvt. Ltd. 2009.
4. Cynthia Gibas, Per Jambeck, **"Developing Bioinformatics Computer Skills",** O'Reilly & Associates, 2001.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BIS312	**SYSTEMS BIOLOGY**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on basic bioinformatics, sequences, and alignment methods.

Course objectives

1. The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
2. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
3. The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
4. The students can develop their algorithms based on the sequence alignment and structure prediction.

Course outcomes

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

1. Understand the methodologies used for database searching and determining the accuracy of database search.
2. Design and implement the algorithms used in sequence and structure prediction to solve biological problems.
3. Analyze and interpret the sequence and structure to predict the evolutionary relationships.

4. Predict the gene and protein structures using publicly available computational tools.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	2	2	2	2	0	0	1	1	1	1
CO2	1	2	2	1	0	3	3	2	3	3	1	2
CO3	1	2	2	1	1	3	3	3	3	3	2	2
CO4	1	2	2	2	2	3	3	3	2	2	1	2

Course content

Unit-I: Principles of Systems Biology **12 hours**

Systems Biology and modelling, Properties of models, Variables, parameters, and constants. Model development, Data integration, Techniques involved in systems biology: Elementary experimental techniques, advanced experimental techniques, Standard models, and approaches in systems biology.

Unit-II: Signal transduction and Biological Processes **12 hours**

Signal transduction, Quantitative measures of properties of signaling pathway. Gene ontology: Biological process, Metabolic process, cellular component (DAVID, PANTHER), Protein-protein interaction: Stringdb, Biocyc, Ecocyc, metacyc.

Unit-III: Gene expression Modelling **12 hours**

Modelling of Gene expression, Bayesian networks, Boolean Networks, The Model according to Griffith, The model according to Nicolis and Prigogine. Evolution and self-organization: Quasispecies and Hypercycles. The Genetic Algorithm, Spin-glass Model of Evolution, Boolean Network Models Data integration: Basic Concepts of database integration and data management, Biclustering and data integration. Applications of Systems Biology

Unit-IV: Simulation techniques **12 hours**

Atomic - level simulation and modeling of bio-macromolecules - molecular dynamics – the force field, molecular dynamics methods – Monte Carlo methods, Kinetic Models: Kinetic models of excitable membranes and synaptic interactions - Kinetic models of ion channels–Voltage-dependent Ion channels – Ligand gated synaptic ion channels.

Reference books

1. EddaKlipp, Ralf Herwig**, "Systems Biology in Practice-Concepts, Implementation and Application",** Wiley VCH, I Edition, 2005.
2. Bernhard. Palsson, **"Systems Biology: Properties of reconstructed network",** Cambridge University Press, 2006.
3. Hiroaki Kitano. **"Foundations of Systems Biology".** MIT Press, 20012.
4. James M. Bower, Hamid Bolouri, **"Computational Modeling of Genetic and Biochemical Networks",** MIT Press, 2000.3.
5. Julio Collado- Vides, Ralf Hofestadt, **"Gene Regulation and Metabolism: Postgenomic Computational Approaches"**, MIT Press,2002.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B2ASO302	**HEALTH & HYGIENE**	OE	3	0	0	3	3

Prerequisites/Pre reading for the course:

The student should be familiar with the 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 microbial diseases and their prevention.
4. To understand various genetic disorders and their implication in human health.

Course outcomes

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

1. Describe about the concept of public health importance and objectives of different healthcare systems.
2. Describe about the dietary requirements, nutritional deficiency diseases symptoms and diagnosis.
3. Apply knowledge about role of nutrition and health for disease prevention and diseases caused by various human pathogens.
4. Explain how genetic mutations cause disease in humans and modern prevention methods by gene therapy.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	3	3	2	2	2	2	3	1	3	2	3
CO2	2	3	3	2	2	1	2	1	1	3	2	2
CO3	2	3	3	2	1	1	2	1	1	3	2	2
CO4	2	3	3	2	1	1	2	1	1	3	2	3

Course content

UNIT-I: Social aspects of health **12 hours**

Health Determinants and Standards; Individual health parameters, Determinants of Health, Health status in India: Standards, Relevance to social aspects, Future challenges in public health. Role of agencies; Role of Public, Private and NGO in Health sector. Community Health Concept; Family health history, Lifestyle and Social cultural aspects.

UNIT-II: Nutritional aspects **12 hours**

Human dietary requirements and deficiency diseases; BMR (Basal Metabolic Rate), Daily nutritional requirements. Deficiency diseases (Malnutrition); Types, Symptoms and Diagnosis of nutritional deficiencies: Iron deficiencies (Anemia), Vitamin A deficiencies (Blindness), Vitamin B1 deficiencies (Beriberi), Vitamin B3 deficiencies (Pellagra)

UNIT-III: Microbial diseases and hygienic practices **12 hours**

Microbial diseases and hygienic practices -Introduction to pathology, bacterial disease-typhoid, salmonellosis, TB, cholera, Fungal Disease-Mycoses, Protozoan Disease-Malaria and trypanosomiasis,

Viral diseases-HBV, HIV & rabies General diagnosis, prevention, and treatment of microbial diseases. Concept of antimicrobial resistance and MDR strains

UNIT-IV: Genetic disease and their management **12 hours**

Genetic disease and their management-Gene disorder – sickle cell anemia, haemophilea, Cystic fibrosis and chromosomal disorders-down syndrome, turner's syndrome cru di chat syndromes. Introduction to gene therapy

Reference Books

1. Gordon Edlin and Eric Golanty, **"Health & Wellness"** (10th Edn) Jones & Barlett Publisher. 2010.
2. Mary-Jane Schneider, **"Introduction to Public Health"** (4th Edn,) Jones & Barlett, 2014.
3. Adams MR and Moss MO **"Food Microbiology"** (3rd Edition) RSC publications, UK. 2008.
4. Geofferey Campbell-Platt **"Food Science and Technology",** Willey and Blackwell Publication, UK. 2009.
5. Lightfoot NF and Maier EA **"Microbiological analysis of food and water",** Elsevier Publication, Netherland. 2003.
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 2010.
7. Edward S. Tobias, Michael Connor, Malcolm Ferguson-Smith, **"Essential Medical Genetics Includes Desktop Edition",** 6th Edition. Wiley-Blackwell Publication.2011.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0302	**APPLIED BIOINFORMATICS LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Students should have basic knowledge on biology, statistics, and computer sciences.

Students should know the basic concepts of DNA, RNA and Protein.

Course objectives

1. The basic objectives of the course are enabling the students to understand biological databases and tools.
2. Understanding the biological databases, literature search methods and data formats.
3. Learn the technical skills on sequence analysis and structure prediction of genes and proteins.
4. Provide the student with a strong foundation on biological data structures.

Course outcomes

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

1. Understand the biological databases and retrieve data structures for problem solving.
2. Design and implement the algorithms for DNA, RNA and protein sequence and structure analysis.
3. Analyze and interpret the sequence, structures, and functions to predict the evolutionary relationships.
4. Prediction of gene and protein structures using publicly available biological tools.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2

CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

1. Entrez and Literature Searches; PubMed, PubMed Central
2. SRS of Biological Databases; Nucleotide/ Genome Databases, Protein Sequence databases, structure databases, Protein patterns databases
3. Sequence Analysis; Dot Plot, pairwise sequence alignment: BLAST, PSI-BLAST
4. Multiple Sequence Alignment: Clustal Omega, Tcoffee,
5. Phylogenetic analysis using MEGA Software
6. Gene structure Prediction: Augustus, GeneMarkHMM,
7. Protein motif and domain analysis: MEME/MAST, eMotif, InterproScan, ProSite, ProDom, Pfam
8. Protein structure Prediction: Protparam, SOPMA, GOR, Chou Fasman
9. Tertiary structure prediction & Evaluation: Swiss Modeller, CPH Server, Phyre2.
10. Software's: Bio Edit, Pymol, Chimera, SPDBViewer.

Reference books

1. Edwards David, Stajich Jason, Hansen David, **"Bioinformatics: Tools and Applications",** Springer-Verlag New York. 2009.
2. Jin Xiong, "**Essential Bioinformatics",** Cambridge University Press, 2006.
3. T.R. Sharma, **"Genome Analysis and Bioinformatics: A Practical Approach",** 1st Edition, IK International publishing house Pvt. Ltd. 2009.
4. Cynthia Gibas, Per Jambeck, **"Developing Bioinformatics Computer Skills",** O'Reilly & Associates, 2001.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0304	**BIOSTATISTICS LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Knowledge on basic mathematics

Course objectives

1. To have the basic knowledge of collection and tabulation of data
2. To describe the univariate and bivariate data analysis
3. To understand the concepts of probability
4. To explore the basics of R

Course outcomes

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

1. Tabulate the data and analyses them graphically.
2. Summarize the analysis of univariate and bivariate data
3. Customize the data on the basis of probability

4. Acquire the knowledge of R software in statistical analysis.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

1. Construction of frequency distribution and graphical representation.
2. Measures of central tendency I (Mathematical averages).
3. Measures of central tendency II (Positional averages & Partition values).
4. Measures of dispersion I (Range, QD, MD, SD and CV).
5. Moments, skewness, and kurtosis for a frequency distribution.
6. Correlation and regression for ungrouped data
7. Spearman's rank correlation coefficient.
8. Computation of probabilities using Binomial and Poisson distribution.
9. Computation of probabilities Normal distribution

Reference Books

1. Palanichamy, S. and Manoharan, M., **"Statistical methods for biologist"**, Paramount publications, 2001.
2. Arora P.N and Malhon.P.K., **"Biostatistics",** Himalaya publishing house, Mumbai, 2009
3. Wayne W. Daniel, **"Biostatistics: A Foundation for analysis in the Health Sciences"** 9th Edition, Wiley Publications. 2009.
4. Douglas S. Shafer, Zhiyi Zhang, **"Beginning Statistics",** prince publications, 2012.
5. Robert R. Sakal and F. James Rohlf, **"Introduction to Biostatistics":** Second Edition, Dover Publications. Inc, 2011.
6. S.C. Gupta, and V.K. Kapoor, **"Fundamentals of mathematical Statistics",** S. Chand and Sons, New Delhi, 2002.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0302	**RDBMS LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Knowledge on basic mathematics

Course objectives

1. To present SQL and procedural interfaces to SQL comprehensively
2. To give an introduction to systematic database design approaches covering conceptual
3. Design, logical design, and an overview of physical design.
4. To give a good formal foundation on the relational model of data.

Course outcomes

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

1. Understand, appreciate, and effectively explain the underlying concepts of database technologies.
2. Design and implement a database schema for a given problem-domain, Normalize a database.
3. Populate and query a database using SQL DML/DDL commands.
4. Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	1				1	2	2
CO2	3	2	2	2	2					1	2	3
CO3	3	2	2	2	2					1	2	2
CO4	3	2	2	2	2		1			1	2	2

Course content

1. Draw E-R diagram and convert entities and relationships to relation table for a given scenario.
    a. Two assignments shall be carried out i.e., consider two different scenarios (e.g., Bank, college)
2. Date and Time Functions
3. The STUDENT detail databases have a table with the following attributes. The primary keys are underlined.

   STUDENT (regno: int, name: string, dob, date, marks: int)

i. Create the above table.
ii. Remove the existing attributes from the table.
iii. Change the data type of regno from integer to string.
iv. Add a new attribute phone no to the existing table.
v. Enter five tuples into the table.
vi. Display all the tuples in student table.

4. A LIBRARY database has a table with the following attributes.

LIBRARY (bookid:int, title: string, author: string, publication: string, yearpub:int, price: real)

i. Create the above table.
ii. Enter the five tuples into the table
iii. Display all the tuples in student table.
iv. Display the different publishers from the list.
v. Arrange the tuples in the alphabetical order of the book titles.
vi. List the details of all the books whose price ranges between Rs. 100 and Rs. 300

5. The SALARY database of an organization has a table with the following attributes.

EMPSALARY (empcode:int, empname: string, dob: date, department: string, salary: real)

i) Create the above table.

ii) Enter the five tuples into the table

iii) Display all the number of employees working in each department.

iv) Find the sum of the salaries of all employees.

v) Find the sum and average of the salaries of employees of a particular department.

vi) Find the least and highest salaries that an employee draws.

6. Consider the following DATABASE OF STUDENTS ENROLLMENT in courses and books adopted for each course. (ER-Diagram).

STUDENT (regno: string, name: string, branch: string, bdate: date)

COURSE (course-no: int, cname: string, dept: string)

ENROLL (reg-no: string, course-no: int, sem: int, marks: int)

BOOK-ADOPTION (course-no: int, sem: int, book-isbn: int)

TEXT (book-isbn: int, book-title: string, publisher: string, author: string)

i) Create the above tables by properly specifying the primary keys and the foreign keys

ii) Enter at least five tuples for each relation.

iii) Demonstrate how you add a new textbook to the database and make this book be adopted by some department.

iv) Produce a list of textbooks (include Course-no, book-isbn, book-title) in the alphabetical order for courses offered by the 'Compute Science' department that use more than two books.

v) List any department that has all its adopted books published by a specific publisher.

7. The following tables are maintained by a Book Dealer

AUTHOR (author-id: int, name: string, city: string, country: string)

PUBLISHER (publisher-id: int name: string, city: string, country: string)

CATLOG (book-id: int, title: string,author-id:int, publisher-id:int, category:int, year:int, price: int)

CATEGORY (category-id: int, description: string)

ORDER-DETAILS (order-no: int, book-id: int, quantity: int)

i) Create above tables by properly specifying the primary keys and the foreign keys.

ii) Enter atleast five tuples for each relation.

iii) Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2010.

iv) Find the author of the book which has maximum sales.

v) Demonstrate how to increase price of books published by specific publisher by 10%

8. Consider the following DATABASE FOR ORDER PROCEESING.

CUSTOMER (cust-no: int, cname: string, city: string)

ORDER (orderno: int, odate: date, ord-amt: real)

ORDER_ITEM (orderno: int, itemno:int, qty: int)

ITEM (itemno: int, UNITprice: real)

SHIPMENT (orderno: int, warehouseno: int, ship-date: date)

WAREHOUSE (warehouseno: int, city: string)

i) Create the above tables by properly specifying the primary keys and the foreign keys

ii) Enter at least five tuples for each relation.

iii) List the order number and ship date for all orders shipped from particular warehouse.

iv) Produce a listing: customer name, no of orders, average order amount

v) List the orders that were not shipped within 30 days of ordering.

Reference books

1. Remez Elmasri and Shamkant B. Navathe, **"Fundamentals of Database Systems",** 5th Edition, Pearson Education, 2007.
2. Abrahamsi. Silberschatz, Henry. F. Korth, S. Sudarshan, **"Database System Concepts"** 6th Edition, McGraw Hill, 2012.
3. J.A. Hoffer, V. Rames & H. Topi, **"Modern Database Management"** Pearson. 2012.
4. Silberschatz, Korth & Sudarshan, **"Database System Concepts"** McGraw Hill. 2014.
5. Krishna P. Radha, Das Gupta Pranab Kumar, **"Database Management System Oracle SQL And PL/SQL"** Prentice-Hall of India Pvt. Ltd, 2013.

FOURTH SEMESTER

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHK401	**LANGUAGE-IV: KANNADA-IV**	HC	1	1	0	2	3

Prerequisites/Pre reading for the course:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨ sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨ sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÅå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, z sÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.
4. ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨sÁªÀ ªÀÄvÀÄÛ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	0	0	0	3	0	0
CO2	0	0	0	0	2	3	0	0	0	3	0	0
CO3	0	0	0	0	0	3	0	0	0	3	0	0
CO4	0	0	0	0	0	0	3	2	0	3	0	0

Course content

Unit-I: £ÀªÀå-¹ÛçÃªÁ¢ PÀ«vÉUÀ¼ÀÄ
7 hours

1. §Ä¢ÞªÀAvÀjUÉ PÀ£À¸ÀÄ ©zÀÝgÉ J. PÉ. gÁªÀÄ£ÀÄd£ï
2. PÀÄjUÀ¼ÀÄ ¸Ágï PÀÄjUÀ¼ÀÄ PÉ. J¸ï.¤¸Ágï CºÀªÀÄzï
3. CPÀÌ ºÉÃ½zÀÄÝ ¸À. GµÁ

Unit-II: zÀ°vÀ-§AqÁAiÀÄ **7 hours**

1. £À£Àß PÀªÀ£ÀUÀ¼À°è ºÀÄqÀÄPÀ¢gÀÄ £À£Àß ZÀA¥Á
2. zÀ°vÀgÀÄ §gÀÄªÀgÀÄ zÁj©r ¹zÀÞ°AUÀAiÀÄå
3. PÀlÖqÀzÀ PÉ®¸ÀUÁgÀgÀÄ JZï J¸ï ²ªÀ¥ÀæPÁ±À

Unit-III: ¯ÉÃR£ÀUÀ¼ÀÄ **6 hours**

1. ºÀ¹gÀÄ ºÉÆ¸ÀPÀÄªÀ UÀtÂUÀ¼ÀÄ AiÀÄ® è¥Àà gÉrØ
2. eÁUÀwÃPÀgÀtzÀ »£Éß¯ÉAiÀÄ°è UÁA¢üÃfAiÀÄ ¥Àæ¸ÀÄÛvÀvÉ ¹. £ÁUÀtÚ
3. ZÁªÁðPÀgÀÄ: MAzÀÄ n¥ÀàtÂ ¦ J£ï gÀAUÀ£ï

Unit-IV: PÁzÀA§j **6 hours**

1. ¸ÀA¸ÁÌgÀ (DAiÀÄÝ¨sÁUÀ) AiÀÄÄ.Dgï. C£ÀAvÀªÀÄÆwð

Reference Books:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÅå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÅå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÅå ¸ÀA¸Àløw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÅå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
4. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÅå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016

5. zÉÃ±À¥ÁAqÉ J¸ï.J¯ï., ¨ÉÃAzÉæ ±ÀjÃ¥ sÀgÀ PÁªÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
6. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, z sÁgÀªÁqÀ. 2009
7. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
8. ¸ÀA. qÁ! ¹. Dgï. ZÀAzÀæ±ÉÃRgï, ªÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨É¼É¹PÉÆ¼ÀÄîªÀÅzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀªÀPÀ£ÁðlPÀ ¥À© èPÉÃµÀ£ï ì ¥ÉæöÊªÉmï°«ÄmÉqï. 2010
9. Dz sÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨ sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
10. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 201

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHH401	**LANGUAGE-IV: HINDI-IV**	HC	1	1	0	2	3

Prerequisites/Pre reading for the course: पूर्वापेक्षा:

- अध्येता को,हिन्दी खंडकाव्य का संक्षिप्त ज्ञान आवश्यक है |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |

Pedagogy: सिक्षशास्त्र:

1. Direct method
2. ICT and Digital support
3. Collaborative and Cooperative learning
4. Flipped Classroom

Course objectives: पाठ्यक्रम उद्देश्य:

- संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
- साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
- छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
- अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course outcomes: अधिगम परिणाम:

अध्ययन की समाप्ति पर अध्येता –

- सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |
- साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |
- समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करसकता है |

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	2	3	2	0	0	3	0	0
CO2	0	0	0	0	2	2	3	0	0	3	0	0
CO3	0	0	0	0	3	3	3	0	0	3	0	0
CO4	0	0	0	0	3	2	3	0	0	0	0	0

Course Content: अध्ययन विषय सूची / पाठ्यक्रम

इकाई –1: खंड-काव्य – नहुष – मैथिलीशरण गुप्त **7 hours**

1. कवि परिचय
2. काव्य परिचय
3. शची सर्ग
4. नहुष सर्ग

इकाई –2:खंड-काव्य – नहुष – मैथिलीशरण गुप्त **7 hours**

1. उर्वशी सर्ग
2. स्वर्गभोग सर्ग

इकाई –3: खंड-काव्य – नहुष – मैथिलीशरण गुप्त **6 hours**

1. सन्देश सर्ग
2. मंत्रणा सर्ग
3. पतन सर्ग

इकाई –4: सिनिमा रिव्यू **6 hours**

1. **सूपर 30, मिशन मंगल, थप्पड़,आर्टिकल 15**

सूचना : प्रत्येक इकाई 25 अंक के लिए निर्धारित है |

d) Suggested Textbooks and References

1. खंड-काव्य – नहुष – मैथिलीशरण गुप्त
2. रस – छंद – अलंकर - कृष्णदेव शर्मा & सुरेश अग्रवाल
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. मीडिया विमर्श – रामशरण जोशी

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21AHA401	**LANGUAGE-IV: ADDITIONAL**	HC	1	1	0	2	3

	ENGLISH-IV						

Prerequisites/Pre reading for the course:

The student must possess fair knowledge of language, literature, culture and society.

Course objectives:

1. To infer the myths from the contemporary perspective.
2. To outline the idea of family represented in literature.
3. To interpret horror and suspense as a genre of literature.
4. To assess the impact of education in building a society.

Course outcomes:

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

1. Examine the relevance of myths and mythology.
2. Demonstrate family values and ethics essential to live in the society.
3. Analyze horror and suspense as a significant genre of literature.
4. Evaluate the applicability of academic contribution in building a society.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	0	0	0	0	3	3	3	2	0	3	0	0
CO2	0	0	0	0	3	3	3	3	0	3	0	0
CO3	0	0	0	0	3	3	3	2	0	3	0	0
CO4	0	0	0	0	3	3	3	3	0	0	0	0

Course Content:

Unit-I: Myths & Mythology **6 hours**

1. John W. May – Narcissus
2. W.B. Yeats – The Second Coming
3. Devdutt Pattanaik - Shikhandi and the Other Stories They Don't Tell you (Extracts)

Unit-II: Family & Relationships **6 hours**

1. Nissim Ezekiel – Night of the Scorpion
2. Langston Hughes – Mother to Son
3. Kate Chopin – The Story of an Hour
4. Henrik Ibsen – A Doll's House (Extract)

Unit-III: Horror & Suspense **7 hours**

1. Edgar Allan Poe – The Raven
2. Bram Stoker – A Dream of Red Hands
3. Satyajit Ray – Adventures of Feluda (Extract)

Unit-IV: Education **7 hours**

1. The Dalai Lama – The Paradox of Our Times
2. Kamala Wijeratne – To a student
3. Sudha Murthy – In Sahyadri Hills, a Lesson in Humility
4. Frigyes Karinthy – Refund

Reference Books:

1. Finneran, Richard J. The Collected Works of W.B. Yeats (Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.
2. Pattanaik, Devdutt. Shikhandi: And Other 'Queer' Tales They Don't Tell You. Penguin Books, 2014.
3. Ezekiel, Nissim. Collected Poems (With A New Introduction By John Thieme). OUP, 2005.
4. Hughes, Langston. The Collected Poems of Langston Hughes. Vintage, 1995.
5. Chopin, Kate. The Awakening and Selected Stories of Kate Chopin. Simon & Schuster, 2004.
6. Ibsen, Henrik. A Doll's House. Maple Press, 2011.
7. Poe, Edgar Allan. The Complete Poetry of Edgar Allan Poe. Penguin USA, 2008.
8. Stoker, Bram. Dracula. Fingerprint Publishing, 2013.
9. Ray, Satyajit. The Complete Adventures of Feluda (Vol. 2). Penguin Books Ltd., 2015.
10. Lama, Dalai. Freedom In Exile: The Autobiography of the Dalai Lama of Tibet. Little, Brown Book Group, 1998.
11. Murthy, Sudha. Wise and Otherwise: A Salute to Life. Penguin India, 2006.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0401	**BIOPERL & BIOPYTHON**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should know the basic concepts of C- programming, structures, scalars, conditional statements and loops.

Course objectives:

1. Understand the concepts of PERL and python programs.
2. Learn the fundamentals of scalar variables, conditional statements, File I/O
3. Develop and apply the Perl and Python programming languages in biological data interpretation
4. Analyze the algorithms in developing the bio-tools and software's.

Course outcomes:

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

1. Understand Perl and Python program.
2. Apply the tools and software's in bioinformatics data.
3. Formulate stepwise implementation of a script (from developing a pseudo-code to execute a successful bug-free code) for a given problem in Bioinformatics.
4. Develop and implement tools and software's for biological data analysis.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

Unit-I: Data Structure **12 hours**

Command interpretation, Commands, Scalar strings, numbers and Variables, Assignments, Scalar Operations and Functions, Statements and Blocks, Array Variables, Literal Representation of Array, Array Operations and Functions, Scalar and List Context, Hash Variables, Literal Representation of a Hash, Hash Functions, Using Hashes for the Genetic Code, Gene Expression Data Using Hashes, operator precedence, Basic operators, Arithmetic operators, bitwise operators, string operators, File test operators, Conditionals and logical operators: True and false, Logical operators, binding operators, loops, Input/output (I/O).

Unit-II: Modular Programming **12 hours**

Subroutines, Advantage of Subroutines, Scoping and Subroutines, Arguments, Passing Data to Subroutines, Modules and Libraries of Subroutines, Concept about File handle, Opening and Closing a File handle, Opening and Closing a Directory Handle, Reading a Directory Handle, File and Directory Manipulation, Perl Debugger, Regular Expression and Pattern Matching: Concepts about Regular Expressions, Simple uses of Regular Expressions, Patterns, Matching Operator, Substitutions, Split and Join functions.

Unit-III: Bioperl **12 hours**

Introduction to Bioperl, Installing procedures, Architectures, General Bioperl Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Features and Location Classes (Extracting CDS), Alignments (AlignIO), Analysis (Blast, GenScan), Databases (Database Classes, Accessing a local database), Implementing REBASE, Sequences and strings, representing sequence data, concatenating, transcription, calculating the reverse complementing in Perl, motifs and loops, mutations and randomization, genetic code.

Unit-IV: Biopython **12 hours**

Basics on Biopython, installing Biopython, writing python programming, python values and variables, working with sequences, parsing sequence file formats, connecting with biological databases, sequence objectives, sequence input/output, Accessing NCBI's Entrez databases.

Reference books

1. Michael Moorhouse, Paul Barry., **"Bioinformatics, Biocomputing, and Perl: An Introduction to Bioinformatics Computing Skills and Practice".** 1st edition, Wiley, John & Sons, Incorporated. 2004.
2. James D. Tisdall., **"Mastering Perl for Bioinformatics**", O'Reilly & Associates, 2003.
3. Rex A. Dwyer., **"Genomic PERL: From Bioinformatics Basics to Working Code",** Cambridge University Press, 2002.
4. James D. Tisdall., **"Beginning Perl for Bioinformatics",** O'Reilly & Associates, 2001.
5. Jeff Chang, Brad Chapman, Iddo Friedberg, Thomas Hamelryck, **"Biopython Tutorial and Cookbook",** O'Reilly & Associates. 2018.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.

B21ST0403	**STATISTICAL INFERENCE**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should know the basic concepts of statistics and excel sheet.

Course objectives

1. To introduce students about basic concepts of Biostatistics including sampling Distributions
2. To study the concepts of Different Distribution functions
3. To study the concepts of hypothesis testing
4. To introduce the basic concepts of non-parametric methods

Course outcomes:

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

1. Study the concept of estimation theory and apply to the biological problems.
2. Apply the concepts of sampling methods and hypothesis testing to Solve mathematically and interpret simple biological problems.
3. Apply the parametric tests for decision making problems.
4. Apply the parametric methods for decision making problems.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

UNIT-I **12 hours**

Concept and definition of population, sample, random sample, parameter and statistic, sampling distribution of a statistic, standard error of statistic, sampling distribution of sample mean and variance, standard errors of sample mean, sample variance and sample proportion. Sampling distributions: t, F and chi-square distributions: Definition, properties and applications. Estimation-introduction, estimator and estimate, properties of estimators: unbiasedness, consistency, efficiency, Sufficiency, mean square error (MSE), Cramer-Rao lower bound, Minimum variance unbiased estimator, relative efficiency of an estimator

UNIT-II **12 hours**

Methods of estimation: Method of moments, method of MLE, properties of MLE (statements only), method of minimum chi-square, linkage estimation. Interval estimation: Confidence interval, confidence coefficient, shortest confidence interval. Method of constructing confidence intervals using pivotal quantity. Construction of confidence intervals for mean, difference of two means, variance and ratio of variances, proportion, difference of two proportions, and correlation coefficient.

UNIT-III **12 hours**

Hypothesis Testing – Introduction – General Concepts –null and alternative hypothesis One-sided, two-sided alternatives, Type I and type II errors, level of significance, p-value, critical region, Sample size determination. Lage sample tests: test for single mean, difference between means, single proportion, difference between proportions. Small sample tests: test for single mean, difference between mean, paired t-test. test for variance, test for correlation coefficient.

UNIT-IV **12 hours**

Non-Parametric Tests: Introduction, Sign test, Wilcoxon signed- rank test and Mann-Whitney test, run test, median test, chi-square test: goodness of fit, independence of attributes. Test for normality.

Recommended Books:

1. Sheldon Ross, **"A first course in probability",** 6th edition, Pearson education Asia, 2002.
2. Goon Gupta, Das Gupta, **"Fundamentals of Statistics",** 7th ed., Wiley Publishers, 2016.
3. J. P. S. S. Sundar, Richard, **"Introduction to Biostatistics and Research Methods Paperback"** PHI Learning Private Ltd, 2012.
4. S.C. Gupta, and V.K. Kapoor, **"Fundamentals of mathematical Statistics",** S. Chand and Sons Publishers, New Delhi, 2002

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0401	**UNIX AND SHELL PROGRAMMING**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Learn to use the Linux shell to achieve basic commands and simple shell scripting. Shell scripting allows the automation of collections of shell commands. Throughout the course, you will gain practical experience using the commands as you encounter them. Exercise the skills you have learnt by writing simple shell scripts.

Course objectives

1. Learn basic commands to interact with UNIX System and VI editor.
2. Understand the history, origin, features and architecture of UNIX Operating System.
3. The usage of various commands in UNIX environment and develop the ability to evaluate regular expressions and use them for pattern matching.
4. Apply essential facets of SHELL programming in order to solve the SHELL script problems.

Course outcomes:

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

1. Describe history, origin, feature, and architecture of UNIX operating system.
2. Interact with UNIX system easily.
3. Construct and edit files, search for any patterns using regular expressions.
4. Solve complex jobs using tools and utilities available in UNIX. Design and develop various tasks by using Shell scripting.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	2			1	1	2
CO2	3	2	2	2	2	2	2			1	1	3
CO3	3	2	2	2	2	2	2			1	1	2
CO4	3	2	2	2	2	2	2			1	1	2

Course content

UNIT-I: Introduction **12 hours**

Introduction, History, Architecture, General Purpose Utilities: cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, bc. Introduction to Shell Scripting, Shell Scripts, read, Command Line Arguments, Exit Status of a Command, The Logical Operators, exit, if, and case conditions, expr, sleep and wait, while, until, for, redirection, set and shift, trap.

UNIT-II: File System **12 hours**

The File, Home Directory, Parent Child Relationship, Checking Current Working Directory, Making Directories, Removing Directories, Listing Directory Contents. Absolute path names, Relative path names. The UNIX file system. Basic File Attributes: Is options, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, changing ownership and group, hard link, symbolic link, umask, find.

UNIT-III: Simple Filters and Awk **12 hours**

Pr, head, tail, cut, paste, sort, uniq, tr commands, Filters using Regular Expression: grep, egrep, fgrep, sed instruction, Line Addressing, Inserting and Changing Text, Context addressing, writing selected lines to a file, the– f option, Substitution, Awk-Advanced Filters: Simple awk Filtering, splitting a Line into Fields, printf, the Logical and Relational Operators, The –f option, BEGIN and END positional Parameters,

UNIT-IV: Process and System Administration **12 hours**

Process basics: ps: process status, system processes (-e or –a), mechanism of process creation, process states and zombies, running jobs in background, job execution, job control. nice, at and batch, cron, time commands, Essential System Administration root, administrator's privileges, startup & shutdown, managing disk space, cpio, tar.

Reference books

1. Sumitabha Das: **"UNIX – Concepts and Applications",** (Chapters 1,2,4,6-9,11-14,17,19), Tata McGraw Hill, Noida, 4th Edition, 15th Reprint, 2011.
2. Behrouz A. Ferouzan and Richard F. Gilberg: **"UNIX and Shell programming",** Cengage Learning, India, 1st Edition, 2005.
3. M G Venkatesh Murthy: **"UNIX and Shell programming",** Pearson Education, Delhi, 1st Edition, 2005.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21STS411	**INDUSTRIAL STATISTICS**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should have knowledge on basic statistics, R programming and excel sheet.

Course objectives

1. To blueprint the protocol used in SQC
2. To optimize the control charts for variables and attributes
3. To diagnose the sampling plans for product control.
4. To analyze the statistical methods to understand the industrial applications.

Course outcomes:

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

1. Diagram the protocol of control charts in quality check
2. Constructing control charts for mean, range and Standard deviation
3. Applying the concept of Attribute control charts in industry
4. Outline the single and double sampling plans for product control.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

UNIT-I: Basics of SQC **12 hours**

Introduction to statistical quality control (SQC), aims and objectives. Chance and assignable causes of variation. Process control and product control. Control charts and basis for their construction. Action and warning limits. Various tools of SQC. Rational subgroups.

UNIT-II: Control charts for variables **12 hours**

Derivation of control limits, basis, construction and interpretation of mean, range and standard deviation charts. Criteria for detecting lack of control.

UNIT-III: Control charts for attributes **12 hours**

Control charts for attributes: np-chart, p-chart, stabilized p-chart, c-chart and u-chart. Criteria for detecting lack of control.

UNIT-IV: Product control **12 hours**

Product control: Lot acceptance sampling- Sampling inspection, 100 percent inspection and rectifying inspection. AQL, LTPD, Producer's risk and consumer's risk. Acceptance sampling plans – single and double sampling plans by attributes- Derivation of OC, AOQ, ASN, and ATI, functions.

Reference books

1. Montgomery, D.C. **"Introduction to Statistical Quality Control"**, (Wiley Int. Edn.), 2013.

2. Sheldon Ross, **'A first course in probability'**, 6th edition, Pearson education Asia, 2002.
3. Mahajan, M. **"Statistical Quality Control",** Dhanpat Rai & Co. (P) Ltd. New Delhi. 2001.
4. Douglas C. Montgomery, **"Introduction to Statistical Quality Control",** 8th Edition, Wiley publication, 2019.
5. S.C. Gupta, and V.K. Kapoor**, "Fundamentals of mathematical Statistics",** S. Chand and Sons, New Delhi, 2002
6. Goon Gupta, Das Gupta, **"Fundamentals of Statistics",** 7th ed., Wiley Publications, 2016
7. Mukhopadhyay, P. **"Mathematical Statistics"**, Books and Allied (P) Ltd., Kolkata. 2015.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21STS412	**SAMPLING METHODS & OFFICIAL STATISTICS**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should have knowledge on basic statistics, R programming and excel sheet.

Course objectives

1. To learn the basic concepts of sample survey and it's need.
2. To familiarize with various tools and techniques of sampling
3. To learn to design and conduct statistical surveys.
4. To obtain estimator of the population parameter on the basis of selected sample and study its properties.

Course outcomes:

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

1. Demonstrate the understanding of the basic concepts of sample survey.
2. Collect data using statistical survey, analyze and interpret the results.
3. Apply the knowledge of various tools and techniques of sampling in real life.
4. Obtain estimator of the population parameter on the basis of selected sample and study its properties.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	2	2	1	1	1				1	2	2
CO2	2	2	2	1	2					1	2	3
CO3	2	2	2	1	2					1	2	2
CO4	2	2	2	1	2		1			1	2	2

Course content

Unit-I: Introduction to sampling theory **12 hours**

Introduction to sampling theory: Concepts of population and sample. Need for sampling, complete enumeration Vs sample surveys. Principal steps in a sample survey. Planning, execution, analysis and reporting stages. Requisites of a good questionnaire. Drafting of questionnaires and schedules and their

pre-test. Pilot surveys. Sampling and non-sampling errors. Types of sampling: non-probability and probability sampling. Methods of drawing random samples-Lottery method and table of random numbers.

Unit-II: Simple random sampling **12 hours**

Simple random sampling: simple random sampling with and without replacement, definition, and procedure of selecting a sample, estimates of population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination. Advantages and limitations of SRS.

Unit-III: Stratified random sampling **12 hours**

Stratified random sampling: Need for stratification, definition, estimates of population mean and total, variances of these estimates, proportional and optimum allocations, and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision.

Unit-IV: Systematic sampling **12 hours**

Systematic sampling: Linear systematic sampling, its advantages, and limitations. Estimation of mean, total and variance of the estimators. Comparison with SRS and St.R. S. Circular systematic sampling. An outline of present official statistical system in India, Methods of collection of official statistics, their reliability, and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), Registered General Office and National Statistical Commission. Government of India's Principal publications containing data on the topics such as Agriculture, price, population, industry, finance, and employment.

Reference books

1. Douglas C. Montgomery, **"Introduction to Statistical Quality Control",** 8th Edition, Wiley publication, 2019.
2. Cochran. G. **"Sampling Techniques"**. 3/e, John Wiley and Sons, New York. 2007.
3. Mohammed A. Shayib, **"Applied Statistics"** Osram Sylvania Publications, 2015.
4. Des Raj and Chandok, P**. "Sampling Theory",** Narosa, New Delhi. 2006.
5. Mukhopadhyay, P. **"Mathematical Statistics"**, Books and Allied (P) Ltd., Kolkata. 2015.
6. Sampath, S. **"Sampling Theory and Methods"**, 2/e, Narosa, New Delhi. 2006.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0402	**BIOPERL & BIOPYTHON LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

The students should know the basic concepts of c programming, structures, scalars, conditional statements and loops.

Course objectives

1. Understand the concepts of PERL and python programs.
2. Learn the fundamentals of scalar variables, conditional statements, File I/O.

3. Develop and apply, Perl and Python programming languages in biological data interpretation.
4. Analyze the algorithms in developing the bio-tools and software's.

Course outcomes:

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

1. Work on Perl programming.
2. Create a new algorithm to understand and access the sequences.
3. Develop the program to predict the genetic code table, to convert DNA to Protein.
4. Understand the python scripts to develop program to access and analyze DNA, RNA and Protein sequences.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course content

1. Programming to store a DNA sequences
2. Concatenation of Sequences, Reverse complement of DNA strand
3. Transcription: DNA to RNA, Mutate DNA,
4. Reading protein sequences data from a file (4 experiments), searching for motifs (2 Experiments), Generate random DNA,
5. Determining frequency of nucleotides, Genetic Code.
6. Subroutine to append ACGT to DNA, Counting the G's in some DNA on the command line, Subroutines: Pass by value, Pass by reference, Calculate average % identity between pairs of random DNA sequences.
7. Concatenating and adding sequences, nucleotides, and reverse complements
8. Transcription, Translation using Python programming
9. Parsing GenBank records from the databases.

Reference books

1. James Tisdall, **"Mastering Perl for bioinformatics",** O'Reilly & Associates, Inc. 2003
2. James Tisdall, **"Beginning Perl for Bioinformatics: An introduction to Perl for biologists".** O'Reilly 2001.
3. Richard L. Halterman., **Learning to Program with Python,** O'Reilly, 2011.
4. Jeff Chang, Brad Chapman, Iddo Friedberg and Thoma, **"Biopython Tutorial and Cookbook"**, O'Reilly 2015.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0404	**BIOSTATISTICS INFERENCE LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

The students should know the basic concepts of c programming, structures, scalars, conditional statements, and loops.

Course objectives

1. To characterize the sampling distributions
2. To classify the different techniques of point estimation for estimating the parameter values
3. To describe the small sample and large sample test
4. To study non-parametric methods.

Course outcomes:

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

1. Define the sampling distributions
2. Differentiate the different techniques of point estimation for estimating the parameter values
3. Construction of test procedure for large and small samples
4. Construction of test procedure for nonparametric methods.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1	1				1	1	3
CO3	3	2	2	1	1	1				1	1	2
CO4	3	2	2	1	1	1	1			1	1	2

Course content

1. Generating random samples from discrete and continuous distributions (estimating parameters).
2. Drawing SRSWR, SRSWOR and Systematic sampling (using Excel and R)
3. Constructing confidence intervals based on small and large samples.
4. Test for mean, difference between means, proportion, and difference between proportions for large samples.
5. Tests for small samples.
6. Test for variance and correlation coefficient
7. Chi-square test (goodness of fit and independent of attributes)
8. Nonparametric test I
9. Nonparametric test II

Recommended Books:

1. Robert Hogg, Elliot Tanis, Dale Zimmerman, **"Probability and Statistical Inference"** 9th Edition, Pearson Publications, 2015.
2. Sheldon Ross, **"A first course in probability",** 6th edition, Pearson education Asia, 2002.
3. Wayne W. Daniel. **"Biostatistics: A Foundation for analysis in the health sciences"** Willy Publishing house. 2000,

Course code	Course Title	HC/	L	T	P	C	Hrs./

		SC/ OE					Wk.
B21CP0402	**UNIX & SHELL PROGRAMMING LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Learn to use the Linux shell to achieve basic commands and simple shell scripting. Shell scripting allows the automation of collections of shell commands. Throughout the course, you will gain practical experience using the commands as you encounter them. Exercise the skills you have learnt by writing simple shell scripts.

Course objectives

1. learn editors available in UNIX and the detailed working on the most Vi editor to implement shell programming, wild cards and how to write simple shell programs, introduce concepts of decision control, looping, nested looping and control flow clauses in shell programming.
2. Learn command structure of UNIX, various types of commands and familiarize students with some general commands.
3. Directory and file related commands, filters.
4. Process related and user communication related commands in UNIX.

Course outcomes:

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

1. Understand the basic commands of Linux operating system and can write shell scripts
2. Create file systems and directories and operate them
3. Describe and apply various command line utilities
4. Work with the file System and Write shell scripts

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course content

1. Use of Basic UNIX Shell Commands: ls, mkdir, rmdir, cd, cat, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit
2. Write a shell script to generate and print the GCD and LCM of two integers.
3. To print all prime numbers between m and n (m<n).
4. Reverse a given number and check whether it is palindrome or not.
5. Shell script to find maximum and minimum of given set
6. To count the number of vowels in each string.
7. To check whether a given string is a palindrome or not.
8. Write a menu driven program to calculate (i) Simple interest (ii) Compound interest
9. Write a shell script to count lines, words, and characters in its input (do not use wc).
10. Shell script to display all the file permissions.

Recommended Books:

1. Sumitabha Das, **"UNIX – Concepts and Applications",** (Chapters 1,2,4,6-9,11-14,17,19), Tata McGraw Hill, Noida, 4th Edition, 15th Reprint, 2011.
2. Behrouz A. Forouzan and Richard F. Gilberg: **"UNIX and Shell programming",** Cengage Learning, India, 1st Edition, 2005.
3. M G Venkatesh Murthy: **"UNIX and Shell programming",** Pearson Education, Delhi, 1st Edition, 2005.

FIFTH SEMESTER

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0501	**COMPUTATIONAL DRUG DISCOVERY**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should have familiar with the knowledge of basics in chemistry and computational Biology.

Course objectives:

1. Learn the basic concepts of computer based chemical design and drug discovery pipelines.
2. Learn the techniques to identify the disease and predict the targets.
3. Apply and analyses computational methods to predict the protein models and interpret interactions.
4. Explore the challenges in drug discovery and implement using computational methods.

Course outcomes:

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

1. To understand the basic concepts of computational drug design and development.
2. Identify the disease targets and techniques to develop lead compounds.
3. Design and optimize drug active properties and active site prediction for lead binding.
4. Analyze and interpret lead interaction and virtual screening.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

Unit-I: Computer-Aided Drug Design **12 hours**

Drug design overview, reason for failures of drugs, Role of Computers in Drug Design: Their Success and Failure, Rational drug design, factors contributing to drug discovery, Drug discovery process, drug design theory, Advantages and disadvantages of drug designing, Rational Drug Design Software (AutoDock, GOLD, Discovery Studio, Schrödinger, MOE).

Unit-II: Bioinformatic Approaches on target validation **12 hours**

Introduction, Disease target identification, Protein structure prediction, homology modelling, protein-protein interaction, Pharmacokinetics and Pharmacodynamics in Drugs: Pharmacokinetic Parameters,

Pharmacodynamic Parameters, Absorption of Drugs, Distribution of Drugs, Biotransformation/Metabolism, Excretion of Drugs, Pharmacodynamics.

Unit-III: Lead identification & Optimization **12 hours**

Methods and Tools in Computer-aided molecular Design, Analog Based drug design: - Pharmacophore (3D database searching, conformation searches, deriving and using 3D Pharmacophore, constrained systematic search, Genetic Algorithm, clique detection techniques, maximum likelihood method) and QSAR Analysis. Structure based drug design: - Docking, De Novo Drug Design, Virtual screening, Molecular dynamics, and simulation.

Unit-IV: Drug Delivery Systems **12 hours**

Introduction, Development of Sustained-Release Drug Delivery Systems & types, Important Physicochemical Properties of the Drug, Biologic Properties, Safety Considerations, Targeted Delivery Systems, Transdermal Delivery Systems, Choice of Drug, Excipients, Adhesive and Packaging, Pressure-Sensitive Adhesives, In Vitro Release Kinetics, In Vitro Skin-Permeation Kinetics, Optimization of Transdermal Systems, Skin Irritation Sensitization.

Reference books

1. Tari, Leslie W., **"Structure-Based Drug Discovery",** Humana Press, 2012
2. Jhoti, Harren, Leach, Andrew R., **"Structure-based Drug Discovery",** Springer Netherlands., 2007
3. Pandi Veerapandian., **"Structure-Based Drug Design"** 1st Edition., Springer Netherlands., 2012.
4. Mohammed Iftekhar, Shaik Jameel, **"Computational Drug Discovery: Drug Discovery Process & Methods",** Createspace Independent Pub., 2015.
5. D. C. Young., **"Computational Drug Design: A Guide for Computational and Medicinal Chemists".,** 1st edition, Wiley-Interscience; 2009.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0503	**LINEAR MODELS**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should have familiar with the statistics and biostatistics concepts with linear expression models.

Course objectives:

1. To introduce students about basic concepts of Biostatistics including ANOVA, DOE.
2. To study the concepts of Components of time series.
3. To study the concepts of correlation, Regression, and Testing of Hypotheses.
4. To study and understand the time series analysis of the statistical data.

Course outcomes:

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

1. Interpret the Biological Problems using ANOVA and incorporate different methods to solve them.
2. Analyze the data using Designs of experiments.

3. Analyze data using Multiple regression analysis.
4. Carryout analysis of chronological data.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course Content:

UNIT-I **12 hours**

Analysis of variance, one-way and two-way classifications. One way ANOVA – Fixed effect models, testing hypothesis, ANOVA table, Two-way ANOVA fixed effect, mathematical model testing of hypotheses with biological applications

UNIT-II: **12 hours**

Experimental designs: Role, historical perspective, terminology: Treatments, Experimental units & Blocks, Experimental error, Basic principles of Design of Experiments (Fisher). Uniformity trials, fertility contour maps, choice of size and shape of plots and blocks in Agricultural experiments. Uses in Industrial Experiments. Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, relative efficiency. Analysis with one missing observation in RBD and LSD.

UNIT-III: **12 hours**

Multiple correlation and regression analysis examples based on biological data. Regression diagnostics, residual analysis (biological data)

UNIT-IV: **12 hours**

Analysis of time series: components of time series, measurement of trend, seasonal variation, autocorrelation

Reference books:

1. J. Crawshaw and J. Chamber, **"Advanced level Statistics".** 4th edition, Melson Thornes, 2002.
2. S. Dobbs and J. Miller. **"Statistics (Advanced Level Mathematics)",** Cambridge University Press 2002.
3. P.S.S. Sunder Rao and J. Richard, **"Introduction to Biostatistics and Research Methods".** Fourth Edition. Eastern Economic Edition, 2006
4. Wayne W. Daniel, **"Biostatistics: A Foundation for analysis in the health sciences"** 2000.
5. Goon Gupta, Das Gupta, **"Fundamentals of Statistics",** 7th ed., Vol I, Vol II, 1999.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.

B21CP0501	**BASICSC OF WEB PROGRAMMING**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Front-end includes user interaction whereas Back-end involves server-side coding i.e., Data interaction. In Front end Developer most important languages are HTML, CSS, and JavaScript.

Course objectives:

1. Design the web page using HTML, PHP
2. Explain the concept of form handling and Java script.
3. Design a data base related web site.
4. Use PHP and HTML code for file handling and data base connectivity.

Course outcomes:

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

1. Apply a structured approach to identifying needs, interests, and functionality of a website.
2. Gain knowledge on XHTML, JavaScript and other programming tools.
3. Develop website with basic HTML, CSS and PHP, JavaScript programming.
4. Write well-structured, easily maintained, standards-compliant CSS code to present HTML pages in different ways

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1	2				1	1	3
CO3	3	2	2	1	1	2				1	1	2
CO4	3	2	2	1	2	2	1			1	1	2

Course Content:

UNIT-I: Introduction to HTML **12 hours**

HTML Documents - Dividing the document into 2 parts(Headers tags Body tags), Paragraphs, Formatting's, Elements of an HTML Document - Text Elements ,Tag Elements, Special Character elements, Image tags, HTML Table tags, Lists(Numbered list, Non-Numbered lists, Definition lists), Anchor tag, Name tag , Hyperlinks - FTP/HTTP/HTTPS, Links with images and buttons, Links to send email messages, Text fonts and styles, background colors /images, Marquee Behavior, Forms related tags (action, method, name, input, submit etc.), Lab components

UNIT-II: CSS, Form Handling and JavaScript **12 hours**

CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms. Form Handling: Introduction, Creating Forms in HTML, GET and POST, Accessing Form data, $_POST, $_GET, $_REQUEST, Handling the file upload, Saving the uploaded file, Restricting the file type/size, Checking for errors, File inclusion. JavaScript: Introduction JavaScript, HTML DOM, JavaScript Data type, Loops in JavaScript, Functions in JavaScript, Embedding JavaScript in HTML, Lab components

UNIT-III: PHP Basics **12 hours**

Introduction to PHP, Support for Database, PHP Installation, working with PHP, Why PHP?, Basic Syntax of PHP, PHP statement terminator and case insensitivity, Embedding PHP in HTML, Comments, Variables, assigning value to a variable, Constants, Managing Variables. Operators: Arithmetic Operators, Bit-wise Operators, Comparison Operators, Logical Operators, Concatenation Operator, Incrementing/Decrementing Operator, Ternary Operator, Operator Precedence, String Manipulation: strtoupper (), strtolower (), ucfirst (), ucwords (), strcmp (), strlen (), substr (), trim (). Functions: Functions in PHP, User-Defined function, Function Definition, Function Call, Function with arguments, Function with return value, call by value and call by references, understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP

UNIT-IV: Arrays **12 hours**

Introduction to Array, Array in PHP, Creating an Array, Accessing Elements of an Array, Modifying Elements of an Array, Finding the Size of an Array, Printing an Array in the readable way, Iterating Array Elements, Modifying Array while iteration, Iterating Array with Numeric index, Removing Element from an Array, Converting an Array to String, Converting String to an Array, Array Sorting, Multidimensional Array, Accessing elements of a Multidimensional Array, Iterating Multidimensional Array. PHP File Handling: Introduction, File Open, File Creation, writing to files, reading from File, Searching a record from a file, closing a File, Using PHP with HTML Forms.

Reference books

1. Tim Converse, "**PHP Bible"** John Wiley and Sons 2000.
2. Bill McCarthy, **"PHP A beginner's guide"** McGraw-Hill Education; Annotated edition 2001.
3. Luke Welling, "PHP and MySQL Web Development" Addison-Wesley; 5th edition. 2016.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CPS511	**SOFTWARE ENGINEERING**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should have knowledge on C, and C++ Programming, JavaScript.

Course objectives:

1. To provide the knowledge of software engineering discipline.
2. To apply analysis, design & testing principles to software project development.
3. To demonstrate and evaluate real time projects with respect to software engineering principles.
4. Apply testing principles on software project and understand the maintenance concepts.

Course outcomes:

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

1. Understand and demonstrate basic knowledge in software engineering.
2. Identify requirements, analyze, and prepare models.
3. Plan, schedule and track the progress of the projects.
4. Design & develop the software projects, identify risks, manage the change to assure quality in software projects.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	2	2
CO2	3	2	2	1	1					1	3	3
CO3	3	2	2	1	1					1	2	2
CO4	3	2	2	1			1			1	2	2

Course Content:

Unit-1: Software Process Models **12 hours**

Introduction to software engineering, Classification of Software, Software Development Life Cycle- Waterfall Model, Iterative Waterfall Model, Spiral Model, Incremental process Model, Rapid Application Development Model (RAD), Agile Development Model, SCRUM, Extreme Programming.

Unit-2: Software Requirement Analysis and Specification **12 hours**

Software Requirements- Requirements Engineering Process, Classification of Software Requirements, Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modeling, Characteristics of a Good Software, Software Requirement & Specification Document (SRS).

Unit-3: Software Planning & Software Design **12 hours**

Software Project Management (SPM)- Project Management Process, Project size estimation techniques, System Configuration Management (SCM), COCOMO Model, Capability Maturity Model (CMM), Risk Management in SDLC, Role and Responsibility of a Software Project Manager, Software Maintenance. Software Design- Abstraction, Architecture, Patterns, Modularity, Information Hiding, Functional Independence- Cohesion & Coupling, Object Oriented Design- Data Design, Architectural Design, User Interface Design, Component Level Design.

Unit-4: Software Testing & Debugging **12 hours**

Testing Fundamentals- Error, Fault & Failure, Black Box Testing- Equivalence Partitioning, Boundary value Analysis, White Box Testing- Control flow-based Testing, Data flow-based Testing, Testing Strategies- Verification & Validation, Unit Testing, Integration Testing, System Testing, Acceptance Testing, Deriving Test Cases, Alpha and Beta Testing, Regression Testing, Performance Testing, Stress Testing, Debugging.

Reference books

1. R.E. fairly, **"software engineering concepts",** McGraw Hill.1997.
2. Rajib mall **"Fundamentals of software engineering"** 4th edition phi 2014
3. R.S. Pressman, **"Software Engineering" – A Practitioners approach** – McGraw Hill. 2006.
4. Pankaj Jalota: **"An integrated approach to software engineering"** - Narosa. 2009.
5. Prof. S.Parthasathy & Prof. B.W.Khalkar **"System Analysis & Design & Introduction to S/W Engineering".** McGraw Hill. 2001.

Course code	Course Title	HC/	L	T	P	C	Hrs./

		SC/ OE					Wk.
B21CPS512	**CRYPTOGRAPHY & NETWORK SECURITY**	SC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Students should have knowledge on Networks and Security.

Course objectives:

1. To understand basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To understand various protocols for network security to protect against the threats in the networks.

Course outcomes:

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

1. Classify various block ciphers and its usages
2. Design various cryptographic algorithms that used for encryption and decryption purposes
3. Study different techniques used in key exchange protocols
4. Discuss the applications of applied cryptography

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course Content:

Unit-I: Introduction to Cryptography and Block Ciphers 12 hours

Introduction to security attacks - services and mechanism - introduction to cryptography -Conventional Encryption: Conventional encryption model - classical encryption techniques -substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and block ciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion and diffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linear crypt analysis of DES - block cipher modes of operations - triple DES – AES.

Unit-II: Confidentiality and Modular Arithmetic 12 hours

Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.

Unit-III: Public key cryptography and Authentication requirements 12 hours

Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption -

Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.

Unit-IV: IP Security **12 hours**

Overview of IP Security (IPSec); IP Security Architecture; Modes of Operation; Security Associations (SA) – Security Parameter Index (SPI), SA Management, Security Policy; Authentication Header (AH); Encapsulating Security Payload (ESP); Internet Key Exchange. Web Security: Web Security Requirements; Secure Socket Layer (SSL) – SSL Architecture, SSL Protocol; Transport Layer Security (TLS); Secure Electronic Transaction (SET) – Features, Components, Dual Signature.

Reference books

1. William Stallings, **"Cryptography and Network security Principles and Practices",** Pearson/PHI. 2001
2. Wade Trappe, Lawrence C Washington, **"Introduction to Cryptography with coding Theory",** Pearson. 2000
3. W. Mao, **"Modern Cryptography – Theory and Practice",** Pearson Education. 2009
4. Charles P. Pfleeger, Shari Lawrence Pfleeger – **Security in computing** –Prentice Hall of India. 2008

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0502	**COMPUTATIONAL DRUG DISCOVERY LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

The basic knowledge of bioinformatics, Chemoinformatics and biology

Course objectives:

1. Learn the basic concepts of designing chemical structures.
2. Understand and implement physicochemical properties of chemicals
3. Explore the disease target prediction and homology modelling of protein structures.
4. Explore the challenges in drug discovery and implement using computational methods.

Course outcomes:

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

1. Understand and design the chemical structures based on 2D and 3D structures.
2. Analyze and interpret physicochemical properties to predict drug like properties.
3. Analyze and implement drug active properties and drug docking studies.
4. Analyze and interpret virtual screening of compounds and medicinal chemistry.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

1. Disease target identification, protein structure prediction
2. Homology Modelling, Protein structure validation
3. Active site identification
4. Chemical structure design (1D, 2D, 3D) structure prediction
5. Pharmacophore and Pharmacokinetic analysis
6. QSAR and QSPR analysis
7. Molecular Dynamics, Monto Carlo simulation
8. Molecular Docking and Virtual Screening

Reference books

1. Christopher J. Cramer, **"Essentials of Computational Chemistry: Theories and Models",** Wiley, John & Sons, Incorporated, 1st edition, 2002.
2. C. Stan Tsai, **"An Introduction to Computational Biochemistry**"., Wiley, John & Sons, Incorporated 1st Edition, 2002
3. Mohammed Iftekhar, Shaik Jameel, **"Computational Drug Discovery: Drug Discovery Process & Methods",** Createspace Independent Pub., 2015.
4. D. C. Young., **"Computational Drug Design: A Guide for Computational and Medicinal Chemists".,** 1st edition, Wiley-Interscience; 2009.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0504	**SAPLING METHODS & OFFICIAL STATISTICS LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Student should have familiar with the statistics and biostatistics concepts with linear expression models.

Course objectives:

1. To introduce students about basic concepts of Biostatistics including ANOVA, DOE.
2. To study the concepts of Components of time series.
3. To study the concepts of correlation, Regression, and Testing of Hypotheses.
4. To study and understand the time series analysis of the statistical data.

Course outcomes:

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

1. Interpret the Biological Problems using ANOVA and incorporate different methods to solve them.
2. Analyze the data using Designs of experiments.
3. Analyze data using Multiple regression analysis.
4. Carryout analysis of chronological data.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2

CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course Content:

1. Practical Problems one-way classification and two-way classification,
2. Practical Problems based on CRD and RBD.
3. Practical Problems on LSD
4. Practical Problems based on multiple regression I
5. Practical Problems based on multiple regression-II
6. Moving averages method, semi-average method, Graphical method
7. Practical Problems based on measurement of trend by the method of least squares
8. Curve fitting
9. Measurement of seasonal variation
10. Getting data into R and R objects
11. Extracting subsets of data frames by value
12. Sorting data, merging data, and Exporting data
13. Simple functions: tapply, sapply, summary, and table
14. Basic plotting tools
15. Revisiting the plot function
16. Loops
17. Functions and If Statements
18. Analysis of variance
19. Test of Significance

Reference books

1. Robert G, **"R programming in Bioinformatics",** CRC press, Taylor and Francis Group, USA, 2008.
2. Own J, Robert. M, and Andrew R., **"Introduction to Scientific programming and simulation using R"**, CRC Press, Taylor and Francis Group, USA, 2014.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0502	**BASICS OF WEB PROGRAMMING LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Student should have familiar with the statistics and biostatistics concepts with linear expression models.

Course objectives:

1. To develop interactive web pages using HTML, CSS, and image map.
2. To procure the knowledge of information interchange formats like XML.
3. To validate fields of web pages using scripting languages like JavaScript.
4. To develop PHP programs using the concepts.

Course outcomes:

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

1. Apply a structured approach to identifying needs, interests, and functionality of a website.
2. Gain knowledge on XHTML, JavaScript, and other programming tools.
3. Develop website with basic HTML, CSS and PHP, JavaScript programming.
4. Write well-structured, easily maintained, standards-compliant CSS code to present HTML pages in different ways

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	2			1	1	2
CO2	3	2	2	2	2	2	2			1	1	3
CO3	3	2	2	2	2	2	2			1	1	2
CO4	3	2	2	2	2	2	2			1	1	2

Course Content:

PART-A

1. Develop and demonstrate a XHTML document that illustrates the use external style sheet, ordered list, table, borders, padding, color, and the tag.
2. Develop and demonstrate a XHTML file that includes Javascript script for the following:
   i. Input: A number n obtained using prompt
   ii. Output: The first n Fibonacci numbers
3. Develop and demonstrate a XHTML file that includes Javascript script that uses functions for the following:
4. Parameter: A string Output: The position in the string of the left-most vowel
5. Develop and demonstrate, using Javascript script, a XHTML document that collects the USN (the valid format is: A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by two upper-case characters followed by three digits; no embedded spaces allowed) of the user. Event handler must be included for the form element that collects this information to validate the input. Messages in the alert windows must be produced when errors are detected.
6. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.
7. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.
8. Create a XHTML form with Name, Address Line 1, Address Line 2, and E-mail text fields. On submitting, store the values in MySQL table. Retrieve and display the data based on Name.
9. Write a PHP program to check whether a number is positive, negative or zero.

Part-B

1. Create, test, and validate an XHTML document for yourself, including your name, address, and e-mail address. If you are a student, you must include your major and your grade level. If you work, you must include your employer, your employer's address, and your job title. This document must use several headings and , , <hr />, <p>, and
 tags.
2. Create a form for Employee information. Write JavaScript code to find DA, HRA, PF, TAX, Gross pay, Deduction and Net pay.
3. Create a form consists of a two Multiple choice lists and one single choice list

a. The first multiple choice list displays the Major dishes available.
b. The second multiple choice list displays the Starters available.
c. The single choice list displays the soft drinks available.

4. Write a JavaScript code for case conversion
5. Write a program to create chess board in PHP using for loop
6. Write a PHP script to check whether a string contains a specific string?
7. Write a PHP script to calculate and display average temperature, five lowest and highest temperatures.
8. Write a code to:
   a. Set up an html page with a form using which we will upload the file.
   b. Setup a PHP script to upload the file to the server as well as move the file to it's destination.
   c. Inform the user whether the upload was successful or not.

Reference books

1. Tim Converse, **"PHP Bible"** John Wiley and Sons. 2000.
2. Bill McCarthy, **"PHP A beginner's guide"** McGraw-Hill Education; Annotated edition 2016.
3. Luke Welling, **"PHP and MySQL Web Development"** Addison-Wesley; 5th edition (2016).

SIXTH SEMESTER

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0601	**GENOMICS & PROTEOMICS**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should be familiar with the concepts of DNA, RNA and proteins and their specific roles within the cell.

Course objectives:

1. Learn the techniques to identify genes and protein sequences and structures.
2. Introduce the sequencing techniques and gene expression experiments.
3. Analyze the techniques involved for quantifying differential gene/protein expressions.
4. Learn the publicly available tools and software's in genomic data science.

Course outcomes:

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

1. Understand the concepts of genes, genomes, and proteins.
2. Analyze and interpret genes and proteins using various genomic and proteomic techniques.
3. Develop pipelines to understand the gene expression profiles and functional protein expressions.
4. Qualitative and quantitative expression analysis and techniques of various genomic and proteomic data to predict expressions.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1

CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

Unit-I: Introduction to Genomics **12 hours**

Introduction to Genomics, Anatomy of Prokaryotic and Eukaryotic genome, content of genome, Genome size, C-value paradox, Varieties of genome organizations: Chromosomes, organelles, plasmids, Genome sequencing projects, Variations within and between populations, The human genome and medicine: Prevention of diseases, detection and precise diagnosis, discovery, and implementation of effective treatment. Regulation of gene expression, SNPs and Haplotypes, A clinically important haplotype, Mutations, and diseases.

Unit-II: Genome Mapping and Sequencing **12 hours**

Genetic maps, Linkage, Linkage disequilibrium, Chromosome banding pattern maps, High-resolution maps, based directly on DNA sequences, Restriction maps, Genomics in personal identification, Mitochondrial DNA, Gender identification, Physical characteristics of genome, DNA sequencing, Sanger sequencing, Pyro sequencing, Next generation sequencing, HapMap Project, 1000 genome project, and The ENCODE Project: OMIM database, Clinvar database and COSMIC databases. Microarrays and Transcriptomics, Applications of Microarray.

Unit-III: Introduction to Proteomics **12 hours**

Introduction to proteomics, protein nature and types, Protein folding patterns, domains, post-translational modifications, Classification of protein structures: SCOP, CATH, Changes in folding patterns in protein evolution, Protein structure prediction and modelling Relationship between protein structure and function. Separation and analysis of proteins: Polyacrylamide gel electrophoresis (PAGE), Two-dimensional polyacrylamide gel electrophoresis (2D-PAGE), Mass spectrometry for protein and peptide analysis, protein identification by peptide mass fingerprinting, Peptide sequence analysis by Tandem Mass spectrometry, SALSA: Tandem MS data mining specific feature algorithm.

Unit-IV: Protein Profiling and expression analysis **12 hours**

Strategies in medical proteomics, Applications of medical proteomics, proteomics in cancer research, protein sequence databases, protein-protein interaction databases, Technological platforms used in proteomic characterization, Concepts of systems biology, Molecules to pathways, pathways to networks, mathematical representation of cell biological system, network building and analysis, topology to function, Modeling of Biochemical systems.

Reference books

1. Brown T. A, **"Genomes 3"**. Garland Science Publishing, New York. 2007.
2. Dunham, I.. **"Genome Mapping and sequencing".** Horizon Scientific. 2003.
3. Graur, D and W H Li, **"Fundamentals of molecular evolution".** Sinauer Associates. 2000.

4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. **Genetics from Genes to Genomes**. McGraw Hill. 2004.
5. Lewin B. **"Genes VIII".** Oxford University Press. Oxford. 2003.
6. A. Malcolm Campbell and Laurie J. Heyer. **"Discovering Genomics, Proteomics and Bioinformatics"** 2nd edition - Cold Spring Harbor Laboratory Press 2006.
7. Andres Kriete, Roland Eils. **"Computational Systems Biology",** Elsevier Academic Press. 2006.
8. Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, and Ralf Herwig. **"Systems Biology: A Textbook"** Wiley-Vch Publications. 2009.
9. Michael Stumpf, David J. Balding, Mark Girolami. **"Handbook of Statistical Systems Biology".** Wiley Publications. 2011.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21ST0601	**OPERATION RESEARCH**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should be familiar with the concepts of statistics and mathematical models.

Course objectives:

1. To introduce Operation Research
2. To study the concepts of Assignment Problems
3. To study the concepts of Networks.
4. To study the game theorems using mathematical models

Course outcomes:

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

1. Solve mathematically and interpret biologically simple problems using Graphical and simplex Methods.
2. Understand the techniques of solving transportation and assignment problems.
3. Applying Games theory in different competitive situations
4. Solve mathematically simple job sequence models.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course Content:

Unit-I: Introduction **12 hours**

Introduction: origin and development of OR, linear programming problem, mathematical formulation of biological problems, graphical method of solving LPP, standard form of LPP matrix form of LPP, slack and surplus variables, simplex table, simplex algorithm (only for constraints of ≤ type)

Unit-II: Transportation, Assignment Models **12 hours**

Transportation, Assignment Models: Methods of finding initial basic feasible solution to TP by NWCR rule and Vogel's approximation. MODI method of obtaining optimum solution to the TP. Hungarian Method of obtaining optimum solution to Assignment problem.

Unit-III: Game Theory **12 hours**

Game Theory: Meaning and application of games theory in biological sciences. Two-person Zero-sum game, pure strategy and mixed strategy, game with saddle point, game without saddle point, dominance property solution of game with dominance property

Unit-IV: Sequencing problems **12 hours**

Sequencing Problems: Meaning and application of sequencing problems in biological sciences. Johnson's method of processing jobs n jobs through 2 machines, processing n jobs through 3 machines.

Reference books

1. J K Sharma **"Operations Research Theory & Methods",** Vikas Publishing House Pvt. Ltd. 2011.
2. Kanthi Swaroop, Manmohan and P.K. Gupta. **"Operations Research",** Sultan Chand, New Delhi. 2012.
3. Kalavathy, S. **"Operations Research",** Vikas Publishing House Pvt. Ltd. New Delhi. 2004.
4. Chandrasekhara Rao & Shanthi Lata Mishra, **"Operations research"**, Alpha Science International, 2005.
5. Shenoy, G.V., Srivastava, U. K., and Sharma, S.C. **"Operations Research for Management",** New Age International, New Delhi. 2009.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0601	**DATA MINING & DATA WAREHOUSING**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should be familiar with the concepts of statistics and mathematical models.

Course objectives:

1. To understand the scope and importance of Data mining in solving real-world problems.
2. To provide an understanding of the fundamental concepts of data mining and warehousing.
3. To examine the types of data to be mined and apply pre-processing methods on raw data.
4. To understand algorithm and tools of data mining used in real world problems.

Course outcomes:

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

1. Analyze the concept of data warehouse and OLAP.
2. Demonstrate data pre-processing techniques.
3. Apply various Data Mining Techniques.
4. Analyze data mining applications in various field.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	2	2	2	1	1				1	1	2
CO2	3	3	3	3	1					1	1	3
CO3	2	2	2	2	1					1	1	2
CO4	2	2	2	2			1			1	1	2

Course Content:

Unit-I: Data Warehouse and OLAP **12 hours**

Introduction to Data warehouse Data warehouse Characteristics, Data warehouse Architecture and its Components, Extraction Transformation Loading (ETL), ETL Tools. Multidimensional view and Data cube, Introduction to OLAP, OLAP Operations, Difference between (OLTP) and (OLAP), Advantages of Data mining.

Unit-II: Introduction to Data Mining **12 hours**

Introduction to Data Mining: Challenges, Knowledge Discovery in database, Data Mining Tools and Applications, Data Pre-processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

Unit-III: Machine Learning Techniques **12 hours**

Machine Learning Techniques –Types of Machine learning, Supervised Learning: linear and polynomial Regression and Classification using Decision Trees & k-NN, Unsupervised learning: Association, K-Mean Clustering and Reinforcement Learning.

Unit-IV: Applications of Data mining **12 hours**

Introduction, Business Applications Using Data Mining- Financial Data Analysis Retail Industry, Tele Communication Industry, Healthcare applications: Biological Data Analysis, Other Scientific Applications, Intrusion Detection.

Reference books

1. J. Han, M. Kamber, **"Data Mining Concepts and Techniques",** Morgan Kaufmann, 2015
2. M. Kantardzic, **"Data mining: Concepts, models, methods and algorithms,** John Wiley &Sons Inc. 2015.
3. Paulraj Ponnian, **"Data Warehousing Fundamentals",** John Willey. 2005
4. Sam Anahory, Dennis Murray: **"Data Warehousing in the Real World",** Pearson, Tenth Impression,2012.
5. Michael.J. Berry, Gordon.S. Linoff: **"Mastering Data Mining"**, Wiley Edition, second edtion,2012
6. M. Dunham, **"Data Mining: Introductory and Advanced Topics",** Pearson Education. 2012.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BIS611	**MEDICAL INFORMATICS**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Student should have Knowledge on bioinformatics and data mining techniques.

Course objectives:

1. To understand the scope and importance of informatics in medical and healthcare
2. To provide tools, software's and databases used for the medical informatic analysis.
3. To examine and understand the clinical data management and prediction to clinical outputs.
4. To understand algorithm and tools of medical information networks.

Course outcomes:

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

1. Analyze, understand, abstract, and model a specific biomedical problem in terms of their data, information, and knowledge components.
2. Use the analysis to identify and understand the space of possible solutions and generate designs that capture essential aspects of solutions and their components.
3. Implement, evaluate, and refine: Carry out the solution (including obtaining necessary resources and managing projects), evaluate it, and iteratively improve it.
4. Innovate: Create new theories, typologies, frameworks, representations, methods, and processes to address biomedical informatics problems.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

Unit: I **12 hours**

Overview of Medical Informatics: Introduction to Data Science and Biostatistics, Data Management for Clinical Research, current issues in medical informatics, principles of information storage and retrieval, resources for clinical practice.

Unit: II **12 hours**

Managing patient information: mobile medicine, health literacy and consumers, patient education, E-health, refWorks, doing research on medical health, NCBI Databases, Internet search tools, web tools for communication and collaboration, managing patient information, consumer health informatics.

Unit: III **12 hours**

Clinical Research Informatics: Clinical Decision Making, Machine Learning / NLP, Telehealth and Remote Monitoring, Enterprise Data Strategy, HIPAA, Privacy, IRBs, and Ethical Issues, Distributed Research Networks, Population Data and Public Health Informatics, Human Factors in User Interface Design, Quality Improvement Primer,

Unit: IV **12 hours**

Introduction to Medical Networks: Introduction to Medical Network Design & Development, Contemporary Decision-Making Structures, Protocols, Algorithms and Theories, Contemporary Decision-Making Structures, Protocols, Algorithms and Theories.

References

1. Ramona Nelson, Nancy Staggers., **"Health Informatics: An Interprofessional Approach,** Mosby; 2 edition., 2017.

2. Mervat Abdelhak, Sara Grostick, Mary Alice Hanken., **"Health Information - E-Book: Management of a Strategic Resource 5th Edition",** Saunders., 2017.

3. Shortliffe, Edward H., Cimino, James J. **"Biomedical Informatics: Computer Applications in Health Care and Biomedicine"**., springer., 2014.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BIS612	**AI TECHNIQUES IN BIOLOGY**	HC	3	0	0	3	4

Prerequisites/Pre reading for the course:

Knowledge on big data analytics and data mining techniques.

Course objectives:

1. The course aims to understand the AI techniques used to develop AI based tools and software's.
2. It Introduced advanced programming languages based on current industry applications.
3. It also helps to understand the existed tools used to develop different frameworks.
4. To develop algorithms and tools to predict the genomic pipelines using advanced AI techniques.

Course outcomes:

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

1. The students can use python programming to develop AI based tools.
2. Students Can understand the AI based algorithms to develop tools and frameworks.
3. To develop AI based tools to understand genomic data and interpretation of genes and expressions.
4. To develop personalized medicines based on the AI methods.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

Unit-I: Artificial Intelligence **12 hours**

Introduction to AI, AI Basics: concepts, terminologies and workflow, Foundations of AI, History of AI, Agents and Environments, AI Applications, Advantages and disadvantages, Biological Intelligence Vs Artificial Intelligence, Good Behavior: The concept of Rationality, The Nature of Environments, the structure of Agents, Problem Solving Agents, Searching for Solutions, Uniformed search strategies, informed search strategies, Heuristic functions.

Unit-II: Knowledge, reasoning and Planning **12 hours**

Logical Agents: knowledge-based agents, Propositional Logic, Effective propositional model checking, first order logic, representation revisited, syntax and semantics, inference in first order logic, propositional vs. First order inference, Classical planning, Time, schedules and resources, Hierarchical planning, planning, and acting in nondeterministic domains, multiagent planning.

Unit-III: Neural Networks **12 hours**

Neural Networks, Notations, Simple computing elements, network structures, optimal network structures, comparing brains with digital computers, applications of neural networks, Multilayer feed forward networks, back preparation learning, Bayesian methods for learning neural networks, Belief network learning problems, Learning networks with fixed structures, A comparison of belief networks and neural networks.

Unit-IV: Applications of AI Techniques in Biology **12 hours**

Decision trees, Nearest Neighboring, Applications of AI in the Pharmaceutical Industry, AI-driven applications for drug design, lead optimization, and clinical trials, Artificial Intelligence for Biomarker Discovery. Clustering, Secondary Structure prediction, Gene expression study using AI Techniques.

Reference books

1. Shailza Singh, **"Machine Learning and Systems Biology in Genomics and Health"**, Springer Singapore 2022.
2. Bharath Ramsundar, Peter Eastman, Patrick Walters, Vijay Pande, **"Deep Learning for the Life Sciences**", O'Reilly Media, Inc 2019.
3. Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan Mohanty, Xiaobo Zhang, **"Data Analytics in Bioinformatics: A Machine Learning Perspective"** Wiley Online Library, 2021.
4. Altuna Akalin, **"Computational Genomics with R"** Chapman and Hall/CRC, 2020.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0602	**BIOINFORMATICS PROJECT**	HC	0	0	5.5	5.5	8

Bioinformatics Project: Minimum of 12 weeks' duration internship / project should be carried out by the student either in industry or in an R&D organization, including educational institutes with excellent research culture. In case, if a student is unable to secure internship either in industry or in an R&D organization, a project may be carried out within the university. The student is expected to submit a formal report at the end of the project programme. The student shall be awarded the marks for internship based on the (a) presentation and (b) comprehensive viva by the panel of examiners constituted by the school.

Mapping of Course Outcomes with Programme Outcomes

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	3		3							3	2
CO2	2	2	3	3	3	3					2	3

CO3	2	2	3	3	3	3		3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21BI0603	**GENOMICS & PROTEOMICS LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Student should be familiar with the concepts of DNA, RNA and proteins and their specific roles within the cell.

Course objectives:

1. Learn the techniques to identify genes and protein sequences and structures.
2. Introduce the sequencing techniques and gene expression experiments.
3. Analyze the techniques involved for quantifying differential gene/protein expressions.
4. Learn the publicly available tools and software's in genomic data science.

Course outcomes:

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

1. Understand the concepts of genes, genomes, and proteins.
2. Analyze and interpret genes and proteins using various genomic and proteomic techniques.
3. Develop pipelines to understand the gene expression profiles and functional protein expressions.
4. Qualitative and quantitative expression analysis and techniques of various genomic and proteomic data to predict expressions.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	1	2	1	0	1	1	0	0	1	1	1	1
CO2	1	2	1	1	0	3	3	2	3	3	1	2
CO3	2	3	1	1	1	3	3	3	3	3	2	2
CO4	2	3	2	2	2	3	3	3	2	2	1	2

Course Content:

1. Genome comparison
2. Genome Rearrangements
3. Genome Annotation
4. Gene prediction tools
5. RNA structure prediction
6. Methods for detection of transmembrane helices
7. Protein peptide analysis
8. Prediction of gene-gene and Protein-protein interactions.
9. Microarray Data analysis
10. Identification of SNPs from Clinical databases

Reference books

1. Brown T. A. **"Genomes 3"**. Garland Science Publishing, New York. 2007.
2. Dunham, I., **"Genome Mapping and sequencing.** Horizon Scientific. 2003.
3. Graur, D and W H Li. **"Fundamentals of molecular evolution".** Sinauer Associates. 2000.

4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. **"Genetics from Genes to Genomes"**, McGraw Hill. 2004.
5. Lewin B. **"Genes VIII".** Oxford University Press. Oxford. 2003.
6. Malcolm Campbell and Laurie J. Heyer, **"Discovering Genomics, Proteomics and Bioinformatics" 2nd edition** - Cold Spring Harbor Laboratory Press 2006.
7. Andres Kriete, Roland Eils, **"Computational Systems Biology",** Elsevier Academic Press.2006.
8. Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, and Ralf Herwig. **"Systems Biology: A Textbook",** Wiley-Vch Publications.2009.
9. Michael Stumpf, David J. Balding, Mark Girolami. **"Handbook of Statistical Systems Biology"**. Wiley Publications. 2011.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
B21CP0602	**MACHINE LEARNING LAB**	HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Student should be familiar with the concepts of DNA, RNA and proteins and their specific roles within the cell.

Course objectives:

1. Learn the concepts, techniques, design and applications of data mining and artificial intelligence.
2. Understand of data structures and file types.
3. Understand Artificial Intelligence methodologies, techniques, tools and results.
4. Develop skills of using recent machine learning software for solving practical problems and gain experience of doing independent study and research.

Course outcomes:

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

1. Develop a basic understanding of AI building blocks presented in intelligent agents.
2. Ability to choose an appropriate problem-solving method and knowledge representation technique.
3. Analyze the strength and weaknesses of AI approaches to knowledge– intensive problem solving.
4. Ability to develop and implement AI-techniques in neural network development.

Mapping of Course Outcomes with Programme Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1				1	1	2
CO2	3	2	2	1	1					1	1	3
CO3	3	2	2	1	1					1	1	2
CO4	3	2	2	1			1			1	1	2

Course Content:

1) Load the dataset from the below file and write python code to answer below exploratory analysis questions:
   a) How many observations are there in this dataset?
   b) How many various features are there in the dataset?
   c) How many different occupations (unique) are there in the dataset?
   d) What occupation is the most common.

e) What is the average age of all the people in this dataset?
f) What is the average age of people in each occupation group?
g) What are the occupations of the youngest and oldest people in this dataset?

2) Load the dataset from the below file and write python code to answer below exploratory analysis questions:
   a) How many teams participated in this tournament?
   b) List top two teams with high discipline and bottom two teams with low discipline (you can consider red and yellow cards to calculate discipline)
   c) On an average, how many yellow cards are given per team
   d) How many teams that scored more than 5 goals and which are those teams
   e) Which team is most accurate in shooting?
   f) How many teams made more fouls than their opponents?
3) Use appropriate python library to plot the below using the below dataset
   a) Plot the monthly trend of various products as line charts in a single chart.
   b) Get total number of items sold (all products together) and plot them as a line chart to show the trend
   c) Find the relationship between product 2 and product 4 using scatterplot and record your observation
   d) Plot a stacked bar chart and grouped bar chart to show monthly trend in the product sales
4) Write python code for calculating various regression errors/error metrics such as SSE, MSE, RMSE and R2 score. The function should take actual target values and predicted targets from the model as input and return these error metrics as output
5) Create a regression model for the below dataset and predict insurance charges the user must pay. Use appropriate model selection techniques and use the solution from above (question3) to calculate various error metrics for training and testing datasets and explain the findings.
6) Construct a ID3 decision tree model manually from the given dataset (use entropy or gini value as the criterion of impurity). Explain the steps. Also find the most important feature based on information gain.
7) Build a supervised classification model to predict the iris flower variety using the below dataset. Use appropriate algorithm and model selection techniques. Calculate various error metrics for training and testing datasets and explain the findings.
8) Write a python program to implement k-Nearest Neighbor algorithm to classify the iris data set. Use appropriate model selection techniques. Explain your findings with use of a confusion matrix.

Reference books

1. J. Han, M. Kamber, **"Data Mining Concepts and Techniques",** Morgan Kaufmann. 2020.
2. M. Kantardzic, **"Data mining: Concepts, models, methods and algorithms"**, John Wiley &Sons Inc. 2018.
3. Paulraj Ponnian**, "Data Warehousing Fundamentals",** John Willey.2017
4. Sam Anahory, Dennis Murray, **"Data Warehousing in the Real World",** Pearson, Tenth Impression, 2012.
5. Michael.J. Berry, Gordon.S. Linoff:, **"Mastering Data Mining",** Wiley Edition, second edtion,2012

6. M. Dunham, **"Data Mining: Introductory and Advanced Topics",** Pearson Education.2012.

CAREER OPPORTUNITIES

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 does handle all aspects of Internships and placements for the students at 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 pre-placement 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 flavor 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 around 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 center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development center, 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 recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

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.

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