

**10**  
YEARS

OF UNIVERSITY  
RECOGNITION

**20**  
YEARS OF  
ACADEMIC  
EXCELLENCE



**REVA**  
UNIVERSITY

Bengaluru, India

## SCHOOL OF APPLIED SCIENCES

B.Sc. – BIOTECHNOLOGY,  
BIOCHEMISTRY, GENETICS

**HANDBOOK: 2021-24**

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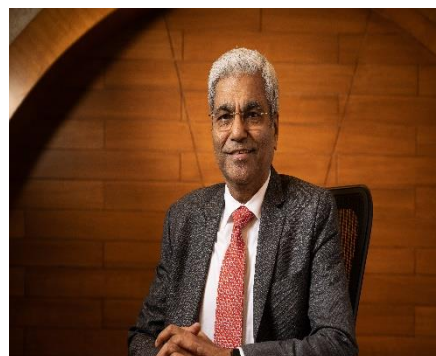
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## Chancellor's Message

*“Education is the most powerful weapon which you can use to change the world.”*

- Nelson Mandela.

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



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 team-work 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 up 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 - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded

projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

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

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

Welcome to the portals of REVA University!

- **Dr. Dhanamjaya M**  
**Vice Chancellor, REVA University.**

## Director's 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.

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, genetists, scientists, teachers, professionals & administrators who are motivated, enthusiasts & creative thinkers to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth. The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. Maximum number of courses are integrated with cross cutting issues, relevance to professional ethics, gender, human values, environment and sustainability. The curriculum caters to and has relevance to local, national, regional and global developmental needs.

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

This 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 BR**  
**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 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

## **ABOUT REVA UNIVERSITY**

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 7<sup>th</sup> 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 centre, the well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

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 so as 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 into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also 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 top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Sensor 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, Nano 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, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC<sup>2</sup>, VMware, SAP, Apollo etc, to facilitate student exchange and teacher-scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates 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 I.I.Sc., 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 '**Life Time 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 6<sup>th</sup> January of every year in presence of dignitaries, faculty members and students gathering. The first **“REVA Life Time 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 of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also 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 classes everyday 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 B.Sc. degree programs in Bio-Chemistry, Bio-Technology, Chemistry, Physics, Mathematics and B Sc with various combinations viz, Biotechnology, Biochemistry and Genetics, Physics Chemistry and Mathematics, Microbiology, Chemistry and Genetics, Mathematics, Statistics and Computer Science, and Bioinformatics, Statistics& Computer Science and also Post Graduate Diploma in Clinical Embryology and Artificial Reproductive Technology. 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, professionalism and research culture among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens with leadership qualities.

#### **Mission**

- To achieve excellence in studies and research through pedagogy and support interface between industry and academia

- To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure
- To establish state of the art laboratories to support research and innovation and promote mastery of science.
- To inculcate an ethical attitude and make students competitive to serve the society and nation.

## BOS MEMBERS

Sl. No.	Panel Members
<b>Biotechnology</b>	
1	Dr. Geetha Hiremath Mendez Scientist I, Global Project Leader, Novozymes Southasia Pvt., Ltd., Bangalore
2	Dr. M. Narayanaswamy, Multiplex Scientist I, Global Project Leader, Novozymes Southasia Pvt., Ltd., Bangalore
3	Dr. Rajaguru Aradhya, Assistant Professor, School of Biotechnology, Amrutha Vishwa Vidya Peetam, Kollam, Kerala.

Sl. No.	Panel Members
<b>Genetics</b>	
1	<b>Dr. Harini BP, Professor,</b> Center for Applied Genetics, Bangalore University, Bangalore.
2	<b>Dr. N. Vijaya Shankar</b> Senior Scientist, Aurigene Discovery Technology, Bengaluru
3	Dr. S. Basavarajappa Associate Prof in Zoology, Bangalore University, Mysore

Sl. No.	Panel Members
<b>Biochemistry</b>	
1	Dr. U.V Babu Head, Research and Development, Himalaya Drug Company, Yeshwanthpur, Bangalore. dr.babu@himalayawellness.com
2	Dr. C S Vivek Babu Principal Scientist, CFTRI , Mysore <a href="mailto:vivekbabu.cs@cftri.res.in">vivekbabu.cs@cftri.res.in</a> 9448581704

3	Dr. Keshamma E Assistant Professor of Biochemistry, Maharani Cluster University, Palace Road, Bangalore <a href="mailto:keshamma76@gmail.com">keshamma76@gmail.com</a> 8660688950.
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**B Sc - B B G**  
**(Biotechnology, Biochemistry, Genetics)**

**Programme Overview**

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

Government of India, cognizant of the fact that Biotechnology is an ever-growing technological field benefitting the whole society, established Department of Biotechnology (DBT) in the year 1986 with a mandate to promote large scale use of Biotechnology. Recent times have seen a surge in research related to innovation, invention and product orientation. In fact, top experts have made it clear that innovation in biosciences can make it a bigger industry than information technology.

The Indian biotech industry holds about 2 percent share of the global biotechindustry. The biotechnology industry in India, comprising about 800 companies, is expected to be valued at US\$ 11.6 billion in 2017. The government has to invest US\$ 5 billion to develop human capital, infrastructure and research initiatives if it is to realize the dream of growing the sector into a US\$100billionindustryby2025, as per Union Minister for Science and Technology. In the Union Budget 2017-18, the Department of Biotechnology (DBT) received Rs 2,222.11 crore (US\$ 333.31 million), an increase of 22 per cent, to continue

implementing the department’s national biotech strategy and target increasing the turnover from the sector to \$100 billion by 2025 from \$7 billion in 2016.

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

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

**Programme Educational Objectives (PEOs)**

After 3 years of graduation, the graduate will:

PEO -1	Adopt strong foundation with skills, ethics, relevant training and education towards understanding life science.
PEO - 2	Apply appropriate tools and techniques for conducting scientific investigations to solve the problems in life science domain, to serve the society.
PEO – 3	Acquire higher degree of work in academics and research.
PEO – 4	Adapt lifelong learning with continuous improvement.

**Programme Outcomes (POs)**

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



1. **Science knowledge:** Apply the knowledge of life science for the solution of complex problems in various domains including healthcare considering public health & safety and the cultural societal & environmental concerns.
2. **Problem analysis:** Identify, formulate & analyse problems related to various domains of life sciences relevant to biotechnology, genetics and biochemistry.
3. **Conduct investigations of relevant problems:** Use basic knowledge including analysis and interpretation of data, and synthesis of the information to provide valid conclusions and also to carry out the research procedures.
4. **Modern tool usage:** To Create, select and apply appropriate techniques, resources and modern technology which in turn benefit the society.
5. **Environment and sustainability:** Understand and implement environmentally friendly approaches in life sciences to support sustainable development.
6. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms in Life Sciences.
7. **Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
8. **Communication:** Communicate effectively with the scientific community and with society at large. Be able to comprehend and document. Make effective presentations, and deduce clear instructions.
9. **Project management and finance:** Demonstrate knowledge and understanding of life sciences and management principles and apply these to one's own work, as a member and leader in a team.
10. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **Program Specific Outcomes (PSO)**

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

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



**Regulations – Bachelor Degree Programs  
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 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 Degree Programs of REVA University offered during 2021-22:

B Com (Industry Integrated)  
B Com (Honors)  
BBA (Industry Integrated)  
BBA (Honors)  
BBA (Entrepreneurship)  
BA - Journalism, English, Psychology  
BA - Tourism, History & Journalism  
BA - Political Science, Economics & Journalism  
BA - Performing Arts, English Psychology  
BCA  
BSc (Honours) Cloud Computing & Big Data  
BSc in Physics, Chemistry, Maths  
BSc in Maths, Statistics, Comp Sci.  
BSc in Bioinformatics, Statistics, Computer Science  
BSc in Biotechnology, Biochemistry, Genetics  
BSc in Microbiology, Chemistry, Genetics

BSc in Physics, Maths, Computer Science

### 3. **Duration and Medium of Instructions:**

**3.1 Duration:** The Bachelor 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 Degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he has to 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 BSc (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:

<b>L</b>	<b>Lecture</b>
<b>T</b>	<b>Tutorial</b>
<b>P</b>	<b>Practice</b>

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, Hard Core Courses, Soft Core Courses, Open Elective Courses, SEC, Mandatory Courses Project work/Dissertation**

4.2.1 **Foundation Course:** The foundation Course is a mandatory 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 have to 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 **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**

4.2.5 **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 considered to be 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.

4.2.6 **Mandatory Course (MC):**

A Mandatory course should be completed successfully as a part of graduate degree program irrespective of the program of study. It doesnot have credits but that the candidates have to complete compulsorily.

4.2.7 **SEC:** It is a mandatory course to equip students with skill sets required as per the industry expectation. Candidate will seek exposure through workshops and other certificate-based courses.

4.2.8 **“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 Degree** Programs (6 Semesters) is given below:

<b>S</b>	<b>Program</b>	<b>Duration</b>	<b>Eligibility</b>
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 (Honours)		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 (Honours)	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 (PEJ) c) Tourism, Journalism & History (TJH)	6 Semesters (3 years)	Pass in PUC /10+2 of any recognized Board / Council or any other qualification recognized as equivalent there to.
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 thereto.
10	B Sc in a)Physics, Chemistry and Mathematics (PCM) b) Mathematics, Statistics and Computer Science (MStCs) c)Physics, Mathematics and Computer Science (PMCs)	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 (BCsSt) 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

<b>Table: CreditPattern</b>					
<b>Lectures(L)</b>	<b>Tutorials(T)</b>	<b>Practice (P)</b>	<b>Credits(L:T:P)</b>	<b>Total Credits</b>	<b>TotalContact Hours</b>
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

- 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. Open Elective Course (OE)
- e. Skill Enhancement Course (SEC)
- f. Mandatory Course (MC)
- g. 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 considered to be 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

Registered candidates are required to earn the credits stated in the below table for the award of degree in the respective program:

Credits	Programs
120	<b>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</b>

The following courses are foundation courses and they 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. Communicative English
2. Languages K / H / Additional English
3. Constitution of India and Professional Ethics
4. Environmental Science

8.2. The concerned BoS 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 and classify the courses as **Foundation Course (FC), Hard Core (HC), Soft Core (SC), Open Elective (OE) and Skill Enhance Course (SEC).**

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.

8.4. A candidate can enrol 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 / subjectbased 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 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 There shall be **two Internal Tests** conducted as per the schedule announced below. **The Students shall attend both the Tests compulsorily.**

- 1<sup>st</sup> test is conducted for 15 marks during **8<sup>th</sup> week** of the Semester;
- 2<sup>nd</sup> test is conducted for 15 marks during **16<sup>th</sup> 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

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

- Question paper of the **1st test should be based on first 50% of the total syllabus;**
- Question paper of the **2<sup>nd</sup> test should be based on second 50% of the total syllabus;**

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

- 9.7 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.
- 9.8 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.
- 9.9 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.
- 9.10 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 plagiarise the answer from web or any other resources. An assignment / Quiz or combination thereof can be set for a maximum of 20 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 also self-study.
- 9.11 Internal assessment marks must be decided well before the commencement of Semester End examinations
- 9.12 Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18<sup>th</sup> and 19<sup>th</sup> week of the semester and the entire course syllabus must be covered while setting the question paper.
- 9.13 Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students' outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

- 9.14 There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.
- 9.15 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 sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.
- 9.16 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.
- 9.17 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 Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.
- 9.18 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
- 9.19 During unforeseen situation like the Covid-19, 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
- 9.20 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper
- 9.21 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor
- 9.22 Online courses may be offered as per BACHELOR 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

IAs for online courses could be avoided and will remain at the discretion of the School.

9.23 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.

9.24 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

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

**Summary of Internal Assessment and Evaluation Schedule**

<b>S</b>	<b>Type of Assessment</b>	<b>When</b>	<b>Syllabus Covered</b>	<b>Max Marks</b>	<b>Reduced to</b>	<b>Date By which the process must be completed</b>
1	Test-1	During 8 <sup>th</sup> week	First 50%	30	15	8 <sup>th</sup> week

2	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 8 <sup>th</sup> week (10 marks)				
3	Test -2	During 16 <sup>th</sup> Week	Second 50%	30	15	16 <sup>th</sup> Week
4	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 16 <sup>th</sup> Week (10 marks)				
5	SEE	During 19/20 <sup>th</sup> Week	100%	100	50	20 <sup>th</sup> Week

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

2. Practical examination wherever applicable shall be conducted after 2nd test and before second test for theory courses); the performance assessments of the mid-term test include performance in the conduction of 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:

- Knowledge of relevant processes;
- Skills and operations involved;
- 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 periment and write up about the experiment.	20 marks
	<b>Total</b>	<b>50 marks</b>

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
	<b>Total</b>	<b>50 marks</b>

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 has to submit the progress reports periodically and also 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, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (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 IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50, SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

**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 computation of 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 :  $SGPA (S_i) = \sum(C_i \times G_i) / \sum C_i$  where  $C_i$  is the number of credits of the  $i$ th course and  $G_i$  is the grade point scored by the student in the  $i$ th 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
	16			129

Thus, **SGPA =  $129 \div 16 = 8.06$**

**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 =  $141 \div 20 = 7.05$**

**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 taking into account all the courses undergone by a student over all the semesters of a program, i. e :

$$\text{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

Where  $S_i$  is the SGPA of the  $i$ th semester and  $C_i$  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
<b>Cumulative</b>	<b>120</b>		<b>930.24</b>

Thus, **CGPA =  $930.24/120 = 7.75$**

**c. Conversion of grades into percentage:**

Conversion formula for the conversion of CGPA into Percentage is:

$$\text{Percentage of marks scored} = \text{CGPA Earned} \times 10$$

**Example: CGPA Earned  $7.75 \times 10=77.5$**



- 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)	Letter Grade	Performance	FGP
	G			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 three-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 25% (13 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 a given 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 six 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 photo copy 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 submitting an application 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

	<b>P O1</b>	<b>P O2</b>	<b>P O3</b>	<b>P O4</b>	<b>P O5</b>	<b>P O6</b>	<b>P O7</b>	<b>P O8</b>	<b>P O9</b>	<b>PO 10</b>	<b>PS O1</b>	<b>PS O 2</b>	<b>PS O 3</b>
<b>PE01</b>	√	√	√	√	√	√	√	√	√	√	√	√	√
<b>PE02</b>	√	√	√	√	√	√	√	√	√	√	√	√	√
<b>PE03</b>	√	√	√	√	√	√	√	√	√	√	√	√	√
<b>PE04</b>	√	√	√	√	√	√	√	√	√	√	√	√	√

CO PO MAPPING OF THE COURSES

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHK101</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHH101</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHA101</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHE101</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0101</b>	CO1	2		1					2		2	2	1	1
	CO2	1	1	1	1				2		2	2	2	1
	CO3	1		1		1			2		2	2	2	1
	CO4	1		1					2		2	2	3	1
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0101</b>	CO1	3	3	3	2	3	3	3	3			2	1	2
	CO2	2	3	1	2	1	2	3	3			1	2	1
	CO3	2	2	2	3	1	2	3	2			2	1	2
	CO4	3	2	2	3	2	2	1	2			2		2
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0101</b>	CO1	3	2	3		2	2				3	3	2	
	CO2	3									3	3		
	CO3	3	3	3			3				3	3	2	
	CO4	3	3	2			3		2	0	3			
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BTS111</b>	CO1	2	3	3	3	2			2		3	2	3	2
	CO2	2	3	3	3	2			3		3	2	2	3
	CO3	2	3			2			3		3		3	3
	CO4	2	3	3	3	2			4		3	2	3	
Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

	COs													
<b>B21BTS112</b>	CO1	2	3	3	2	2	2	2	3		3	2	3	1
	CO2	2	3	3	2	2	1	2	1		3	2	2	3
	CO3	2	3	3	2	1	1	2	1		3	2	2	2
	CO4	2	3	3	2	1	1	2	1		3	2	3	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21LSM101</b>	CO1	3					3	2	2	2	1			1
	CO2	3	3	3			3	2	3		1			
	CO3	3	3	3	3	3	3	3	3		1			3
	CO4	3	3	3	3	3	3	3	3		1			3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0102</b>	CO1	2	3	3					2		3	2	3	2
	CO2	2	3	3	3				2		3	2	3	2
	CO3	2	3	3	0	2			2		3	2	3	2
	CO4	2	3	3	0	0			2		3	2	3	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0102</b>	CO1	1			2	2			1			3	1	
	CO2	1		2	2				2			2	1	
	CO3	2		2	1	2			2			2	1	
	CO4													
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0102</b>	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	2	1			1			2	1	1	
	CO4	1	1	2	2			2	1		2	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHK201</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHH201</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHA201</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	CO1							2	3		3			

<b>B21AHE201</b>	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0201</b>	CO1	1	1	1	2	1		1	2	2	2	1	1	1
	CO2	2	3	3	3	2		2	3	2	2	2	2	3
	CO3	2	3	3	3	2	2	3	3	2	3	2	2	3
	CO4	2	3	3	3	2	2	3	3	2	3	3	2	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0201</b>	CO1	2	2	3	2		3		2	2	2		2	1
	CO2	2		2		2	3		3		3	1	2	
	CO3	3	3		2	2		3	2	3		2		2
	CO4	1	0	2	3	1	1		2	2	1	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0201</b>	CO1	3	3	3	3				3		3	3	2	
	CO2	3	3	3	3		2		2		3	3	2	2
	CO3	3	3								3	3	2	
	CO4	3	3			3			3		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GNS211</b>	CO1	3	3	3			2	3			3	3		3
	CO2	3	3	3			2	3			3	2	3	3
	CO3	3	3	3			2	2			3		3	3
	CO4	3	3	3			2	2			3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GNS212</b>	CO1	3	3	3			3				3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	3
	CO3	3	3	3	3		3				3	3	2	
	CO4	3	3	3	3		3	3	3		3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21ASM201</b>	CO1	1	2	1	1	1	2	3	1	1	1	1	2	1
	CO2	1	3	1	1	1	3	3	1	1	1	1	3	1
	CO3	2	3	2	1	3	3	3	1	1	1	2	3	2
	CO4	1	2	1	1	1	2	3	1	1	1	1	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0202</b>	CO1	2	3	3					2		3	2	2	2
	CO2	2	3	3	3				2		3	2	2	2
	CO3	2	3	3		2			2		3	2	3	2
	CO4	2	3	3					2		3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0202</b>	CO1	1	2	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	1	2			1			2	1	1	



	CO4	1	1	2	2			2	1		2	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0202</b>	CO1	3		3	3						3	3	2	3
	CO2	3	3								3	3	2	
	CO3	3				3					3	3		
	CO4	3	3			3					3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHK301</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHH301</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHA301</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0301</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0301</b>	CO1	2		3		2		2		2	1	1	2	
	CO2	3	2		1	2		3			3		2	2
	CO3	1		2	2		2	3		3	2	2	2	
	CO4	3	2		2	2		3	3		1	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0301</b>	CO1	3	3				3		3		3	3	2	
	CO2	3	3	3	3	3	3		3		3	3	3	
	CO3	3	3	3		3	3				3	3	2	
	CO4	3	3	3	3		3		3		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BCSC311</b>	CO1	2		3		3		2		1	1	2	1	
	CO2	1		2	2		3	3		2	2	2		1
	CO3	2	1		1	2		2	2		1	1	2	
	CO4	3		2	2			1	1		1	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

<b>B21BCS312</b>	CO1	2		3		2		2				2	2	1
	CO2	1			3		2		3		3	2	3	
	CO3	1		3					3		3	2		2
	CO4	2	3		3		2		3	2	2		1	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21ASO302</b>	CO1	2	3	3	2	2	2	2	3	1	3	2	3	1
	CO2	2	3	3	2	2	1	2	1	1	3	2	2	3
	CO3	2	3	3	2	1	1	2	1	1	3	2	2	2
	CO4	2	3	3	2	1	1	2	1	1	3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0302</b>	CO1	2	3	3			2		3	2	3	3	2	3
	CO2	2	3	3	3		2		3	2	3	3	2	3
	CO3	2	3	3		2	2		3	2	2	3	2	3
	CO4	2	3	3			2		3	2	3	3	2	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0302</b>	CO1	2		2	1			2	1		1	1	1	
	CO2	1	2	1	2			1			2	2	1	
	CO3	2	2	2	2			2	1		2	1	1	
	CO4	1	1	1	1			1	1		2	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0302</b>	CO1	3	3	3	3			3	3	3	3	2	3	3
	CO2	3	3	3				3		3	3	2	3	3
	CO3	3	2	3	3			3		3	3	3	3	3
	CO4	3	3	3	3		3	3	3	3	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHK401</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHH401</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21AHA401</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0401</b>	CO1	3	3	3	3		2	3		2	2	1	3	3
	CO2	3	2	3	3		3	3		2	2	1	3	2
	CO3	2	2	2	2		2	2		2	2	1	2	2

	CO4	3	3	3	3		3	3		2	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0401</b>	CO1	1		1	1		2		1	1	2	1		1
	CO2	2	2		2		2		1	1	1			
	CO3	2		1	2	1	1	1		2	1	2	1	
	CO4	2		2	2		2	2		2	1	1		1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0401</b>	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3				2				3	3		
	CO3	3	3	3	3	3	2				3	3	2	
	CO4	3	3	3			3	3	2		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BTS411</b>	CO1	2	3	3	2	2	2	2	1	2	3	2	3	2
	CO2	2	3	3	2	2	1	2	1	2	3	2	3	2
	CO3	2	3	3	2	2	1	2	1	2	3	2	3	2
	CO4	2	3	3	2	2	1	2	1	2	3	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BTS412</b>	CO1	2	3	3	3	1	2	3		3	2	3	3	2
	CO2	2	3	3	3	1	2	3		3	2	2	3	2
	CO3	2	3	3	3	1	2	3		3	2	2	2	2
	CO4	2	3	3	3	2	2	4		3	2	3	3	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0402</b>	CO1	3	3	3	3	3			3	3		2	3	3
	CO2	2	2	2	2	1			3	3		2	3	3
	CO3	3	3	3	3	3			3	3		2	3	3
	CO4	2	2	2	2	2			2	2		2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0402</b>	CO1	2	1	1				1	1		2	1	1	
	CO2	1	2	1	2			1	1		3	2	1	
	CO3	2	2	2	3			2	2		3	2	1	
	CO4													
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0402</b>	CO1	3	3			3	2				3	3	2	
	CO2	3	3			3					3	2	2	
	CO3	3	3			3					3	3		
	CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0501</b>	CO1	1									1	1	1	1
	CO2	2	3								2	3	1	2
	CO3			2							2	3	1	
	CO4			2	3		2				2	3	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

<b>B21BC0501</b>	CO1	2		2		2		1		3		2		1
	CO2	1		2		2	2		1		1		2	
	CO3	2	2			1	1			2	2		2	
	CO4	2	2		2	2	0	1	1	1	2	1	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0501</b>	CO1	3	3	3				3	3		3	3		2
	CO2	3	3	3	3			3	3	3		3	3	2
	CO3	3	3	3				2	2	2		3	3	2
	CO4	3	3	3	3	3	3	3	3	2	2	3	3	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GNS511</b>	CO1	3	3	3				3		3		3	3	2
	CO2	3	3	3				3		3		3	3	3
	CO3	3	3	3	3			2				3	3	3
	CO4	3	3	3	3			3		3		3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GNS512</b>	CO1	3		3					3		3	3	3	
	CO2	3	3	3	3	2	2				3	3	3	
	CO3	3	3	3	3	3	3		3		3	3	3	
	CO4	3	3	3	3	3	3				3	3	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0502</b>	CO1	2	3	3					2		3	2	1	1
	CO2	2	3	3	3				2		3	2	3	2
	CO3	2	3	3		2			2		3	2	3	2
	CO4	2	3	3					2		3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0502</b>	CO1	1	2	1	1			1	1		2	1	1	
	CO2	2	1	1	2			1	1		1	1	1	
	CO3	2	1	2	1			1	1		2	1	1	
	CO4	1	1	1	0				1		2	1	1	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0502</b>	CO1	3	3	3				3			3	3	3	3
	CO2	3	3	3	3			3	3		3	3	3	
	CO3	3	3	3	3			3			3	3	2	3
	CO4	3	3	3	3			3	3	3	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0601</b>	CO1	2	3	2	1	2	2	2	3	1	3	2	3	3
	CO2	2	3	2	1	2	1	2	1	1	3	2	2	3
	CO3	2	3	2	2	1	1	2	1	1	3	2	2	2
	CO4	2	3	2	2	1	1	2	1	1	3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0601</b>	CO1	3		1	2			2		3		2	1	
	CO2	3	1	2		3		3		2	3		2	2
	CO3	2		3		3		3	2		3	2		

	CO4	3		3	2	3		1		3	2	2	1	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0601</b>	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3	2							3	3	2	
	CO3	3	3	3		3	2				3	3	2	
	CO4	3	3	3	3	3	2				3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BCS611</b>	CO1	2	2	3		2	2		3		3	1		1
	CO2	3		2	3		2		2		2		2	2
	CO3	1	3		2		3	2		2	3	3		1
	CO4	3		3		3		2		3	3	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BCS612</b>	CO1	2	1	3		3		2		2	2	1	2	
	CO2	2		2		1			3		1	1		2
	CO3	2	2	2	2	3	3	2		2	3		1	2
	CO4	2		3		3		2		2	3	1	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0602</b>	CO1	2	3	3	2	2	2	2	1	1	3	2	3	3
	CO2	2	3	3	2	2	1	2	1	1	3	2	3	3
	CO3	2	3	3	2	1	1	2	1	1	3	2	3	3
	CO4	2	3	3	2	1	1	2	1	1	3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0602</b>	CO1	3	1	2		2		3		2	2	2	2	
	CO2	2		2	3				2			2		1
	CO3	2	2			2	2	3	3		3	2	2	
	CO4	2		2	3			2	2	3		2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0602</b>	CO1	3	3		3	3	2	3		3	3	3	2	
	CO2	3	3	3	3		3	3	2	3	3	3	2	
	CO3	3	3	3	3		3	3		3	3	2		
	CO4	3	3	3		3	3	3		2	3	3	2	

**B Sc – B B G**  
**(Biotechnology, Biochemistry, Genetics)**  
**Scheme of Instruction and Detailed Syllabus**  
**(Effective from the Academic Year 2021-22)**

**Scheme of Instruction**

**Duration: 6 Semesters (3 Years)**

Sem	Sl. No	Title of the Course	HC/SC/ SE/CC	Credit Pattern				Hours
				L	T	P	Total	
First	B21AHK101	Language – I: Kannada - I	FC	1	1	0	2	3
	B21AHH101	Language – I: Hindi - I						
	B21AHA101	Language – I: Additional English - I						
	B21AHE101	Communicative English – I	FC	1	1	0	2	3
	B21BT0101	Cell Biology	HC	2	1	0	3	4
	B21BC0101	General Biochemistry I	HC	2	1	0	3	4
	B21GN0101	Classical Genetics	HC	2	1	0	3	4
	B21BTS111	Environment and Ecosystem Management	SC	2	1	0	3	4
	B21BTS112	Food Nutrition and Health						
	B21LSM101	Constitution of India and Professional Ethics	MC	0	0	0	0	2
	B21BT0102	Cell Biology lab	HC	0	0	1.5	1.5	3
	B21BC0102	General Biochemistry I lab	HC	0	0	1.5	1.5	3
	B21GN0102	Classical Genetics lab	HC	0	0	1.5	1.5	3
	<b>Total Credits</b>			<b>10</b>	<b>6</b>	<b>4.5</b>	<b>20.5</b>	<b>33</b>
Second	B21AHK201	Language – II: Kannada - II	FC	1	1	0	2	3
	B21AHH201	Language – II: Hindi - II						
	B21AHA201	Language – II: Additional English - II						
	B21AHE201	Communicative English – II	FC	1	1	0	2	3
	B21BT0201	General Microbiology	HC	2	1	0	3	4
	B21BC0201	Biomolecules	HC	2	1	0	3	4
	B21GN0201	Cytogenetics	HC	2	1	0	3	4
	B21GNS211	Analytical techniques in Genetics	SC	2	1	0	3	4
	B21GNS212	Forensic Biology						
	B21ASM201	Environmental Science	MC	0	0	0	0	2
	B21BT0202	General Microbiology lab	HC	0	0	1.5	1.5	3
	B21BC0202	Laboratory course II	HC	0	0	1.5	1.5	3
	B21GN0202	Cytogenetics lab	HC	0	0	1.5	1.5	3
	<b>Total Credits</b>			<b>10</b>	<b>6</b>	<b>4.5</b>	<b>20.5</b>	<b>33</b>
Third	B21AHK301	Language – II: Kannada - III	FC	1	1	0	2	3
	B21AHH301	Language – II: Hindi - III						
	B21AHA301	Language – II: Additional English - III						

	B21BT0301	Environmental Biotechnology	HC	2	1	0	3	4
	B21BC0301	Human Physiology	HC	2	1	0	3	4
	B21GN0301	Molecular Genetics	HC	2	1	0	3	4
	B21BCS311	Nutritional Biochemistry	SC	2	1	0	3	4
	B21BCS312	Hormonal Biochemistry						
	B21ASO302	Open Elective – Health and Hygiene	OE	3	0	0	3	4
	B21BTM301	Skill Enhancement Program (Mandatory course)	SEC/MC	0	0	0	0	2
	B21BT0302	Environmental Biotechnology lab	HC	0	0	1.5	1.5	3
	B21BC0302	Laboratory course III	HC	0	0	1.5	1.5	3
	B21GN0302	Molecular Genetics lab	HC	0	0	1.5	1.5	3
	<b>Total Credits</b>			<b>12</b>	<b>5</b>	<b>4.5</b>	<b>21.5</b>	<b>34</b>
<p><b>Note: Open elective offered by School of Biotechnology, Health &amp; Hygiene shall be opted by other schools. The B. Sc BBG students shall have to opt Open Elective course offered by other schools.</b></p>								
<b>Fourth</b>	B21AHK401	Language – II: Kannada - IV	FC	1	1	0	2	3
	B21AHH401	Language – II: Hindi - IV						
	B21AHA401	Language – II: Additional English - IV						
	B21BT0401	Molecular Biology & Genetic Engineering	HC	2	1	0	3	4
	B21BC0401	Biochemical techniques	HC	2	1	0	3	4
	B21GN0401	Developmental Genetics	HC	2	1	0	3	4
	B21BTS411	Animal Biotechnology	SC	2	1	0	3	4
	B21BTS412	Bioinformatics and Biostatistics						
	B21PTM401	Soft Skill Training (Mandatory course)	SEC/MC	0	0	0	0	2
	B21BCM401	Skill Enhancement Program (Mandatory course)	SEC/MC	0	0	0	0	2
	B21BT0402	Molecular Biology & Genetic Engineering Lab	HC	0	0	1.5	1.5	3
	B21BC0402	Developmental Genetics Lab	HC	0	0	1.5	1.5	3
	B21GN0402	Laboratory Course - IV (Biochemistry)	HC	0	0	1.5	1.5	3
		<b>Total Credits</b>			<b>9</b>	<b>5</b>	<b>4.5</b>	<b>18.5</b>
<b>Fifth</b>	B21BT0501	Immunology	HC	2	1	0	3	4
	B21BC0501	Metabolism I	HC	2	1	0	3	4
	B21GN0501	Human Genetics	HC	2	1	0	3	4
	B21GNS511	Medical Genetics	SC	2	1	0	3	4
	B21GNS512	Applicative Genetics						
	B21SBON01	MOOC/SWAYAM	SEC	2	0	0	2	2

	B21GNM501	Skill Enhancement Program (Mandatory course)	SEC/MC	0	0	0	0	2
	B21BT0502	Immunology Lab	HC	0	0	1.5	1.5	3
	B21BC0502	Human Genetics Lab	HC	0	0	1.5	1.5	3
	B21GN0502	Laboratory Course – V (Biochemistry)	HC	0	0	1.5	1.5	3
	<b>Total Credits</b>			<b>10</b>	<b>4</b>	<b>4.5</b>	<b>18.5</b>	<b>29</b>
<b>Sixth</b>	B21BT0601	Plant Biotechnology	HC	2	1	0	3	4
	B21BC0601	Metabolism – II	HC	2	1	0	3	4
	B21GN0601	Evolutionary & Biometrical Genetics	HC	2	1	0	3	4
	B21BCS611	Biochemistry of plant sciences	SC	2	1	0	3	4
	B21BCS612	Biochemistry of animal sciences						
	B21SB0601	Project	HC	0	0	4	4	8
	B21BT0602	Plant Biotechnology Lab	HC	0	0	1.5	1.5	3
	B21BC0602	Evolutionary & Biometrical Genetics Lab	HC	0	0	1.5	1.5	3
	B21GN0602	Laboratory Course – VI	HC	0	0	1.5	1.5	3
	<b>Total Credits</b>			<b>8</b>	<b>4</b>	<b>8.5</b>	<b>20.5</b>	<b>33</b>
	<b>Total Credits of all Semesters</b>						<b>120</b>	<b>194</b>

Semester	Credit Pattern				
	L	T	P	Total	Hours
First	10	6	4.5	20.5	33
Second	10	6	4.5	20.5	33
Third	11	5	4.5	21.5	34
Fourth	11	5	4.5	18.5	32
Fifth	10	4	4.5	18.5	29
Sixth	8	4	7.5	20.5	33
<b>Total</b>	<b>60</b>	<b>30</b>	<b>30</b>	<b>120</b>	<b>194</b>







**Unit II <sup>a</sup>ÄzsÄâPÁ°ÄÉÄ PÁ<sup>a</sup>Äâ**

7 Hrs

- 1. C@PaiÄÄ<sup>a</sup>ÉÆ<sup>a</sup>ÉÄð PÁ@<sup>a</sup>Ä±ÄçA <sup>a</sup>ÄÄgÄázÉAiÄÄÄ zÁAizÉÄ.... £ÁUÀZÄAzÄæ
- 2. <sup>a</sup>ÄZÄÉÄUÄ¼ÄÄ §,Ä<sup>a</sup>ÄtÜ
- 3. wgÄÄ<sup>a</sup>Ä@PÄAoÄgÄ gÄUÄ¼É °Äj<sup>o</sup>ÄgÄ

**Unit III <sub>Ä</sub>tÜ PÄxÉUÄ¼ÄÄ**

6 Hrs

- 1. PÄ<sup>-</sup> ÄärAiÄÄ PÉÆÄt <sup>a</sup>ÄiÄ<sup>1</sup>Ü
- 2. AiÄiÄgÄÄÆ CjAiÄÄZÄ «ÄgÄ PÄÄ<sup>a</sup>ÉA¥ÄÄ
- 3. <sub>Ä</sub>ÄÄÄ,ÉâAiÄÄ <sup>a</sup>ÄÄUÄÄ wæ<sup>a</sup>ÉÄtÄ

**Unit IV £ÄIPÄ**

6 Hrs

- 1. mÉÆ¼ÄÄiUÄnÖ n.i. PÉÊ<sup>-</sup> Ä,ÄÄ

**¥ÄgÄ<sup>a</sup>ÄÄ±Äð£Ä UÄæAxÄUÄ¼ÄÄ:**

- 1. <sup>a</sup>ÄÄÄUÄ½ gÄA.<sup>2</sup>æÄ., PÄ£ÄßqÄ <sub>Ä</sub>Ä»vÄâ ZÄjvÉæ, ¥ÄæPÄ±ÄPÄgÄÄ VÄvÄ §ÄPi °E,Ä, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ. 2014
- 2. <sub>Ä</sub>ÄUÄæ<sup>o</sup>. £ÄUÉÄUËqÄ JZi.J<sup>-</sup>i., ZÄjwæPÄ d£Ä¥ÄzÄ PÄxÄ£Ä PÄ<sup>a</sup>ÄâUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ PÄ£ÄðIPÄ eÄ£Ä¥ÄzÄ ¥ÄjuÄvÄÄÜ, °ÉÄUÄ¼ÄÄÆgÄÄ. 2008
- 3. <sup>1</sup>Ä<sup>a</sup>ÄiÄwÄvÄ PÄ£ÄßqÄ <sub>Ä</sub>Ä»vÄâ ZÄjvÉæ <sub>Ä</sub>Ä¥ÄÄl 1,2,3,4,5 <sup>a</sup>ÄÄvÄÄÜ 6, PÄÄ<sup>a</sup>ÉA¥ÄÄ PÄ£ÄßqÄ CzsÄâAiÄÄ£Ä <sub>Ä</sub>Ä,ÉÜ, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ «±Äé«zÄâ@ÄiÄÄ, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ. 2014
- 4. <sub>Ä</sub>ÄUÄæ<sup>o</sup>. £ÄUÉÄUËqÄ JZi.J<sup>-</sup>i., PÄ£ÄßqÄ d£Ä¥ÄzÄ PÄxÄ£Ä PÄ<sup>a</sup>ÄâUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ PÄ£ÄðIPÄ eÄ£Ä¥ÄzÄ ¥ÄjuÄvÄÄÜ, °ÉÄUÄ¼ÄÄÆgÄÄ. 2007
- 5. °ÄA¥Ä £ÄUÄgÄdÄiÄÄâ, <sub>Ä</sub>ÄUÄvÄâ PÄ«UÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ <sub>Ä</sub>Äé¥Äß §ÄPi °E,Ä, °ÉÄUÄ¼ÄÄÆgÄÄ. 2010
- 6. £ÄgÄAiÄÄt !.«, ZÄA¥ÄÆ PÄ«UÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ <sub>Ä</sub>Äé¥Äß §ÄPi °E,Ä, °ÉÄUÄ¼ÄÄÆgÄÄ. 2010
- 7. PÄ¼ÄÉÄUËqÄ £ÄUÄ<sup>a</sup>ÄgÄ, wæ¥Äç, gÄUÄ¼É <sup>a</sup>ÄÄvÄÄÜ eÄ£Ä¥ÄzÄ <sub>Ä</sub>Ä»vÄâ, ¥ÄæPÄ±ÄPÄgÄÄ <sub>Ä</sub>Äé¥Äß §ÄPi °E,Ä, °ÉÄUÄ¼ÄÄÆgÄÄ. 2010
- 8. <sub>Ä</sub>Ä. °ÉÄUÄ<sup>-</sup>i gÄ<sup>a</sup>ÄÄ gÄ<sup>a</sup>i <sup>a</sup>ÄÄvÄÄÜ ¥Ä£ÄâÄ <sub>Ä</sub>ÄÄzÄgÄ ±Ä<sup>1</sup>ÜçÄ, ¥ÄÄgÄt £Ä<sup>a</sup>Ä ZÄÆqÄ<sup>a</sup>ÄÄtÄ, ¥ÄæPÄ±ÄPÄgÄÄ ¥Äæ,ÄgÄAUÄ, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ «±Äé«zÄâ@ÄiÄÄ. 2010
- 9. qÄ. azÄ£ÄAzÄ <sup>a</sup>ÄÄÆwð, <sup>a</sup>ÄZÄ£Ä <sub>Ä</sub>Ä»vÄâ, ¥ÄæPÄ±ÄPÄgÄÄ <sub>Ä</sub>Äé¥Äß §ÄPi °E,Ä, °ÉÄUÄ¼ÄÄÆgÄÄ. 2013
- 10. <sub>Ä</sub>Ä. §,Ä<sup>a</sup>ÄgÄdÄ J<sup>-</sup>i. <sub>Ä</sub>Ä<sup>a</sup>ÄððÖ£Ä <sup>a</sup>ÄZÄ£ÄUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ VÄvÄ §ÄPi °E,Ä, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ. 2012
- 11. <sub>Ä</sub>Ä. §,Ä<sup>a</sup>ÄgÄdÄ J<sup>-</sup>i. CPÄ£Ä <sup>a</sup>ÄZÄ£ÄUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ VÄvÄ §ÄPi °E,Ä, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ. 1997
- 12. <sub>Ä</sub>Ä <sup>a</sup>ÄÄgÄÄ¼Ä¼zÄÝ¥Äà PÉ, £ÄUÄgÄd Q. gÄA. <sup>a</sup>ÄZÄ£Ä PÄ<sup>a</sup>ÄÄäl, ¥ÄæPÄ±ÄPÄgÄÄ <sub>Ä</sub>Äé¥Äß §ÄPi °E,Ä, °ÉÄUÄ¼ÄÄÆgÄÄ. 2016
- 13. £ÄgÄ<sup>1</sup>A<sup>o</sup>ZÄgÄ. r. J<sup>-</sup>i., ¥ÄA¥Ä °sÄgÄvÄ çÄiPÉ, ¥ÄæPÄ±ÄPÄgÄÄ r.«. PÉ <sup>a</sup>ÄÄÆwð ¥ÄæPÄ±Ä£Ä, <sup>a</sup>ÉÄÊ,ÄÆgÄÄ. 2012
- 14. gÄAeÄfi zÄUÄð, ±ÄgÄtgÄ <sub>Ä</sub>ÄÄÄUÄæ PÄæAw, ¥ÄæPÄ±ÄPÄgÄÄ. °ÉÆÄ»AiÄiÄ ¥ÄæPÄ±Ä£Ä, §¼Äij. 2015
- 15. zÉÄ±Ä¥ÄAqÉ J,ÄJ<sup>-</sup>i. °ÉÄAzÉæ ±ÄjÄ¥sÄgÄ PÄ<sup>a</sup>ÄâAiÄiÄ£Ä, ¥ÄæPÄ±ÄPÄgÄÄ zÉÄ<sup>1</sup> ¥ÄÄ,ÄÜPÄ, °ÉÄUÄ¼ÄÄÆgÄÄ. 2013

16. ,À. ©. J,i. PÉÃ±ÀªÀgÁªi. PÉÊ-Á,ÀÀ PÀ£ÀßqÀ £ÁIPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ,ÀÛPÀ, °ÉAUÀ¼ÀÆgÀÄ. 2005
17. ±ÁªÀÄgÁAiÀÄ vÀ. ,ÀÄ., PÀ£ÀßqÀ ,Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ,ÁäGÀPÀ UÀæAxÀªAiÁ-É, ªÉÄÊ,ÀÆgÀÄ -2014
18. ªÀgÀÄZæ¥Àà f. J,i. PÀ£ÀßqÀ ,Á»vÀå ,À«ÄÁPÉè, ¥ÀæPÁ±ÀPÀgÀÄ ,Àæ¥Àß §ÄPì °È,i, °ÉAUÀ¼ÀÆgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH101	Language I: Hindi - I	FC	1	1	0	2	3

**Course description: अध्यनवर्णन:**

यह पाठ्यक्रम नौ सिखिया, 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.सीके 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 जरूरी है।

**c) Pedagogy: शिक्षाशास्त्र:**

- 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 जवाब दे ही को स्वीकार कर सकता है।
- साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।

- समाजमें अंतर्निहितपद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHH101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course content: अध्ययनविषयसूची / पाठ्यक्रम

**इकाई-1** : कहानी, संस्मरण

7

hrs

1. कहानी – नशा-प्रेमचंद
2. कहानी – सुखमयजीवन-चंद्रधरशर्मागुलेरी
3. संस्मरण – शरतकेसाथबितायाकुछसमय-अमृतलालनागर

**इकाई-2**: कहानी, आत्मकथा

6

hrs

4. कहानी-मरनेसेपहले-भीष्मसाहनी
5. कहानी-लालहवेली-शिवानी
6. रेखाचित्र – घीसा – महादेवीवर्मा

**इकाई-3**: एकांकी, व्यंग्यरचना

7

hrs

7. एकांकी – आवाजकानीलाम – धर्मवीरभारती
8. व्यंग्यरचना-भेड़ेऔरभेड़ियें-हरिशंकरपरसाई

**इकाई-4**: अनुवाद

6

hrs

**अनुवाद** : अंग्रेज़ी-हिन्दी(शब्द एवं अनुच्छेद)

**सूचना** : प्रत्येक इकाई 25 अंककेलिए निर्धारित है।

### d) Suggested Text Books and References

**Text book/s:** पाठ्यपुस्तक:

1. हिन्दी पाठ्यपुस्तक-रेवा विश्वविद्यालय।

**References:** सन्दर्भग्रन्थ:

1. सुबोधव्यवहारिकहिन्दी – डॉ. कुलदीपगुप्त
2. अभिनवव्यवहारिकहिन्दी – डॉ.परमानन्दगुप्त
3. हिन्दीसाहित्यकाइतिहास - डॉ. नागेन्द्र
4. आधुनिकहिन्दीसाहित्यकाइतिहास - डॉ. बच्चनसिंह
5. हिन्दीसाहित्यकानवीनइतिहास - डॉ. लालसाहबसिंह
6. शुद्धहिन्दीकैसेबोलेकैसेलिखे- पृथ्वीनाथपाण्डे
7. कार्यालयअनुवादनिदेशिका
8. संक्षेपणऔरपल्लवन - के.सी.भाटिया&तुमनसिंग

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHA101	Language I: Additional English - I	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:

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

### Course Outcome:

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

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

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHA101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course Contents:

#### Unit-I: Values & Ethics

7

hrs

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

hrs

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

hrs

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

hrs

Literature: Emily Dickinson – Success is Counted Sweetest

Dr. Martin Luther King - I Have a Dream

Helen Keller – Excerpt from The Story of My Life

Writing Skills: Brochure & Leaflet

#### Reference Books:

- Tagore, Rabindranath. Gitanjali. Rupa Publications, 2002.
- Wordsworth, William. The Complete Works of William Wordsworth. Andesite Press, 2017.
- Munro, Hector Hugh. The Complete Works of Saki. Rupa Publications, 2000.
- Shakespeare, William. The Complete Works of William Shakespeare. Sagwan Press, 2015.

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

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHE101	Communicative English – I	FC	1	1	0	2	3

### Course Description:

This 2-credit course focuses on improving the spoken and written communication of the learners. The course develops personal, inter-personal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.

**Prerequisites:** The student must have knowledge of intermediate English Grammar and LSRW skills.

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

### Course Objectives:

- To enhance functional communication skills.
- To develop functional use of language in professional contexts.
- To utilize oral presentations in multiple contexts.
- To apply effective written skills in formal communication.



**Course Outcomes:**

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

- Identify pressing issues relating to society, environment and media.
- Develop a process-oriented approach to writing.
- Apply the grammatical skills developed during the course aptly.
- Demonstrate a good command over language usage and refined interpersonal skills.

**Mapping of Course Outcomes with programme Outcome**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHE101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

**Course Contents:****Unit-I: Functional English****7 Hrs**

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 Hrs**

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 Hrs**

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 Hrs**

Remedial Grammar: Collocations; Prepositions

Writing Skills: Precise Writing

Activities: Offers, Suggestions & Requests

Literature: Avijit Pathak – Onscreen Magic

**Reference Books:**

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

Course Code	Cell Biology	Course Type	L	T	P	C	CH
B21BT0101		HC	2	1	0	3	4

**Prerequisites/Pre reading for thecourse:**

The student should be familiar with the basic biology and various forms of cellular structures.

**Course Objectives:**

- Provide students the ability to recognize and identify the function(s) of cell features and distinguish between: prokaryotic and eukaryotic cells; and between the two types of eukaryotic cells: animal cells and plants cells
- Provide students with the understanding of major events of the cell organelles
- Provide students with an understanding of the cell division
- Provide information about cell signaling and its mechanism.

**Course Outcomes:**

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

- Understand the various forms of cell, their structures
- Understand the basics of the cellular energetics and functions related to plasma membrane
- Able to describe the mechanism of cell divisions, inheritance and organization at cellular and organism level
- Illustrate the membrane transport and membrane models of various cells

**Mapping of Course Outcomes with programme Outcomes**

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

B21BT0101	CO2	1	1	1	1				2		2	2	2	1
	CO3	1		1		1			2		2	2	2	1
	CO4	1		1					2		2	2	3	1

### Course Contents:

#### UNIT I:

12 Hrs

Historical perspectives of cell, cell theory, Prokaryotic and Eukaryotic cells; Ultrastructure of eukaryotic cells (Plant and animal), different types of cells; Plasma membrane Ultrastructure, chemical composition, models of plasma membrane; Specializations of plasma membrane, functions of plasma membrane.

#### UNIT II:

12 Hrs

Structure and functions of cell organelles: (a) Mitochondria (b) Ribosomes (c) Lysosomes (d) Centrioles (e) Golgi Complex (f) Endoplasmic reticulum. Structure and functions of Nucleus and nucleolus, Lysosomes, peroxisomes, cytoskeleton elements

#### UNIT III:

12 Hrs

Cell division – (a) Mitosis (Process and stages of mitosis and significance of mitosis), (b) Meiosis (Process of meiosis, structure and functions of synaptonemal complex, significance of meiosis), (c) Cell cycle, check points, regulation of cell cycle, achromatic apparatus Apoptosis and necrosis

#### UNIT IV:

12 Hrs

Cell interaction and motility: Cell signaling, cell junctions-septate, tight and gap junctions, cell motility, flagellar and ciliary motion, Structure and functions of muscle cells, muscle contraction, nerve cell structure and functions. Special cells: Blood cells, identification- structure and different types of blood cells, Cancer cells. Concept of chromosome structure. Structure and functions of polytene and lampbrush chromosomes, barr body

#### Reference Books:

1. Verma P.S. and Agarwal V.K. Cell Biology (Cytology, Biomolecules, Molecular Biology), 2016
2. Kumar P. and Mina U. Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., 2018
3. Hardin J. and Bertoni G. Becker's World of the Cell. 9th Edn (Global Edition). 2017
4. Karp G., Iwasa J. and Masall W. Karp's Cell and Molecular Biology – Concepts and experiments. 8th Edn. 2015
5. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. 2014
6. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. 2018
7. Cooper G.M. and Hausman R.E. The Cell – A Molecular Approach, 7th Edn., 2016
8. Mason K.A., Losos J.B. and Singer S.R. Raven and Johnson's Biology. 9th Edn. 2011
9. Alberts B., Johnson B., Lewis J., Morgan D., Raff M., Roberts K. and Walter P. 2015
10. Challoner J. The Cell: A visual tour of the building block of life 2015

<b>Course Objectives:</b>
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**The objective of the course is to:** To make the students to recollect the basic chemistry concepts required for biochemical reactions.

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

1. Analyze the properties of fluids
2. Apply knowledge on preparation of buffers solutions.
3. Understand the relationship between kinetics and equilibrium.
4. Apply knowledge on understanding of catalysis
5. Analyze the toxic levels of organic substances and the biochemical mechanism of toxicity.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0101</b>	CO1	3	3	3	2	3	3	3	3			2	1	2
	CO2	2	3	1	2	1	2	3	3			1	2	1
	CO3	2	2	2	3	1	2	3	2			2	1	2
	CO4	3	2	2	3	2	2	1	2			2		2

### UNIT I

**12 hrs**

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

### UNIT II

**12 hrs**

Liquids: Properties of liquids – vapour pressure, viscosity and surface tension. Relationship

Course Code	General Biochemistry - I	Course Type	L	T	P	C	CH
<b>B21BC0101</b>		<b>HC</b>	2	1	0	3	4

between vapour pressure and boiling point, freezing point-heat of fusion. Viscosity-Definition, units, experimental determination using Ostwald's viscometer. Viscosity and shape/size of

molecules. Surface tension: - Definition, units, experimental determination using stalagmometer. Surfactants – effect of surfactants on surface tension. Viscosity and Surface tension in everyday life. pH and Buffers: Lewis's concept of acids and bases. Ionic product of water, pH scale, weak acids and bases, Ionization of weak acids, Titration of a weak acid by a strong base. Henderson-Hasselbalch equation and its applications, types of buffers, buffer capacity, Buffer action. Biological buffer systems: Mechanism of action of Phosphate, Bicarbonate, protein and haemoglobin buffer systems in human body.

### **UNIT III**

**12 hrs**

Chemical Equilibrium: Definition and examples of Reversible reactions. Law of mass action, Chemical equilibrium – definition and characteristics. Relationship between  $K_p$  and  $K_c$ . Homogeneous and heterogeneous systems with examples. Le Chatelier's principle, Equilibrium constant and free energy change. Biological applications of ATP and its role in bio-energetics and binding of oxygen by myoglobin and haemoglobin. Redox equilibria with example  $Fe^{2+}$ ,  $Fe^{3+}$  System. Reaction Kinetics & Catalysis: Definition of Molecularity, Order and rate of reactions. Factors influencing rate of reaction. Rate law or Rate equation, rate constant and half-life period expressions for zero, first and second order reactions. Theories of reaction rates – Arrhenius equation, transition state theory. Experimental methods of studying kinetics of reactions. Pseudo unimolecular reaction, Characteristics of catalysts, Types of catalysis– Homogeneous and heterogeneous with both biological and non-biological examples. Theories of catalysis.

### **UNIT IV**

**12 hrs**

Bio-inorganic and Environmental Chemistry: Metal ions in biological systems. Types of ligands with examples; Role of iron in Myoglobin, Haemoglobin and cytochromes. Copper in Hemocyanin. Magnesium in chlorophyll. Cobalt in vitamin B-12 and Molybdenum in nitrogenase. Metal activated enzymes. Toxicology- toxicity and detoxification of Pb, Hg, Cd. LD and ED values of major toxicants. Water pollution: Treatment of sewage and industrial effluents (tanning and electroplating); Pesticides hazards – DDT, Malathion, lindane and 2,4-D. Brief Introduction to Bioremediation and Phytoremediation with applications.

### **Reference Books:**

1. Atkins, P.W. & Paula, J. de Atkin's Physical Chemistry 8<sup>th</sup> Ed., Oxford University Press 2006.
2. Ball, D. W. Physical Chemistry Thomson Press, India 2007.
- 6 Text book of Physical Chemistry K. K. Sharma & C. K. Sharma Vani Educational Books
- 7 Principles of physical chemistry Puri, Sharma & Pathania

- 8 Essentials of physical chemistry B. S. Bahl, Arun Bahl & G. D. Tuli 9 Lee, J.D. Concise Inorganic Chemistry ELBS,1991.
- 9 Cotton, F.A., Wilkinson, G.&Gaus, P.L. Basic Inorganic Chemistry,3<sup>rd</sup>ed., Wiley.
- 1011 Text book of Chemical Kinetics Laidier New AgePublication
- 11Principles and Applications of Catalysis B. Vishwanath Narosa Publishing House.
- 12 Casarett and Doull's Essentials of Toxicology by Curtis Klaassen 3rd Edition
- 13 Principles and Practice of Toxicology in Public Health by Ira S. Richards2nd Edition
- 14 Principles of Toxicology by Karen E. Stine and Thomas M. Brown 3rd Edition 16 Biochemistry by Satyanarayana, 5th Edition 2017

Course Code	Classical Genetics	Course Type	L	T	P	C	CH
B21GN0101		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

The objective of this Course is to:

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

**Course Outcomes:**  
By the end of the course the student will be able to:

1. Compare the different model organisms used for research and its significance.
2. List out the milestones in the evolution of genetics.
3. Outline the inheritance patterns of traits and the interaction of genes.
4. Illustrate the involvement of chromosomes in sex determination and the mechanisms involved in sex differentiation.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0101	CO1	3	2	3		2	2				3	3	2	
	CO2	3									3	3		
	CO3	3	3	3			3				3	3	2	

	CO4	3	3	2			3		2		3			
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<b>Course Content:</b>
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### UNIT I Scope of Genetics

12 hrs

**Model organisms** -Structure, life cycle, genetic and industrial applications)  
**Prokaryotes** –Bacteriophage, TMV, *Escherichia coli*  
**Eukaryotes** – *Coenorhabditis elegans*, *Drosophila melanogaster*, *Arabidopsis thaliana*, Zebrafish, Rattus species, *Saccharomyces cerevisiae*, *Pichia pastoris*  
**History of Genetics** – Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory.

### UNIT II Mendelian Genetics

12 hrs

Biography of Mendel and his experiments on pea plants.

Principle of dominance.

**Law of Segregation:** Monohybrid cross, back cross and Test cross, Problems related.

**Law of Independent Assortment:** Dihybrid cross in pea plant, Back cross and Test cross.

### UNIT III Multiple alleles & gene interactions

12 hrs

**Multiple Alleles:** Definition, ABO blood groups and Rh factor in Human,

#### Gene Interactions

Inter allelic: -

Complementary gene interaction (9:7) Ex: *Lathyrus odoratus*

Supplementary gene interaction (9:3:4) Ex: Grain color in Maize.

Epistasis - Dominant Ex.: Fruit color in *Cucurbita pepo*, Recessive - Ex.: Coat color in *Mice*.

Non- Epistasis - Ex.: Comb pattern in Poultry. Related problems

### UNIT IV Sex Determination

12 hrs

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

Environment and sex determination; Hormonal control of Sex determination (Free martins).

Gynandromorphs. Sex differentiation. Dosage compensation.

Deviations from Mendelism: Incomplete inheritance and Co-dominance.

Related problems

#### Reference Books:

1. Biology: The Dynamic Science, 2nd Edition, Peter J. Russell, Paul E. Hertz. Beverly 2012
2. Cell and Molecular Biology, 4th Edition, P.K. Gupta. 2014
3. Cytogenetics, 1st Edition, P.K. Gupta. 2013
4. Microbiology, 3rd Edition, P.D. Sharma. 2012.
5. Gardner/Simmons/Snustad. Principles of Genetics. 8th edition, 2006.

<b>Course Code</b>	<b>ENVIRONMENT AND ECOSYSTEM MANAGEMENT</b>	<b>Course Type</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CH</b>
<b>B21BTS111</b>		<b>HC</b>	2	1	0	3	4

**Course Objectives:**

1. To familiarize with the Knowledge of the environmental ecology and the role of human beings in shaping the environment.
2. To understand various components of the environment and interfaces.
3. To acquire knowledge on various environmental toxins, its effects and control
4. To understand the concept of waste management in spreading awareness regarding the environmental issues.

**Course Outcomes:**

**After completion of this course, students will be able to:**

1. Gain theoretical knowledge on environment issues and its control measures.
2. Analyse the ecological imbalances and suggest mitigation measures.
3. Imbibe knowledge of various hazardous and toxic materials effecting the environment.
4. Provide solutions regarding the methods and strategies for remediating the problems related to waste management.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BTS111</b>	CO1	2	3	3	3	2			2		3	2	3	2
	CO2	2	3	3	3	2			3		3	2	2	3
	CO3	2	3			2			3		3		3	3
	CO4	2	3	3	3	2			4		3	2	3	

**UNIT1:**

**12hrs**

**ENVIRONMENTAL ECOLOGY:** Importance and Scope of Ecology, Environmental factors - Climate - Temperature - Light - Humidity - Edaphic and Biotic factors, Habitat and ecological niche: Study of pond, grass - land, forest, concept of energy, food chain, food web and ecological pyramids. Animal Association - Symbiosis, Mutualism, Antagonism, Commensalism, Predation and Parasitic relationships

**UNIT 2:**

**12hrs**

**GLOBAL WARMING AND CLIMATE CHANGE:** Role of ozone in environment-ozone layer-ozone depleting gases-Green House Effect, Causes of Climate change: Change of Temperature in the environment, melting of ice Pole-sea level rise-role of fossil fuels, Mitigation Measures- Cleaner production-alternative fuel measures, Climate and Health, Global warming, Types of pollution and control. Causes and Reasons for environmental changes.



**Unit 3:****12hrs**

**ENVIRONMENTAL TOXICOLOGY:** Principles of toxicology- introduction – classification of toxic agents- toxic responses-mechanisms of toxicity- reaction of the toxicant with target molecules, Factors influencing toxicity- abiotic and biotic factors- interaction of chemicals bioaccumulation and biomagnification, carcinogen and mutagens – causes mode and evaluation, heavy metal– Impact on Man, animals & Plants.

**Unit 4:****12hrs**

**SOLID WASTE MANAGEMENT AND VERMITECH:** Solid waste generation and characteristics, Impacts of Municipal Solid Waste (MSW), Disposal of Municipal Solid Waste (MSW)-Collection-Process of waste collection, segregation and composting, Vermicomposting – Sources of organic waste- Vermicompost Process and products, Application of vermicompost: Organic Insecticide-Humic acid.

**References:**

1. Odum, E. P., Fundamentals of Ecology, W. B., Saunders Company, Philadelphia. 1971

Course Code	FOOD NUTRITION AND HEALTH	Course Type	L	T	P	C	CH
B21BTS112		SC	2	1	0	3	4

- Jeyaraj, M. S. and Veer Bala Rastogi, Animal Ecology and Distribution of Animals. 1998
- Verma, P.S., and V. K. Agarwal, Principles of Ecology, 1983.
- Houghton, J. Global warming: The Complete Briefing. 2005
- Saha, T.K. Ecology and Environmental Biology. 2008.
- Timbrel Elements Toxicology, 1989
- Trivedy, R. K Encyclopaedia of Environmental Pollution and Control. 1994
- Purohit, S.S., Q.J. Shammi and A.K.Agarwal.A text book of Environmental Sciences.2004

**Course Objectives:**

- To familiarize with the knowledge of the food types and diet
- To understand various nutrient components, present in food.
- To imbibe the concept of functionalized foods.
- To recognize the correlation between a nutritional diet and its health benefits

**Course Outcomes:**

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

- Acquire knowledge on good and nutritional foods.
- Familiarize with various micronutrients and macronutrients of food and their related deficiency disorders.
- Understand the concept of functional foods and electrolytes.
- Develop the basic understanding of balanced diet and its health benefits

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 0	PSO 1	PSO 2	PSO 3
B21BTS112	CO1	2	3	3	2	2	2	2	3		3	2	3	1
	CO2	2	3	3	2	2	1	2	1		3	2	2	3
	CO3	2	3	3	2	1	1	2	1		3	2	2	2
	CO4	2	3	3	2	1	1	2	1		3	2	3	2

**Unit 1** **1**  
**12hrs**

**Food and Nutrition:** Definition of food, food and its types, nutrition, health, Nutraceuticals, Food guide – Basic food groups, my plate. Energy requirements: Factors affecting energy requirements, BMR - activity, age, climate, diet induced thermo genesis (SDA), Physiological conditions. RDA (ICMR) – formation and applications.

**UNIT 2:** **12**

**hrs Diet and its nutritional components:** Macro Nutrients: Protein, Carbohydrate, Fat-Classification, functions, Digestion& absorption (in brief), RDA, sources and deficiencies. Micronutrients: Calcium, Phosphorus and magnesium, Iron, Zinc, Fluorine and Iodine, Vitamins: Fat-soluble Vitamins (A, D, E & K) Function, RDA, sources and deficiency and excess. Water soluble vitamins: Thiamine, Riboflavin, Niacin, B12, Folic acid, Biotin and Vitamin C: functions, RDA, food sources, deficiencies and excess.

**Unit 3:** **12**  
**hrs**

**Functional foods and electrolytes:** Phytonutrients: Phytates, Tannins and Polyphenols, Beta glucan, Omega 3-Fatty acids their sources and functions. Probiotics and its importance in diet. Water: Functions, requirements, sources, water balance Electrolyte and acid base balance: Electrolyte- Sodium, Chloride, Potassium sources and RDA, function.

**Unit 4:** **12**  
**hrs**

**Balance Diet and health benefits:** Basics of balance diet-Definition, characteristic features of balance diet, proximate analysis of foods for carbohydrate, proteins, fats, fibres and water content. Definition of calorific value of foods. Health benefits of functional foods. Health benefits of balanced diet- Physical, mental and social health

**References:**

1. Antia F.P., Philip Abraham, Clinical Dietetics and Nutrition.
2. Kathleen Mahan L., Sylina Escott-Stump, Krause's food, nutrition and diet therapy.
3. Passmore R. and Davidson S. Human nutrition and Dietetics. 1986
4. Robinson C.H. Careme, Chenometh W.L., Garmick A.E. 16th edition Normal Therapeutic nutrient 1986
5. Shil's M.E., Alfon J.A., Shike M, Modern nutrition in health and diseases eighth edition. 1994

Course Code	Indian Constitution & Professional Ethics	Course Type	L	T	P	C	CH
B21LSM101		FC	2	0	0	2	2

### 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 also know about professional ethics.
5. Explore ethical standards followed by different companies.

### Course Outcomes:

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

CO1: Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution

CO2: Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen

CO3: Illustrate the professional ethics and human values.

CO4: Summarize ethical standards followed by different companies.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21LSM101	CO1	3					3	2	2	2	1			1
	CO2	3	3	3			3	2	3		1			
	CO3	3	3	3	3	3	3	3	3		1			3
	CO4	3	3	3	3	3	3	3	3		1			3

### Course Content:

#### UNIT-I:

6 Hrs

**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 Hrs

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****6Hrs**

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

**Unit-IV:ProfessionalEthics****6Hrs**

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 Companiesin India and Abroad; Corporate Social Responsibilities,Code of Conduct and Ethical Excellence.

**Text Books:**

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

Course Code	Cell Biology Lab	Course Type	L	T	P	C	CH
<b>B21BT0102</b>		<b>HC</b>	0	0	1.5	1.5	3

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

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

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

**Course outcomes:**

1. Determination of cell division of eukaryotes
2. Qualitative and quantitative examination of cells
3. Staining procedure of cell organelles cell counting.
4. Enzyme catalytic action of enzymes using enzyme markers.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0102</b>	CO1	2	3	3					2		3	2	3	2
	CO2	2	3	3	3				2		3	2	3	2
	CO3	2	3	3		2			2		3	2	3	2

	CO4	2	3	3					2		3	2	3	2
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**Course Contents:**

1. Measurements with the help of light microscope Calibration of ocular micrometer Finding out average cell size
2. Temporary preparation of Stained samples for Mitosis (onion root tips)
3. Temporary preparation of Stained samples for Meiosis (grass hopper testis/ pollen)
4. Barr body preparation
5. Vital staining of Mitochondria
6. Cell counting methods; haemocytometer
7. Separation of cell organelles by differential centrifugation and assay of marker enzymes
8. Blood smear preparation and identification of blood cells.

**Reference Books:**

1. J Sambrook & DW Russell (2001). Molecular cloning: a laboratory manual Vol 1, 2 & 3, CSHL Press.
2. Cell and Molecular Biology , S. C. Rastogi
3. Cytology, T. S. Verma and V. K. Agarwal
4. Cell Biology, C. B. Pawar
5. Cell and Molecular Biology, P. K. Gupta
6. Fundamentals of Molecular Biology, Veer Bala Rastogi
7. Fundamentals of Molecular Biology, G. K. Pal and Ghaskadabi
8. Cell Biology, Molecular Biology, Genetic, Evolution and Ecology, Verma and Agarwal
9. Cell and Molecular Biology, Robertis and DeRobertis
10. Molecular Cell Biology, 4th Edition, Lodish S. Baltimore
11. Molecular Biology of Gene, Watson J. D.
12. Biochemistry and Molecular Biology of Plants, Buchanan B. B.
13. Molecular and Cell Biology, Wolfe S.L

Course Code	Laboratory course I (Biochemistry)	Course Type	L	T	P	C	CH
B21BC0102		HC	0	0	2	2	3

**Prerequisites:**

Requires knowledge of pre-university chemistry, physics and biology

**Objectives:**

The objective of this Course is to:

1. Understand the preparation of various chemical components.
2. Know the analysis and quantification of chemical compositions.

**Course Outcomes:**

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

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

#### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BC0102	CO1	1			2	2			1			3	1	
	CO2	1		2	2				2			2	1	
	CO3	2		2	1	2			2			2	1	
	CO4													

#### Course Contents:

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

#### Reference Books:

1. An Introduction to practical Biochemistry—Plummer D.T, Tata McGraw Hill
2. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
3. Modern Experimental Biochemistry R.F. Boyer [Ed.] (1986) Addison Wesley.
4. Analytical Biochemistry; D.J. Holme and H. Pick Longman (1983).
5. Experimental Biochemistry: A Student **Publisher:** I.K. International Publishing House Pvt. Ltd. (Deshpande)
6. Biochemical methods S. Sadasivam A Manickam, New Age International Pvt Ltd Publishers; Third edition
7. Introductory practical Biochemistry, Sawhney, Randhir singh, 11<sup>th</sup> Edition (2015)

Course Code	Classical Genetics Lab	Course Type	L	T	P	C	CH
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<b>B21GN0102</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>
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**Prerequisites/Pre reading for the course:**

Requires theoretical knowledge of chemicals and biotechniques.

**Course Objectives:**

The objective of this Course is to

1. Apply basic techniques in the organic laboratory for preparation, purification and Identification of organic compounds.
2. To develop the skills among students to understand the theory and practice of bio analytical techniques
3. To provide among students the scientific understanding of analytical techniques and detail interpretation of results.

**Course Outcomes:**

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

1. Elucidate structures of unknown compounds using qualitative organic analysis.
2. Identify the amino acids given in the sample.
3. Identify the carbohydrates given in the sample.
4. To determine the extent of pollution in water.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0102</b>	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	2	1			1			2	1	1	
	CO4	1	1	2	2			2	1		2	2	2	

**Course Contents:**

1. Study of Model organisms and their genetic significance -  
**Prokaryotes** – Bacteriophage, TMV, *Escherichia coli*
2. Study of Model organisms and their genetic significance  
**Eukaryotes** – *Coenorhabditis elegans*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Arabidopsis thaliana*, Zebrafish.
3. Gram Staining – *Lactobacillus* and *E. coli*
4. Blood grouping.
5. Genetic problems on: Multiple alleles
6. Genetic problems on Gene Interactions (Complementary/ Supplementary/ Dominant Epistasis gene interactions)
7. Study of Barr body in buccal epithelial cells.

8. Study of mitochondria using Janus green.

**Reference Books:**

1. Biology: The Dynamic Science, 2nd Edition, Peter J. Russell, Paul E. Hertz. Beverly Mc Millan publications. 2012
2. Cell and Molecular Biology, 4th Edition, P.K. Gupta. 2014
3. Cytogenetics, 1st Edition, P.K. Gupta. 2013
4. Microbiology, 3rd Edition, P.D. Sharma. 2012.
5. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th edition, John Wiley and sons.

**SECOND SEMESTER**

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHK201	Language II: Kannada-II	FC	1	1	0	2	3

**Course Overview:**

ಸುಮೇಶ್ವರಿ ಅವರ 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ', 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಎಂಬ ಕೃತಿಗಳು ಕನ್ನಡದ ಇತಿಹಾಸ ಮತ್ತು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಮಾಹಿತಿ ಒದಗಿಸುತ್ತವೆ. 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಒಂದು ಸಾಹಿತ್ಯಿಕ ಚಿತ್ರಣವಾಗಿದೆ, 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಒಂದು ಚಿತ್ರಣವಾಗಿದೆ ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಒಂದು ಚಿತ್ರಣವಾಗಿದೆ.

**Pre-requisites:**

- ಪಾಠ್ಯಕ್ರಮಕ್ಕೆ 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.

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

**Course Objectives:**

- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.
- 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ' ಮತ್ತು 'ಸುಮೇಶ್ವರಿ ಅವರ ಪೇಟೆ'.



UÀ<sup>a</sup>ÀÄÉÅZÀ<sup>o</sup>è IÄÖPÉÆAqÄÄ , ÀEPÀÛ ¥ÀoÀåUÀ¼ÄÉÄÄß DAIÉÄI<sup>a</sup> ÀiÁrPÉÆ¼ÄÏ<sup>-</sup> ÁVzÉ.

**Course Outcomes:**

- dÉÀ¥ÄzÀ, ¥ÁæaÄÉÀ, <sup>a</sup>ÄÄzsÀâPÁ<sup>o</sup>ÄÉZÀ «zsÀ ¥ÀæPÁgÄzÀ PÁ<sup>a</sup>ÀåUÀ¼ÄÄ, °ÉÆ, ÅUÀÉÄßqÄzÀ, ÄtÚPÁxÉUÀ¼ÄÄ °AUÄÄ ÉÁIPÄ, Á»vÀå PÁ<sup>o</sup>PÉAIÄÄ <sup>a</sup>ÄÄÆ@PÄ PÄ@zÀ 1ÜvÀåAvÄgÄUÀ¼ÄÉÄÄß CzÄgÄ M¼ÄÉÉÆÄIUÀ¼ÄÉÄÄß "É¼É, ÄÄvÄÛzÉ.
- ,Á<sup>a</sup>ÄiÁfPÄ, gÄdQÄÄiÄÄ, z sÁ«ÄðPÄ, ,ÁÄ, ÀìøwPÄ, ¥Äj, ÄgÄ °AUÄÆ °AUÄ, ÄAŞAç ü «ZÄgÄUÀ¼ÉqÉ UÀ<sup>a</sup>ÄÄÉÀ °Äj, ÄÄ<sup>a</sup>ÄÄzÄgÉÆAçUÉ «zÄåyðUÀ¼Ä<sup>o</sup>è ZÄZÄð <sup>a</sup>ÄÄÉÉÆÄ" sÁ<sup>a</sup>Ä<sup>a</sup>ÄÄ "É¼ÉAIÄÄÄvÄÛzÉ.
- fÄ<sup>a</sup>ÄÉÅzÀ<sup>o</sup>è §gÄÄ<sup>a</sup>Ä C@ü¥ÁæAiÄÄ "ÉÄzsÀUÀ¼ÄÄ, ,Ä<sup>a</sup>ÄÄ, ÉåUÀ¼ÄÉÄÄß Dz sÄÄæPÄ, ÄAzÄ"sÄðzÀ<sup>o</sup>è <sup>a</sup>ÄiÁÉÄ«ÄÄiÄÄvÉAiÉÆAçUÉ æ<sup>a</sup>Äð», ÄÄ<sup>a</sup>ÄAvÉ ¥ÉæÄgÉÄ!, ÄÄvÄÛzÉ.
- GvÄÛ<sup>a</sup>ÄÄ, ÄA<sup>a</sup>Ä<sup>o</sup>ÉÄ PÄ<sup>-</sup> ÉAiÄÄÉÄÄß "É¼É, ÄÄ<sup>a</sup>Ä GzÉÝÄ±Ä<sup>a</sup>ÄÉÄÄß FqÉÄj, ÄÄvÄÛzÉ.
- ,ÄÄ±ÉÆÄzÀÉÄ <sup>a</sup>ÄÄÉÉÆÄÄ"sÄ<sup>a</sup>Ä <sup>a</sup>ÄÄvÄÄÛ, ÄàzsÄðvÄäPÄ ¥ÄjÄPÉëUÀ¼UÉ «zÄåyðUÀ¼ÄÉÄÄß, ÄdÄÓUÉÆ½, ÄÄvÄÛzÉ.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHK201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

**Course Content:**

Unit-I <sup>a</sup>ÄÄzsÀâPÁ<sup>o</sup>ÄÉÄ PÁ<sup>a</sup>Äå

7 Hrs

1. ZÄAzÄæ<sup>a</sup>ÄÄw «<sup>-</sup> Á¥Ä gÄWÄ<sup>a</sup>ÄAPÄ
2. °ÄUÉUÀ¼ÄÉÄÄ »ArzÄÉÄÄ <sup>a</sup>ÄÄÉÄzÉÆ¼ÄUÉ PÄÄ<sup>a</sup>ÄiÁgÄ<sup>a</sup>Äå, Ä
3. UÉÆÄgÄPÄë ¥Äæ, ÄAUÄ ZÄ<sup>a</sup>ÄÄgÄ, Ä

Unit II <sup>a</sup>ÄÄzsÀâPÁ<sup>o</sup>ÄÉÄ PÁ<sup>a</sup>Äå

7 Hrs

1. wæ¥ÄçUÀ¼ÄÄ ,Ä<sup>a</sup>ÄðdÖ
2. V½AiÄÄÄ ¥ÄAdgÄzÉÆ½@è ¥ÄÄgÄAzÄgÄ zÄ, ÄgÄÄ
3. PÄgÉzÄÄ PÉÆIÖÉÄÄ ±Ä¥Ä<sup>a</sup>ÄÉÄÄ PÄÉÄPÄzÄ, ÄgÄÄ

Unit III <sup>-</sup> ÉÄRÉÄUÀ¼ÄÄ

6 Hrs

1. DvÄä<sup>2</sup>æÄUÄV ægÄAPÄÄ±Ä<sup>a</sup>ÄÄwUÀ¼ÄÄV PÄÄ<sup>a</sup>ÉA¥ÄÄ
2. <sup>a</sup>ÄiÁÉÄ«ÄÄiÄÄvÉ CAVÄgÄ<sup>-</sup> Äè zÉÄ<sup>a</sup>ÄÉÄÆgÄÄ <sup>a</sup>ÄÄ<sup>o</sup>ÄzÉÄ<sup>a</sup>Ä
3. "sÄÆvÄ<sup>-</sup>Ä <sup>a</sup>ÄÄÄæzÄ¼ÄÄ <sup>a</sup>ÄÄÄgÄj §<sup>-</sup> Ä è¼Ä

Unit IV ¥Ä æ<sup>a</sup>Ä, Ä PÄxÄÉÄ

6 Hrs

1. ÉÄÉÉÆß¼ÄVÉÄ °ÄqÄÄ PÄÆÄ<sup>-</sup>Ä (ÄAUÄæ<sup>o</sup>Ä) f. JÉi. <sup>a</sup>ÉÆÄ<sup>o</sup>ÄÉi

Reference Books:

1. <sup>१</sup>ÄÄUÄ½ gÄÄ.²æÄ., PÄÉÄßqÄ ‚Ä»vÄå ZÄjvÉæ, ¥ÄæPÄ±ÄPÄgÄÄ VÄvÄ §ÄPĩ °É,ĩ, °ÉÄÉ, ÄÆgÄÄ. 2014
2. ‚ÄAUÄæ°Ä. £ÄUÉÄUËqÄ JZi.J ĩ., ZÄjwæPÄ d£Ä¥ÄzÄ PÄxÄ£Ä PÄªÄåUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ PÄ£ÄðIPÄ eÄ£Ä¥ÄzÄ ¥ÄjµÄvÄÄÜ, °ÉAUÄ¼ÄÆgÄÄ. 2008
3. <sup>1</sup>ÄªÄiÄwÄvÄ PÄÉÄßqÄ ‚Ä»vÄå ZÄjvÉæ ‚Ä¥ÄÄI 1,2,3,4,5 ªÄÄvÄÄÜ 6, PÄªÄÉA¥ÄÄ PÄÉÄßqÄ CzsÄªÄiÄÄ£Ä ‚ÄÄ, ÉÜ, °ÉÄÉ, ÄÆgÄÄ «±Äé«zÄªÄªÄÄÄ, °ÉÄÉ, ÄÆgÄÄ. 2014
4. ‚ÄAUÄæ°Ä. £ÄUÉÄUËqÄ JZi.J ĩ., PÄÉÄßqÄ d£Ä¥ÄzÄ PÄxÄ£Ä PÄªÄåUÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ PÄ£ÄðIPÄ eÄ£Ä¥ÄzÄ ¥ÄjµÄvÄÄÜ, °ÉAUÄ¼ÄÆgÄÄ. 2007
5. £ÄgÄÄiÄÄt !.«, ZÄA¥ÄÆ PÄ«UÄ¼ÄÄ, ¥ÄæPÄ±ÄPÄgÄÄ ‚Äé¥Äß §ÄPĩ °É,ĩ, °ÉAUÄ¼ÄÆgÄÄ. 2010
6. PÄ¼ÄÉÄUËqÄ £ÄUÄªÄgÄ, wæ¥Äç, gÄUÄ¼ÄÉ ªÄÄvÄÄÜ eÄ£Ä¥ÄzÄ ‚Ä»vÄå, ¥ÄæPÄ±ÄPÄgÄÄ ‚Äé¥Äß §ÄPĩ °É,ĩ, °ÉAUÄ¼ÄÆgÄÄ. 2010
7. ÄÄ. °É£ÄUÄ ĩ gÄªÄÄ gÄªÄ ªÄÄvÄÄÜ ¥Ä£ÄªÄ, ÄÄAZÄgÄ ±Ä¹ ÜçÄ, ¥ÄÄgÄt £ÄªÄÄ ZÄÆqÄªÄÄtÄ, ¥ÄæPÄ±ÄPÄgÄÄ ¥Äæ, ÄgÄAUÄ, °ÉÄÉ, ÄÆgÄÄ «±Äé«zÄªÄªÄÄÄ. 2010
8. qÄ. azÄ£ÄAZÄ ªÄÄÆwð, ªÄZÄ£Ä ‚Ä»vÄå, ¥ÄæPÄ±ÄPÄgÄÄ ‚Äé¥Äß §ÄPĩ °É,ĩ, °ÉAUÄ¼ÄÆgÄÄ. 2013
9. ÄÄ ªÄÄgÄÄ¼Ä¹zÄÝ¥Äà PÉ, £ÄUÄgÄd Q.gÄÄ. ªÄZÄ£Ä PÄªÄÄäI, ¥ÄæPÄ±ÄPÄgÄÄ ‚Äé¥Äß §ÄPĩ °É,ĩ, °ÉAUÄ¼ÄÆgÄÄ. 2016
10. ªÄÄgÄÄ¼Ä¹zÄÝ¥Äà PÉ, µÄIàç ‚Ä»vÄå, ¥ÄæPÄ±ÄPÄgÄÄ ‚Äé¥Äß §ÄPĩ °É,ĩ, °ÉAUÄ¼ÄÆgÄÄ. 2010
11. ÄÄ. ÉÄvÄÄgÄªÄÄ gÄªÄ C.gÄ., ²æÄ ®QööäÄ±Ä£Ä eÉÉ«Äª " sÄgÄvÄ(ªÄÄÆ®-vÄvÄªÄiÄÄð- ÄävÄæ), ¥ÄæPÄ±ÄPÄgÄÄ PÄªÄÄzsÉÉ£ÄÄ ¥ÄÄ, ÄÜPÄ "sÄªÄ£Ä, °ÉAUÄ¼ÄÆgÄÄ. 2010

Course Code	Course Title	Course	L	T	P	C	Hrs
B21AHH201	Language – II: Hindi - II	FC	1	1	0	2	3

**Course description: अध्ययनवर्णन :**

यह पाठ्यक्रम नौ सिखिया, 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:**

- अध्यापिका, पी.यु.सीके 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।
- हिन्दी-अंग्रेजी अनुवाद से संबंधित जानकारी जरूरी है।

**c) Pedagogy: शिक्षाशास्त्र :**

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

- Differentiated Instruction
- Flipped Classroom

**Objectives: पाठ्यक्रमउद्देश्य:**

- 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।

**Learning 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 पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHH201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

**Course Content: अध्ययन विषय सूची / पाठ्यक्रम**

**इकाई – 1** कविता: प्राचीन एवं आधुनिक 7

hrs

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

**इकाई – 2** कविता: प्राचीन एवं आधुनिक 6

hrs

4. तुलसीदास के पद
5. कविता – पाषाणी – नागार्जुन
6. कविता – चलना हमारा काम है - शिवमंगल सिंह सुमन

**इकाई – 3** कविता: प्राचीन एवं आधुनिक 7

hrs

7. मीराबाई के पद
8. कविता – मेरे सपने बहुत नहीं हैं - गिरिराज कुमार माथुर
9. कविता – अभी न होगी मेरा अंत – निराला

hrs

अनुवाद : शब्द एवं अनुच्छेद (हिन्दी से अंग्रेज़ी)

सूचना : प्रत्येक इकाई 25 अंक के लिए निर्धारित है।

**Suggested Text Books and References****Text book/s: पाठ्यपुस्तक :**

1. हिन्दी पाठ्यपुस्तक – रेवा विश्वविद्यालय।

**References: सन्दर्भग्रन्थ:**

1. सुबोधव्यवहारिक हिन्दी – डॉ. कुलदीपगुप्त
2. अभिनवव्यवहारिक हिन्दी – डॉ. परमानन्दगुप्त
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चनसिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लालसाहबसिंह
6. शुद्ध हिन्दी कैसे बोलें कैसे लिखें - पृथ्वीनाथ पाण्डे
7. संक्षेपण एवं पल्लवन

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHA201	Language II: Additional English – II	FC	1	1	0	2	3

**Course Description:**

This is a 2-credit course designed to help the learner gain competency in language through an exploration to the various genres of literature. The syllabus is designed to encourage critical ability of the learner to guide them towards career opportunities. This course is intended to develop the capacity to appreciate and assess the various dimensions of society, culture and life.

**Prerequisites:** The student must possess fair knowledge of language and literature.

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

**Course Objectives:**

- To assess ecological and environmental concerns through literature.
- To identify the unequal structures of power in society.
- To compare and relate the position of men and women in society.
- To interpret the representation of society in popular culture.

**• Course Outcome:**

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

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

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21AHA201</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course Contents:

#### Unit-I: Ecology & Environment

7

hrs

Literature: Toru Dutt - Casuarina Tree

Gordon J.L. Ramen – Daffodils No More

C.V. Raman – Water – The Elixir of Life

Language: Degrees of Comparison

#### Unit-II: Voices from the Margin

6

hrs

Literature: Tadeusz Rozewicz – Pigtail

Jyoti Lanjewar – Mother

Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl

Language: Prefix and Suffix

#### Unit-III: Women & Society

7

hrs

Literature: Kamala Das – An Introduction

Rabindranath Tagore – The Exercise Book

Jamaica Kincaid – Girl

Writing Skills: Dialogue Writing

#### Unit-IV: Popular Culture

6

hrs

Literature: Rudyard Kipling – The Absent-minded Beggar

Sir Arthur Conan Doyle – The Adventure of Lion's Mane

Aldous Huxley – The Beauty Industry

Writing Skills: Story Writing

#### Reference Books:

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

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHE201	Communicative English – II	FC	1	1	0	2	3

### Course Description:

This 2-credit course focuses on enhancing written proficiency required for professional enhancement. It also polishes the spoken skills of the learners to make them effective and confident presenters. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The practical components discussed in this course enable a fruitful transition from academia to the industry of their choice.

**Prerequisites:** The student must possess functional knowledge of LSRW skills.

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

### Course Objectives:

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

### Course Outcomes:

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

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

Course Code	POS / COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21AHE201</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course Contents:

#### Unit-I: Language Acquisition

7 Hrs

Remedial Grammar: Questions & Negatives; Questions Tags

Writing Skills: Email Writing

Activities: Group Discussions

Literature: Alphonse Daudet - The Last Lesson

#### Unit-II: Persuasive Skills

6 Hrs

Remedial Grammar: Past Simple & Past Perfect

Writing Skills: Report Writing

Activities: Book & Movie Reviews

Literature: Lord Alfred Tennyson – Ulysses

#### Unit-III: Cognitive Skills

7 Hrs

Remedial Grammar: Present & Past Passive; Conditionals

Writing Skills: Creative Writing

Activities: Role Plays

Literature: O. Henry – The Gift of the Magi

#### Unit-IV: Employability Skills

6 Hrs

Remedial Grammar: Reported Speech; Idioms

Writing Skills: Cover Letter & CV

Activities: Exchanging Information

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. Dixon, 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.

<b>Course Code</b>	<b>General Microbiology</b>	<b>Course Type</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>C</b>
<b>B21BT0201</b>		<b>HC</b>	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

The student should have the basic knowledge of biology and microscopy.

**Course Objectives:**

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

**Course Outcome:**

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

1. Understand the scope and importance of microbiology in biotechnology
2. Handle microorganisms and utilize for other purpose
3. Exploit various methodologies involved in microbiology
4. Illustrate the microbial metabolism

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0201</b>	CO1	1	1	1	2	1		1	2	2	2	1	1	1
	CO2	2	3	3	3	2		2	3	2	2	2	2	3
	CO3	2	3	3	3	2	2	3	3	2	3	2	2	3
	CO4	2	3	3	3	2	2	3	3	2	3	3	2	3

**Course Content:**

**Unit-I Introduction to microbiology**

**12Hrs**

Origin and historical development of MB, contribution of microbiologist- Leeuwenhoek, Robert hook, Koch, Pasteur, Lister & Fleming; Biogenesis & abiogenesis theory, Microbiology as interdisciplinary science, importance and scope. Kingdom of classifications-two, three & four kingdom classification, classification criteria in the microbes-Bergeys' classification & phylogentic analysis, Binomial nomenclature, classification systems in different microbial classes and



commission for the naming the organism. Molecular characterization of microbes- PCR based methods and FISH.

### Unit-II Prokaryotic and Eukaryotic Microbes

12Hrs

Brief history of bacteriology, general characteristics of bacterium, classification of bacteria based on the morphology, flagella and nutritional aspects, ultrastructure of bacterial cells-cell wall composition, cell membrane, flagella, cell surface appendages, genomes & extra chromosomal DNA and functions of bacterial structure. Mycoplasma. Eukaryotic microbes general characteristics, classification and importances of fungi, algae and protozoa.

### Unit-III Microbiological techniques

12Hrs

Microscopy-properties of light, Resolution, numerical aperture, Principle of light microscope-bright field, dark field, phase contrast, fluorescent & electron microscopy-scanning & transmission; Sterilisation techniques-physical, chemical (including antibiotics) & filtration techniques. Isolation-pour, streak & spread plating and enumeration of microbes-indirect & direct methods. Staining techniques in microbiology-simple, differential & structural; microbial medium. Nutritional basis for classification of microbes-phototrophs, autotrophs, heterotrophs, oxygen, pH and temperature, growth curve-phases & their importance, reproduction in microbes.

### Unit-IV Microbial physiology

12Hrs

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

### Reference Books:

1. M J Pelzer Jr, ECS Chan, NR Krieg, Microbiology, TMH Publishing Co Ltd, 5<sup>th</sup> Edition, 2007.
2. Starrier, Ingraham and Wheeler, General Microbiology, McMillan Publisher, 5<sup>th</sup> Edition, 1998.
3. Atlas R.M. Microbiology: Fundamentals and applications 4<sup>th</sup> Edition, Singapore: Pearson Asia, 2000.
4. Prescott L.M, Harley T.P and Klein D.A. Microbiology, 9<sup>th</sup> Edition, WMC. Brown publishers, 2012.

Course Code	Biomolecules	Course Type	L	T	P	C	CH
B21BC0201		HC	2	1	0	3	4

### Course Objectives:

1. To study the structures of carbohydrates.
2. To understand the structures of Amino acids and proteins.
3. To provide among students the scientific understanding of the structures of Lipids.

- To study the structures of Nucleic acids, their Isolation and sequencing.

### Course Outcomes:

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

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

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21BC0201	CO1	2	2	3	2		3		2	2	2		2	1
	CO2	2		2		2	3		3		3	1	2	
	CO3	3	3		2	2		3	2	3		2		2
	CO4	1		2	3	1	1		2	2	1	2	2	1

### Course Contents

#### UNIT I

12 hrs

Introduction to Biochemistry: History, scope and applications of Biochemistry, Biochemistry as molecular logic of living organisms. Contributions of various scientists in the field of Biochemistry.

**Carbohydrates:** Definition, empirical formulae, classification, biological importance.

**Monosaccharides:** Configuration and relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation – phenyl hydrazine, addition – HCN. Interconversion of aldoses and ketoses by chemical method. Ascending and descending the series by chemical methods. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, and diastereoisomers.

Elucidation of open chain structure and ring structure of glucose. Conformation of pyranose and furanose rings: glucose and fructose, mutarotation. Structure of galactose, mannose, ribose and fructose. Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acid.

**Disaccharides:** Establishment of structures of Sucrose and Lactose, Biological Importance and structure of Isomaltose, Trehalose and Maltose.

**Polysaccharides:** Partial structure, occurrence and importance of Starch, Glycogen, Inulin, Cellulose, Chitin, and Pectin.

**Glycosaminoglycans:** Occurrence, importance and the structure of the repeating units of Heparin, Hyaluronic acid, Teichoic acid and Chondroitin sulphate Bacterial cell wall polysaccharide, peptidoglycans.

#### UNIT II

12 hrs

**Amino acids and proteins:** Structure and classification of  $\alpha$ -amino acids based on the polarity of

R group; amino acids as **ampholytes**– zwitterions structure of amino acids, Isoelectric pH, titration curve of alanine; reactions of amino acids with ninhydrin, FDNB, Edman's reagent and decarboxylation of amino acids; peptides: structure and conformation, biological importance of peptides;

**Proteins:** classification based on composition shape and function with examples; colour reactions: ninhydrin, xanthoproteic, Lowry, Sakaguchi's and Biuret reaction;

**Overview of structural organization of proteins:** Primary structure-importance of restoration of primary structure by taking sickle cell anaemia as example, Secondary structure-Types – $\alpha$ -helix,  $\beta$ -pleated structure, triple helix –example and characteristic features of each type; Tertiary structure and Quaternary structure-factors stabilizing both; Denaturation-Denaturing agents and mechanism of operation, renaturation of ribonuclease-Anfinsen's experiment.

### UNIT III

12 hrs

**Lipids:** Classification and biological role, Fatty acids – Nomenclature of saturated and unsaturated fatty acids. Properties of fatty acids: cis-trans isomerism, reaction with NaOH, alcohol, catalytic hydrogenation, Acid hydrolysis of triglycerides; Rancidity: definition, oxidative and hydrolytic rancidity. Acylglycerols: Mono, di and triglycerols. Saponification, Saponification value, Iodine value, Acid value and significance.

**Phosphoglycerides:**Structure and biological importance of phosphatidyl choline, phosphatidyl ethanolamine, Phosphatidyl inositol, Plasmalogens, and Cardiolipin. Sphingolipids: structure of 4- sphingenine, ceramides and sphingomyelin, Structure and importance of Sphingomyelin.

**Glycosphingo lipids:** Structure and importance of Gangliosides and Cerebrosides. Eicosanoids: Biological role of Prostaglandins, prostacyclin, Thromboxane and leukotrienes. Structure of PGE<sub>2</sub>, PGF<sub>2</sub> Alpha and TXA<sub>2</sub>.

**Plasma lipoproteins:**Types – Chylomicrons, VLDL, LDL and HDL and their significance. Biological Membrane: Composition of membrane, micelles and liposomes. Fluid Mosaic Model, functions of the plasma membrane. Endocytosis and phagocytosis. Membrane receptors and their functions.

### UNIT IV

12 hrs

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

### Reference Books:

1. Biochemistry; Voet , D. and Voet, J.G. [Eds.] 5 Ed. Jhon Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., [Eds.] 7thEdn. Worth Publishers.
3. Principles of Biochemistry; Smith et al., [Ed.] 19<sup>th</sup>EdnMcGarw Hill.
4. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [ 7<sup>th</sup> Ed.] , Wiley-Liss.
5. P.K. Stump, Outlines Of Biochemistry, 5th edn. , Wiley Eastern, New Delhi,
6. L. Stryer Biochemistry 8th Ed. W.H. Reeman Co., San Francisco, US

Course Code	Cytogenetics	Course Type	L	T	P	C	CH
B21GN0201		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

The objective of this Course is to

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

**Course Outcomes:**

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

1. Describe the structure and organization of eukaryotic chromosomes.
2. Diagnose the syndromes depending on karyotypic data.
3. Understand the mechanism of linkage and recombination.
4. Explain the inheritance followed by non-nuclear genes

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21GN0201	CO1	3	3	3	3				3		3	3	2	
	CO2	3	3	3	3		2		2		3	3	2	2
	CO3	3	3								3	3	2	
	CO4	3	3			3			3		3	3	2	

**Course Contents:**

**UNIT I**

**12hrs**

**Microscopy:** Magnification, Resolving power, Principles and Applications of Simple, Compound, Stereozoom, Phase contrast, Fluorescent and Electron microscopes, confocal microscopy.

**Cell organelles:** Ultrastructure, Chemical composition and Functions of Cytoplasmic organelles: Plasma membrane, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies and Nucleus. Cell cycle and cell division. Apoptosis (extrinsic and intrinsic mechanisms).

**UNIT II**

**12hrs**

**Chromosomal** theory of inheritance.

**Eukaryotic Chromosome:** Macro-molecular organization. Primary and Secondary constriction, Sat-bodies, Telomeres, Heterochromatin and Euchromatin and its significance.  
**Ultra structure of Chromosome** - Histones, DNA, Nucleosome model, solenoid, scaffold, domains.

**Special types of Chromosomes:** Structure and Significance of: Polytene Chromosome - Salivary gland chromosome in *Drosophila*, Lampbrush chromosome in amphibian Oocyte. B Chromosome.

### UNIT III

12 hrs

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

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

### UNIT IV

12hrs

**Sex linkage:** Definition of sex linkage; Sex linkage in *Drosophila*. Sex linked genes in poultry, moths and man. Sex linked inheritance in man (Colour-blindness, Haemophilia). Meiotic behavior of chromosome and non - disjunction. Bridge's theory of non-disjunction. Attached X-chromosome.

**Extra Chromosomal Inheritance / Cytoplasmic Inheritance:** Characteristic features of Cytoplasmic Inheritance. Maternal effect inheritance. Structure and organization of Mitochondria and Chloroplast Inheritance of: Mitochondrial DNA, Chloroplast DNA, Kappa articles in *Paramecium*, Sigma factor in *Drosophila*, Shell coiling in snail. Cytoplasmic Male Sterility (CMS) in maize.

#### Reference Books:

1. Cytogenetics, Plant Breeding and evolution by U. Sinha and Sunita Sinha, Vikas Publishing House Private, Limited, 1998.
2. Cytology, Genetics and Molecular Biology by P.K. Gupta 2002.
3. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
4. Genetic Maps, 6th edition by O'Brien, S 1993
5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. 1992.
6. Instant notes in Genetics by P.C.Winter, G.I. Hickey and H.L.Fletcher 2003
7. Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.1998.

CourseCode	Analytical techniques in Genetics	Course Type	L	T	P	C	CH
B21GNS211		SC	2	1	0	3	4

#### Prerequisites/Pre reading for the course:

1. Students should have the basic knowledge of biomolecules.
2. They should know the basics of physical and chemical analysis techniques.

#### Course Objectives:

The Objectives of this course is:

1. To emphasis on the techniques and technologies used in genetics and molecular biology.
2. To understand the different methods used for analysis of biomolecules.
3. To interpret the presence of metabolite.
4. To outline the protocol used for different analysis.

<b>Course Outcomes:</b>
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By the end of the Course students will be able to:

1. Visualize the microscopic images and document them effectively.
2. Blueprint the techniques used to detect proteins and DNA.
3. Understand the techniques of spectroscopy and computational biology.
4. Interpret the presence of metabolite using chromatographic techniques.

### Mapping of Course Outcomes with program Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21GNS211</b>	CO1	3	3	3			2	3			3	3		3
	CO2	3	3	3			2	3			3	2	3	3
	CO3	3	3	3			2	2			3		3	3
	CO4	3	3	3			2	2			3	2	3	3

<b>Course Contents:</b>
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#### Unit-I

**12 hrs**

Microscopy: Light Microscopy-Introduction, Geometrical optics, Image formation, Magnification and Resolution, Lens aberrations, Distortion of image and curvature of field; Types of microscopes-Compound, Bright field and dark field, Fluorescence, Polarized, Stereo, their basic principles, working and applications; Electron Microscopy-Introduction, Historical review, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Theory and basic principles, Instrumentation, applications. FISH – Fluorescence In situ Hybridization and FACS – Fluorescence Activated Cell Sorter

#### Unit -II

**12 hrs**

Chromosome banding - Principles and techniques of nucleic acid hybridization and cot curves; Sequencing of nucleic acids; Southern, Northern and Western blotting techniques; Protein sequencing, Polymerase chain reaction (PCR), Real Time-PCR, Methods for measuring nucleic acid and protein interaction. Electrophoresis: Principle, procedure and application of-Agarose, PAGE, SDS-PAGE, Pulse field electrophoresis, Paper cellulose acetate and High voltage electrophoresis; Isoelectric focusing (IEF).

#### Unit -III

**12 hrs**

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy; Structure determination using X-ray diffraction and NMR analysis using light scattering; Different types of mass spectrometry and surface plasma resonance methods; Computation methods; Nucleic acid method and protein sequence databases, data mining method for sequence searches, motif analysis and prediction.

#### Unit -IV

**12 hrs**

Principle and applications of gel filtration, ion exchange & affinity chromatography; Thin layer chromatography; Gas chromatography; GLC; High pressure liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC); Ultracentrifugation (Velocity and buoyant density). Radioactivity, detection and measurement, construction and use of scintillation counters, Autoradiography, preparation of labelled compounds. Applications in biological sciences, use of non-radioactive compounds.

#### References:

1. Molecular cloning A Laboratory Manual 3rd edition Vol. 1, 2, 3-Sambrook and Russell, Churchill press 2007.
2. Principles and Techniques of Biochemistry and Molecular Biology-Edited by Keith Wilson and John Walker, Sixth Edition, 2010
3. Chromosome Structural analysis -A Practical Approach (Ed.) W.A. Bickmore, Oxford University Press, 1999
4. The AGT Cytogenetics Lab Manual 3<sup>rd</sup>ed. -, Barch, Knutsen and Spurbeck, Lippincott Raven publications, 1997
5. Techniques in lifesciences D. B. Tembhare; Himalaya publishing house
6. Principles of Gene Manipulation and Genomics; S B Primrose and R M Twyman; seventh edition; Blackwell publishing.

Course Code	Forensic Biology	Course Type	L	T	P	C	CH
B21GNS212		SC	2	1	0	3	4

#### Prerequisites/Pre reading for the course:

1. Students should have Critical thinking capacity.
2. They should have knowledge of crime scene.

#### Course Objectives:

The Objectives of this course is:

1. To teach the methodology involved in forensic investigation.
2. To understand and utilize the facilities available at forensic laboratories.
3. To document and analyze the crime scene.
4. To analyze the biological and entomological evidences for interpretation.

#### Course Outcomes:

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

1. Outline the protocol of forensic science investigation.
2. Involve in forensic investigation.
3. Categorize the evidences and analyze them.
4. Explore the significance of different biological evidences and their significance in interpretation.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO 3
<b>B21GNS212</b>	CO1	3	3	3			3				3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	3
	CO3	3	3	3	3		3				3	3	2	
	CO4	3	3	3	3		3	3	3		3	3	3	3

**Course Contents:**

**UNIT-1**

**12 Hrs**

**Introduction: Scope and future prospects of forensic sciences** - Forensic science Laboratories – CFSL & SFSL.

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes. Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. Crime Scene Evidence - Classification of crime scene evidence - physical and trace evidence. Locard principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene.

**UNIT-II**

**Biological Evidence**

**12Hrs**

Nature and importance of biological evidence. Types and identification of microbial organisms of forensic significance. Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance. Dermatoglyphics. Wildlife Forensics - Fundamentals of wildlife forensic. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Forensic entomology - Insects of forensic importance. Collection of entomological evidence during death investigations.

**UNIT-III**

**Forensic Serology**

**12 Hrs**

Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins. Composition, functions and forensic significance of saliva, sweat, semen, milk and urine. Tests for their identifications. Bloodstain Pattern Analysis - Bloodstain characteristics. Impact bloodstain patterns. Cast off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.



**UNIT IV Genetic Marker Analysis****12 Hrs**

Cellular antigens. ABO blood groups. Extracellular proteins and intracellular enzymes. Significance of genetic marker typing data. Sexual assault investigations. Principles of heredity. Genetics of paternity. DNA markers in forensics. DNA testing in disputed paternity. Missing body cases. Reference populations and databases.

**Reference Books:**

1. Richard Saferstein, Criminalistic: An Introduction to Forensic Science. 7th edition 2001
2. Evidence in Civil and Criminal cases, IV edition, Foundation Press, Westbury, New York.
3. James, S.H. and Nordby J.J. Forensic Science: An introduction to Scientific and investigative techniques, CRC Press, USA, 2003.
4. Chowdhri, S., Forensic Biology B.P.R. & D, Govt. of India.
5. Najjar and NacWillim, Forensic Authropology. 1978.
6. Byrd, J.H. and Cartner, J.L.,. Forensic Entomology, 2001.
7. Robertson, J., Forensic Examination of Hair. Taylor & Forensic. 1999.
8. Cammins, H. and Middle C., Fingerprints Palms and Soles. 1961.

Course code	Environmental Science	L	T	P	C
B21ASM201		2	0	0	2

**Prerequisites:**

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 as a whole 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:**

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

1. Adapt the environmental conditions and protectit
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 protectit.

**Mapping of Course Outcomes with programme Outcomes****Course Contents:**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21ASM201</b>	CO1	1	2	1	1	1	2	3	1	1	1	1	2	1
	CO2	1	3	1	1	1	3	3	1	1	1	1	3	1
	CO3	2	3	2	1	3	3	3	1	1	1	2	3	2
	CO4	1	2	1	1	1	2	3	1	1	1	1	2	1

### Unit-I

6Hrs

**Multidisciplinary Nature Of Environmental Studies:** 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

6Hrs

**Environmental pollution, degradation & Waste management:**

**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 waste water 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

6Hrs

**Energy & Natural resources:**

**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

6Hrs

##### Ecology and ecosystem:

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. “Environmental Studies”, by R.J. Ranjit Daniels and Jagadish Krishnaswamy, (2017), Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr. M. S. Reddy & Chandrashekar, REVA University.
2. “Environmental Studies”, by R.J. Ranjit Daniels and Jagadish Krishnaswamy, (2009), Wiley India Private Ltd., New Delhi.
3. “Environmental Studies” by Benny Joseph, Tata McGraw – Hill Publishing Company Limited.
4. Environmental Studies by Dr. S. M. Prakash, Elite Publishers Mangalore, 2007
5. Rajagopalan R. 2005, “Environmental Studies – from Crisis to Cure”, Oxford University Press.
6. Environmental Science by Arvind walia, Kalyani Publications, 2009.
7. Environmental Studies by Anilkumar Dey and Arnabkumar Dey.

Course Code	General Microbiology Lab	Course Type	L	T	P	C	CH
B21BT0202		HC	0	0	1.5	1.5	3

##### Prerequisites/Pre reading for the course:

The student should have basic knowledge of microscopy & biology.

##### Course Objectives:

The objective of this Course is to:

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

##### Course Outcomes:

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

1. Handle the microscopes and observe the live and fixed specimens.
2. Understand the stages of meiosis and mitosis.
3. Culture and maintain the *Drosophila* in laboratory.
4. Familiarize the structure of polytene chromosomes.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0202</b>	CO1	2	3	3					2		3	2	2	2
	CO2	2	3	3	3				2		3	2	2	2
	CO3	2	3	3		2			2		3	2	3	2
	CO4	2	3	3					2		3	2	3	3

#### Course Content:

1. Microbiological media preparation-NA, NB & MRBA
2. Sterilisation of medium and aseptic techniques, Concept of Pre and Post sterilization
3. Isolation of MOs from air and soil and identification.
4. Pure culture methods-pour, spread & streak plate methods, Preparation of Glycerol Stock
5. Staining methods-Simple, Gram, endospore and negative staining
6. Biochemical test-oxidase, starch hydrolysis, catalase
7. Antimicrobial Susceptibility Test.
8. Cell count by haemocytometer

#### Reference Books:

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

Course Code	Laboratory Course II (Biochemistry)	Course Type	L	T	P	C	CH
<b>B21BC0202</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>

#### Prerequisites:

Requires theoretical knowledge of chemicals and biotechniques.

**Course Objective:**

1. Apply basic techniques in the organic laboratory for preparation, purification and Identification of organic compounds.
2. To develop the skills among students to understand the theory and practice of bio analytical techniques
3. To provide among students the scientific understanding of analytical techniques and detail interpretation of results.

**Course Outcomes:**

1. Apply basic techniques in the organic laboratory for preparation, purification and Identification of organic compounds.
2. To develop the skills among students to understand the theory and practice of bio analytical techniques
3. To provide among students the scientific understanding of analytical techniques and detail interpretation of results.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BC0202</b>	CO1	1	2	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	1	2			1			2	1	1	
	CO4	1	1	2	2			2	1		2	2	2	

**Contents:**

1. Partition Coefficient of benzoic acid between toluene and water.
2. Kinetics of iodination of acetone by colorimetric method
3. Effect of surfactants on surface tension of water.
4. Systematic Qualitative Analysis of organic compound: Amides, Carboxylic acids, alcohol, aldehydes, ketones, Esters
5. Determination of BOD & COD.
6. Estimation of amino acids by formal titration.
7. Separation and identification of amino acids by paper chromatography.
8. Separation and identification of Sugars/lipids by TLC.
9. Estimation of ascorbic acid from biological samples by titrimetric method.

**Reference Books:**

1. An Introduction to practical Biochemistry—Plummer D.T,
2. Biochemical Calculations, Irwin H. Segel 2<sup>nd</sup> Ed. 1976.

3. Modern Experimental Biochemistry R.F. Boyer [Ed.] 1986
4. Analytical Biochemistry; D.J. Holme and H. Pick Longman 1983.
5. Experimental Biochemistry
6. Biochemical methods S.Sadasivam A Manickam Third edition
7. Introductory practical Biochemistry, Sawhney, Randhir singh, 11th Edition 2015
8. Principles and techniques of Biochemistry and Molecular Biology; Keith Wilson and John Walker; 6th Edn. 2005.

CourseCode	Cytogenetics Lab	Course Type	L	T	P	C	CH
B21GN0202		HC	0	0	1.5	1.5	3

#### Course Objectives:

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

#### Course Outcomes:

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

1. Handle the microscopes and observe the live and fixed specimens.
2. Understand the stages of meiosis and mitosis.
3. Culture and maintain the *Drosophila* in laboratory.
4. Familiarize the structure of polytene chromomsomes.

#### Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0202	CO1	3	0	3	3						3	3	2	3
	CO2	3	3								3	3	2	
	CO3	3				3					3	3		
	CO4	3	3			3					3	3	2	

#### Course Contents

1. Microscopy: Handling of Dissection& Simple Microscope.
2. Stereozoom and Compound Microscopes.
3. Temporary squash preparation of onion root tips for mitosis.

- 4.. Temporary squash preparation of onion flower buds for meiosis.
5. Culturing and Handling of *Drosophila*:
  - a) Media Preparation
  - b) Cleaning and Sterilization of bottles
  - c) Handling of *Drosophila*
6. Morphology and Sexual dimorphism
7. Salivary gland Chromosome-  
Dissection of Salivary glands and Preparation of Polytene chromosome.
8. Problems on:
  - a. Sex linkage
  - b. Genetic map

**Reference Books:**

1. Cytogenetics, Plant Breeding and evolution by U. Sinha and Sunita Sinha, Vikas Publishing House Private, Limited, 1998.
2. Cytology, Genetics and Molecular Biology by P.K. Gupta 2002.
3. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
4. Genetic Maps, 6th edition by O'Brien, S (1993) Book 3: Lower Eukaryotes. Book 4: Nonhuman Vertebrates. Book 5: The Human maps. Book 6: Plants. Cold Spring Harbor Lab press New York.
5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. 1992
6. Instant notes in Genetics by P.C. Winter, G.I. Hickey and H.L. Fletcher 2003.
7. Principles of Genetics by E.J. Gardener, M.J. Simmons and D.P. Snustad.J. 1998.

Course Code	Enviromental Biotechnology	Course Type	L	T	P	C	CH
B21BT0301		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

The student should have knowledge of environment science and chemistry

**Course Objectives:**

The Objective of this Course is to:

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

**Course Outcomes:**

After completion of the course students will be able to:

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

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BT0301</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course Contents:

#### Unit-I

##### Energy Sources and Environmental hazards

**12 Hrs**

Various forms of Energy sources, Pollution and its hazardous impact on environment, Role of biotechnology to solve the environmental problems. Current scenario of environmental hazards  
Biotechnological methods of pollution detection: general bioassay, cell biological methods, immunoassays, DNA-based methods, use of biosensors.  
Biotechnological methods in pollution abatement: Reduction of CO<sub>2</sub> emission. Wastewater treatment – conventional wastewater treatment, use of algae, Bioreactors for waste-water treatment, eutrophication, concept of chlorination, application of cell immobilization.

#### Unit-II

##### Bioremediation

**12Hrs**

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

#### UNIT III

##### Solid waste Management

**12 Hrs**

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

#### Unit-IV

##### Eco-friendly bio-products

**12 Hrs**



Biomass resources, Biogas, alcohol as fuel, biological hydrogen generation, Bio-plastics and Biopolymers. Biofertiliser and Biopesticides, Biofuels and Bio-diesel. Azola and Azotobacter, VAM, Sustainable Environment and concept of Circular Economy. Current Rules and Regulations for eco-friendly bi-products

**Reference Books:**

1. Biotechnology. Keshav Trehan, New Age International (P) Ltd, New Delhi, 2001.
2. Agricultural Biotechnology, Purohit
3. Environmental Biotechnology, Foster C.F., John Wae D.A., Ellis Horwood Limited.
4. Introduction to Environmental Biotechnology. A. K. Chatterji. Prentice-Hall of India Pvt.Ltd. New Delhi, 2002.

Course Code	Human Physiology	Course Type	L	T	P	C	CH
<b>B21BC0301</b>		<b>HC</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>4</b>

**Course Objective:**

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

**Course Outcomes:**

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

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

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0301</b>	CO1	<b>2</b>		<b>3</b>		<b>2</b>		<b>2</b>		<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	
	CO2	<b>3</b>	<b>2</b>		<b>1</b>	<b>2</b>		<b>3</b>			<b>3</b>		<b>2</b>	<b>2</b>
	CO3	<b>1</b>		<b>2</b>	<b>2</b>		<b>2</b>	<b>3</b>		<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	
	CO4	<b>3</b>	<b>2</b>		<b>2</b>	<b>2</b>		<b>3</b>	<b>3</b>		<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>

## Course Contents:

### UNIT I

12 hrs

**The Body Fluid Compartments:** Intracellular, extracellular and interstitial fluid. Plasma as an extracellular fluid; plasma composition; plasma proteins; Blood cellular components.

**The Cardio Vascular System:** Anatomy of heart; Physiology of the cardiac muscle; relationship between cardiac cycle, heart sound ventricular volumes and the ECG; Control of cardiac function and output; Control of blood flow to the tissues; Portal circulations. Arterial pressure and its regulation. Hypertension, Congestive heart disease, atherosclerosis and Myocardial infarction.

### UNIT II

12 hrs

**Renal Physiology:** Anatomy of the kidney and the nephron; Regulation of renal blood flow; physiology of glomerular filtration; GFR; Tubular processing of the glomerular filtrate; Renal clearance; Assessment of kidney function. Glomerular nephritis, renal failure, definition and use of dialysis and diuretics.

**Respiration:** Organization of the pulmonary system; Mechanism of respiration; Principles of Gas exchange and transport; Regulation of respiration; pH; Acidosis and Alkalosis. Hypoxia, hypercapnia, pulmonary distress, emphysema.

### UNIT III

12 hrs

**Gastrointestinal and Hepatic Physiology:** Secretion, regulation of secretion, composition and functions of saliva, gastric, pancreatic and intestinal juices and bile. Gastrointestinal hormones. Digestion, absorption and transport of carbohydrates, proteins, lipids, nucleic acids, Anatomy of the hepatic lobule; blood flow into the liver. Metabolic importance of liver; Liver function tests. Jaundice and Liver cirrhosis. Musculoskeletal system: Bone structure and formation. Physiology of muscle contraction in striated and nonstriated muscle.

### UNIT IV

12 hrs

**Reproductive Physiology:** Development of female and male genital tracts; Spermatogenesis; capacitation of sperm; testis blood barrier; Physiology of female reproductive of placenta; the feto placental unit.

**Neurophysiology:** Organization of the central nervous system; cells of the nervous system and anatomy and physiology of Blood Brain Barrier. Introduction to neural networks: central, autonomic and peripheral; the sensory and motor tracts; mechanism and importance of myelination. Sensory perception of Pain, temperature, touch and vision; Physiology of reflex action; the motor cortex; corticospinal tracts.

### Reference Books:

- 1) Human Physiology, Vol. I & II, O C. C. Chatterjee – Medical Allied Agency – Calcutta.
- 2) Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
- 3) Textbook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
- 4) Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
- 5) Textbook of medical physiology: A. C. Guyton, and J. E Hall. Saunders Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd .New Delhi

- 6) Principles of anatomy and physiology: 13<sup>th</sup> edition, Gerard J Totoro, Bryan Derrickson.  
 7) Widmaler, E.P, Raff.H, Strang, K.T. (2008) Vander's Human Physiology 11th edition, McGraw Hill International Publications.  
 8) Fox, S.I. (2002) Human Physiology 7th edition, McGraw Hill Publications.

Course Code	Molecular Genetics	Course Type	L	T	P	C	CH
B21GN0301		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

The objective of this Course is:

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

**Course Outcomes:**

After the end of the Course students will be able to

1. Understand the characteristics of nucleic acids.
2. Illustrate the processes of gene expression and various stages of gene regulation.
3. Understand the inheritance pattern in bacteria.
4. Associate the mutations linked with several disorders.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0301	CO1	3	3				3		3		3	3	2	
	CO2	3	3	3	3	3	3		3		3	3	3	
	CO3	3	3	3		3	3				3	3	2	
	CO4	3	3	3	3		3		3		3	3	2	

**Course Contents:**

**UNIT I**

**12 hrs**

**a. Chemical Basis of Heredity:**

DNA as genetic material 0 Experiments of Griffith; Avery, McLeod and McCarty; Hershey and Chase. RNA as genetic material 0 Experiment of Fraenkel and Singer.

**Nucleic acids:**

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

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

**DNA Replication:** Meselson and Stahl Experiment.

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

## **UNIT II**

**12 hrs**

### **Gene expression:**

Transcription: Prokaryotes and eukaryotes initiation, elongation and termination (rho dependent and rho independent).

Post transcriptional modifications: methylation, polyadenylation, RNA splicing.

Translation: Prokaryotes and eukaryotes, Genetic code and its properties; process of translation Initiation, elongation and termination. Posttranslational modifications of proteins.

Protein sorting

## **UNIT III**

**12 hrs**

### **Gene regulation:**

Concept of operon, Inducible operon – Lac operon – structure and mechanism, Catabolite repression. Repressible operon – Tryptophan operon – structure and mechanism.

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

## **UNIT IV**

**12 hrs**

### **Mutations:**

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

Pleiotropy definition and examples.

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

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

Mutation as raw material for evolution.

Beneficial effects of mutation.

### **References Books:**

1. Advanced Genetics by G.S. Miglani. 2002.
2. Advanced Molecular Biology by Twyman R.M 1998.
3. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder College. 1980.
4. Genes IX, 9<sup>th</sup> Ed., Benjamin Lewin. Jones and Bartlett Publishers, 2008.
5. Genetics – Analysis of Genes and genomes – VII edition – Daniel L. Hartl and Elizabeth W. Jones. 2011.

6. Genetics – from genes to genomics – Leland Hartwell, Leroy Hood, Charles (Chip) Aquadro, Michael L. Goldberg, Maria Papaconstantinou, Fischer, Janice, Jim Karagiannis. McGrawHill Education, 2017.
7. Genomes by T.A. Brown 2002.
8. Instant Notes in Molecular Biology by P.C. Turner et al 2002.
9. Molecular cell Biology, 2<sup>nd</sup> edition by Darnell, J., H. Lodish and D. Baltimore 1990.
10. Molecular Genetics by D.N. Bharadwaj. Kalyani, 2008

Course Code	Nutritional Biochemistry	Course Type	L	T	P	C	CH
B21BCSC311		SC	2	1	0	3	4

### Course Objective:

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

### Course Outcomes:

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

1. Understand the requirement of balanced diet, energy content of food.
2. Receive knowledge about the different types of macronutrients and micronutrient required for normal physiological functions.
3. Understand the different types of anti nutrient compound and crop to hamper normal metabolism.
4. Understand requirement of nutrition during normal and pregnancy conditions.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21BCSC311	CO1	2		3		3		2		1	1	2	1	
	CO2	1		2	2		3	3		2	2	2		1
	CO3	2	1		1	2		2	2		1	1	2	
	CO4	3		2	2			1	1		1	2	2	

### Course Content:

#### UNIT 01

12 hrs

**Nutrition:** Understanding relationship between food, nutrition and health, Principles of Meal Planning, Energy content of foods, Balanced diet Definition, characteristic feature of balanced diet, proximate analysis of foods for carbohydrate, proteins, fats, fibre material and water content.

Bomb calorimeter diagram and description, Determination of calorific value of foods (Carbohydrate, fat and protein); respiratory quotient of food stuffs and significance of RQ. BMR determination by direct and indirect method; BOD; SDA definition; SDA for carbohydrate, fat and mixed diet and its significance. RDA for different physical activities pregnant women, lactating woman, infants and children.

**Methods of Cooking:** Dry, moist, frying and microwave cooking. Advantages, disadvantages and the effect of various methods of cooking on foods. Nutrient losses in cooking and enhancing the nutritional quality of foods.

#### **UNIT 0II**

**12hrs**

Macronutrients Carbohydrate, proteins, lipid and fibre; Essential amino acids, semi essential and nonessential amino acids; complete and incomplete proteins, protein efficiency ratio; Nitrogen balance Positive and negative nitrogen balance.; Fortification Definition and Biomedical importance; Protein Energy malnutrition: Kwashiorkor & Marasmus causative factors, treatment and prevention.

**Micronutrients:** Nutritional importance of vitamin, classification, source, daily requirements and functions; Deficiency symptoms hyper vitaminoses of fat soluble vitamins. Nutritional importance of Minerals Definition, classification, source, daily requirement and deficiency symptoms.

#### **UNIT 0III**

**12 hrs**

Anti nutritional factors: Sources and harmful effects of anti vitamins (avidin, dicoumarol), Natural toxicants (Lathyrus sativa) and adulterants (butter yellow, lead chromate, malachite green)

Acid base balance disorders: Acidosis and Alkalosis. Functions of water, Distribution of total body water, Regulation of water balance, disorders of water metabolism. Distribution of fluids in the body, ECF, ICF. Interaction between immunity, nutrition and infection. Impact of malnutrition on immunity and occurrence of infections. Effect of Infection on nutritional status

#### **UNIT 0IV**

**12 hrs**

Adults – Nutrition for adult man and woman, nutritional concerns, diet and lifestyle related diseases and their prevention.

Pregnancy – Physiological changes in pregnancy, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them.

Lactation – Physiology of lactation, nutritional needs of a nursing mother, feeding the baby. Elderly – Life expectancy, physiological changes in elderly, nutritional and health concerns in old age and their management, factors contributing to longevity

#### **Reference Books:**

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009).
2. Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd.
3. Srilakshmi (2010). Food Science, 5th Edition. New Age International Ltd.
4. Wardlaw MG, Insel PM (2004). Perspectives in Nutrition, Sixth Edition, Mosby

5. Principles of Nutrition by M.S Swaminathan
6. Principles of Nutrition by Dr.C. Gopalan.
7. Human Nutrition and Dietetics by Davidson and Passmore; 8th edition (1986)
8. Modern Nutrition and Health disease by M.E. Skillis and V.R. Young

Course Code	Hormonal Biochemistry	Course Type	L	T	P	C	CH
B21BCS312		SC	2	1	0	3	4

**Course Objective:**

1. To understand about types of endocrine gland, hormone and signaling pathways
2. To know about hormones and their receptors, toxic compounds effect on signalling pathways.
3. To understand role of hormone in various disorders.

**Course Outcomes:**

After completing the course the student shall be able to:

1. Understand the classification and their functions concerned with metabolism.
2. Gain knowledge about signaling molecule, pathways and how toxic compound hamper normal pathways
3. Know the types of disease related with endocrine disorder.
4. Understand about the sex hormone for male and female development and physiology

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BCS312	CO1	2		3		2		2				2	2	1
	CO2	1			3		2		3		3	2	3	
	CO3	1		3					3		3	2		2
	CO4	2	3		3		2		3	2	2		1	

**Course Content:**

**UNIT I**

**12 Hrs**

Introduction 0 History, endocrine glands, and hormones as chemical messengers, stimulus for hormone release: change in homeostasis, sensory stimulus and others. Cell signalling & Mechanism of Hormone action: Receptor study, Binding affinity, specificity, Scat chard plot and purification. G protein linked receptor family; Signal transduction pathways involving G0 proteins. Phosphoprotein phosphatases& Phosphodiesterase. Receptor tyrosine kinase family0 EGF receptor family, Insulin receptor family, & Cytokine/erythropoietin receptor family associated with non0receptor Tyrosine kinase (Signal transduction pathways involving: SH2 proteins, ras, IRS01, Raf, MEK, MAP kinase, JAK0STAT pathway).

**UNIT II**

**12 hrs**

Intra0cellular Receptors 0 Steroid hormone receptors, Thyroid hormone receptors. Sensitisation

& Desensitization of receptors; Short term regulation & Long term regulation. Drugs and Toxins affecting cell signalling: Cholera toxin, pertussis toxin, anthrax toxin, Bubonic Plague virulence, Forskolin, theophylline, Phorbol esters, Sildenafil (Viagra). Hypothalamic Hormones: CRH, TRH, GnRH, PRL/PRIH, GHRH/GHRIH. Pituitary Hormones 0 Anterior Pituitary hormones0 Growth hormone, Prolactin, POMC peptide family, LH, FSH, TSH; Posterior Pituitary: Vasopressin, Oxytocin.

### UNIT III

12 hrs

Endocrine disorders: Gigantism, Acromegaly, dwarfs, pigmies  
 Pathophysiology: Diabetes insipidus. Thyroid Hormone (include biosynthesis) Goitre, Graves' disease, Cretinism, Myxoedema, Hashimoto's disease.  
 Hormones regulating Ca<sup>2+</sup> Homeostasis: PTH, Vit D, Calcitonin. Pathophysiology: Rickets, Osteomalacia, Osteoporosis.  
 Pancreatic Hormones: Insulin, Glucagon, Diabetes type I & II. GI tract Hormones: Gastrin, Secretin, CCK, GIP, Ghrelin

### UNIT IV

12 hrs

Hormones of Adrenal Cortex: Aldosterone (renin angiotensin system) & cortisol.  
 Pathophysiology: Addison's disease, Conn's syndrome, Cushing's syndrome. Hormones of Adrenal Medulla, Epinephrine & norepinephrine.  
 Reproductive Hormones: Male & female Sex hormones.  
 Other organs with endocrine function: Heart (ANP), Kidney (erythropoietin), Liver (Angiotensinogen, IGF01), Adipose tissue (Leptin, adiponectin). Pathophysiology: Obesity.  
 Growth factors: PDGF, EGF, IGF01, II, & NGF.

### Reference Books:

1. Nelson, D.L. and Cox, M.M. (2005). Lehninger Principles of Biochemistry, W.H. Freeman & Com
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008). Vander, Sherman, Luciano's Human Physiology, McGraw-Hill Higher Education.
3. Darnell, J., Lodish, H. and Baltimore, D. (2008). Molecular Cell Biology, Scientific American Books.
4. Human Physiology by CC. Chatterjee, 11th edition (1985)
5. Essentials of Medical physiology by K Sambulingam, 3rd edition, 2005
6. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
7. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1997), Wiley-Liss.

Course Code	Health & Hygiene	Course Type	L	T	P	C	CH
B21AS0302		OE	3	0	0	3	4

### 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:**

After completing the course students should 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**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21ASO302</b>	CO1	2	3	3	2	2	2	2	3	1	3	2	3	1
	CO2	2	3	3	2	2	1	2	1	1	3	2	2	3
	CO3	2	3	3	2	1	1	2	1	1	3	2	2	2
	CO4	2	3	3	2	1	1	2	1	1	3	2	3	3

**Course Content:****UNIT I****12 Hrs**

Social aspects of health

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, Life style and Social cultural aspects.

**UNIT II****12 Hrs**

Nutritional aspects

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****12 Hrs**

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

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

**UNIT IV**

**12 Hrs**

Genetic disease and their management Gene disorder – sickle cell anemia, haemophilia, Cystic fibrosis and chromosomal disorders down syndrome, turner’s syndrome crucefield-jacobson syndromes. Introduction to gene therapy

**Reference Books:**

1. Gordon Edlin and Eric Golanty (2010) Health & Wellness (10th Edn) Jones & Barlett Publisher.
2. MaryJane Schneider (2014) Introduction to Public Health (4th Edn,) Jones & Barlett
3. Adams MR and Moss MO (2008) Food Microbiology (3rd Edition) RSC publications, UK.
4. Geoffrey Campbell Platt (Editor) (2009) Food Science and Technology, Wiley and Blackwell Publication, UK.
5. Lightfoot NF and Maier EA (Editor) (2003) Microbiological analysis of food and water, Elsevier Publication, Netherland.
6. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2010) Jawetz, Melnick and Adelberg’s Medical Microbiology. 25th Edition. McGraw Hill Publication
7. Essential Medical Genetics Includes Desktop Edition, 6th Edition (2011) Edward S. Tobias, Michael Connor, Malcolm Ferguson-Smith, Wiley Blackwell Publication.

Course Code	Environmental Biotechnology Lab	Course Type	L	T	P	C	CH
B21BT0302		HC	0	0	1.5	1.5	3

**Prerequisites/Pre reading for the course:**

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

**Course Objective:**

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

**Course Outcomes:**

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

1. Analyse the detrimental effect of the different pollutants bioremediation in the environment.
2. Develop remedies to control pollution.
3. Categorise the pollutants depending on their hazardous effect.

4. Establish and practice vermicomposting.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0302</b>	CO1	2	3	3			2		3	2	3	3	2	3
	CO2	2	3	3	3		2		3	2	3	3	2	3
	CO3	2	3	3		2	2		3	2	2	3	2	3
	CO4	2	3	3			2		3	2	3	3	2	3

#### Course Contents

1. Determination of DO and BOD of water sample.
2. Determination of COD of water sample.
3. Determination of total dissolved solids.
4. Microbial analysis of water through MPN method.
5. Estimation of Hardness of water through calcium estimation.
6. Estimation of chromium in industrial effluents.
7. Biodegradation of industrial aromatic compounds.
8. Vermicomposting, Azolla production

#### Reference Books:

1. Biotechnology. Keshav Trehan, New Age International (P) Ltd, New Delhi, 2001.
2. Agricultural Biotechnology, Purohit
3. Environmental Biotechnology, Foster C.F., John Wae D.A., Ellis Horwood Limited.
4. Introduction to Environmental Biotechnology. A. K. Chatterji. Prentice Hall of India Pvt.Ltd. New Delhi, 2002.

Course Code	Laboratory course III (Biochemistry)	Course Type	L	T	P	C	CH
<b>B21BC0302</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>3</b>

#### Prerequisites

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

#### Course Objectives:

1. To gain practical knowledge on chemistry of biomolecules.
2. To analyse the contents of amino acids & proteins by qualitative methods
3. To analyse the contents of amino acids & proteins and quantitatively methods. 3. To know the characterization of proteins from samples.

**Course Outcomes:**

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

1. Analyze carbohydrates, proteins and lipids qualitatively
2. To get the ability to evaluate carbohydrates, proteins and lipids quantitatively.
3. Isolate and separate and determine protein contents from biological samples.
4. To determine protein contents from biological samples

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BC0302</b>	CO1	2		2	1			2	1		1	1	1	
	CO2	1	2	1	2			1			2	2	1	
	CO3	2	2	2	2			2	1		2	1	1	
	CO4	1	1	1	1			1	1		2	2	2	

**Course Contents:**

1. Qualitative tests for Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids
2. Mutarotation of sugars.
3. Preparation of casein from milk and determination of its isoelectric point.
4. Determination of iodine & saponification value of a lipid.
5. Estimation of Proteins by Biuret, Lowry and Bradford.
6. Estimation of amino acid (alanine/glycine) using ninhydrin by colorimetric method.
7. Separation of Amino acids by Ion Exchange Chromatography /Gel Filtration Chromatography.
8. SDS PAGE analysis of proteins.

**Reference Books:**

1. An Introduction to practical Biochemistry—Plummer D.T, Tata McGraw Hill
2. Biochemical Calculations, Irwin H. Segel (1976) 2<sup>nd</sup> Ed. Jhon Wiley and Sons.
3. Modern Experimental Biochemistry R.F. Boyer [Ed.] (1986) Addison Wesley.
4. Analytical Biochemistry; D.J. Holme and H. Pick Longman (1983).
5. Experimental Biochemistry: A Student Publisher: I.K. International Publishing House Pvt. Ltd. (Deshpande)
6. Biochemical methods S. Sadasivam A Manickam, New Age International Pvt Ltd Publishers; Third edition
7. Introductory practical Biochemistry, Sawhney, Randhir singh, 11<sup>th</sup> Edition (2015)
8. Lab manual of Biochemistry, Immunology and BioTechnology, Artinagam and Archana Ayyagiri 00 Tata McGraw Hill

Course Code	Molecular Genetics Lab	Course Type	L	T	P	C	CH
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<b>B21GN0302</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>
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**Prerequisites/Pre reading for the course:**

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

**Course Objective:**

The objective of this Course is:

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

**Course Outcomes:**

After the end of the Course students will be able to

1. Extract and estimate the DNA from different sources.
2. Estimate the DNA and RNA using standard protocols.
3. Characterize DNA and proteins using agarose gel electrophoresis and SDS PAGE.
4. Analyse the genetic disorders.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0302</b>	CO1	3	3	3	3			3	3	3	3	2	3	3
	CO2	3	3	3				3		3	3	2	3	3
	CO3	3	2	3	3			3		3	3	3	3	3
	CO4	3	3	3	3		3	3	3	3	3	3	3	3

**Course Contents**

1. Genomic DNA isolation in plants – Cauliflower, Coconut endosperm
2. DNA isolation in bacteria
3. DNA isolation in animal – liver
4. Estimation of DNA by Diphenyl amine method
5. Estimation of RNA by Orcinol method
6. Agarose gel electrophoresis
7. SDS PAGE – Poly Acrylamide Gel Electrophoresis
8. Study of mutations:
  - Sickle cell Anaemia Mis – sense mutation.
  - Thalassemia – frame shift mutation.
  - Identification of point mutation types based on the given representation.

**Reference Books:**

1. Advanced Genetics by G.S. Miglani. 2002.



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- «zÄÿðUÄ¼Ä, ÄaÄðvÉÆÄaÄÄÄR "É¼ÄÄtÄUÉUÉ CÆÄÄaÄUÄÄaÄAvÉ °ÁUAÆ CªAgÄ°è aÄiÁÆÄaÄ, ÄAŞAz sÄUÄ¼Ä §UÉÍ UËgÄaÄ, ÄaÄiÁÆÄvÉ aÄÄÆr1, "É¼É, ÄÄaÄ an ÖÆÄ°è ÆAoÄaUÄ¼Ä DAIÉÄiÄiÄvzÉ.
- CªAgÄ°è ÄÈdÆÄÄ@vÉ, ±ÄÄzÄP " sÁµÉ, GvÄÛaÄÄ «aÄÄ±Äð UÄÄt, ægÄUÄð¼Ä ÄÄ"sÁµÄuÉ, " sÁµÄt PÄ- É °ÁUAÆ §gÄ°Ä PË±Ä@äUÄ¼ÄÆÄÄß "É¼É, ÄÄaÄÄzÄÄ UÄÄjÄiÄiÄvzÉ
- Äaz sÄðvÄäPÄ ÆAjÄPÉëUÄ½UÉ CÆÄÄPÄÆ®aÄUÄÄaÄAvÄ°Ä «µÄAiÄÄUÄ¼ÄÆÄÄß UÄÄÄÆÄzÄ°è IÄÖPÉÆAqÄÄ, ÄÆPÄÛ ÆAoÄaUÄ¼ÄÆÄÄß DAIÉÄiÄ aÄiÄrPÉÆ¼ÄÄ ÄvzÉ.

Course Outcomes:

- dÆÄÆÄzÄ, ÆÄæaÄÆÄ, aÄÄzsÄäPÄ°ÄÆÄzÄ ««zsÄ ÆÄæPÄgÄzÄ PÄaÄaUÄ¼ÄÄ, °ÉÆ, ÄUÄÆÄßqÄzÄ, ÄtÜPÄxÉUÄ¼ÄÄ °ÁUAÄ ÄÁIPÄ, Ä»vÄä PÄ°PÉAiÄÄ aÄÄÆ®PÄ PÄ®zÄ 1ÜvÄäAvÄgÄUÄ¼ÄÆÄÄß CzÄgÄ M¼ÄÆÉÆÄiUÄ¼ÄÆÄÄß "É¼É, ÄÄvÄÛzÉ.
- ÄaÄiÄfPÄ, gÄdQÄAiÄÄ, z sÄ«ÄðPÄ, ÄÄ, ÄløwPÄ, ÆAj, ÄgÄ °ÁUAÆ °AUÄ, ÄAŞAç ü «ZÄgÄUÄ¼ÄÉqÉ UÄaÄÆÄÄ Äj, ÄÄaÄÄzÄgÉÆAçUÉ «zÄÿðUÄ¼Ä°è ZÄZÄð aÄÄÆÉÆÄ" sÄaÄaÄÄ "É¼ÉAiÄÄÄvÄÛzÉ.
  - fÄÄÆÄzÄ°è §gÄÄÄ C© üÆÄæAiÄÄ "ÉÄz sÄUÄ¼ÄÄ, ÄaÄÄ ÄäUÄ¼ÄÆÄÄß Dz sÄÄæPÄ ÄAzÄ"sÄðzÄ°è aÄiÁÆÄ«ÄAiÄÄvÉAiÉÆAçUÉ æÄð», ÄÄaÄAvÉ ÆÉæÄgÉÄi, ÄÄvÄÛzÉ.
  - GvÄÛaÄÄ, ÄAaÄ°ÄÆÄ PÄ- ÉAiÄÄÆÄÄß "É¼É, ÄÄaÄ GzÉYÄ±ÄaÄÆÄÄß FqÉÄj, ÄÄvÄÛzÉ.
  - ÄÄ±ÉÆÄzÄÆÄ aÄÄÆÉÆÄ" sÄaÄ aÄÄvÄÄÛ Äaz sÄðvÄäPÄ ÆAjÄPÉëUÄ½UÉ «zÄÿðUÄ¼ÄÆÄÄß, ÄdÄÓUÉÆ½, ÄÄvÄÛzÉ.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21AHK401</b>	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content:

Unit I ÄÄÄä01ÜçÄÄÄç PÄ«vÉUÄ¼ÄÄ  
7 Hrs

1. ŞÄçPªAAvÄjUÉ PÄÆÄ, ÄÄ ©zÄÝgÉ J.PÉ.gÄaÄÄÆÄÄdÆi
2. PÄÄjUÄ¼ÄÄ, ÄgÄ PÄÄjUÄ¼ÄÄ PÉ.J, i, æ, ÄgÄ C°ÄÄÄzi
3. CPÄi °ÉÄ½zÄÄÝ, Ä. GµÄ

Unit II zÄ°vÄ0ŞAqÄAiÄÄ  
7 Hrs

1. ÄÆÄß PÄªÆÄUÄ¼Ä°è °ÄÄqÄÄPÄçgÄÄ ÄÆÄß ZÄÄÆÄ
2. zÄ°vÄgÄÄ §gÄÄªgÄÄ zÄj©r 1zÄP°AUÄAiÄÄä

3. PÄIÖqAzÀ PÉ@, ÀUÁgÀgÀÄ JZi J, i 2ªÀ¥ÀæPÁ±À

Unit III - ÉÄR£ÀUÀ¼ÄÄ  
6 Hrs

1. °Ä¹gÄÄ °ÉÆ, ÀPÄÄªÀ UÄtÄUÄ¼ÄÄ AiÄÄ® è¥Äà gÉrØ
2. eÄUÄwÄPÄgÄtzÀ »£Éß- ÉAiÄÄ°è UÁAçüÄfAiÄÄ ¥Àæ, ÄÄÜvÄvÉ 1. £ÄUÄtÜ
3. ZÁªÄðPÄgÄÄ: MAzÄÄ n¥ÄàtÄ ! J£i gÄAUÄ£i

Unit IV PÄzÄÄSj  
Hrs

6

1. ,ÄÄ, ÄlgÄ (DAiÄÄÝ" sÄUÄ) AiÄÄÄ.Dgï. C£ÄAvÄªÄÄÆwð

Reference Books:

1. ªÄÄÄUÄ½ gÄÄ.ªæÄ., PÄ£ÄßqÄ ,Ä»vÄå ZÄjvÉæ, ¥ÀæPÁ±ÀPÄgÄÄ VÄvÄ §ÄPi °É, i, ªÉÄÉ, ÄÆgÄÄ. 2014
2. 1ªÄAiÄwÄvÄ PÄ£ÄßqÄ ,Ä»vÄå ZÄjvÉæ ,ÄÄ¥ÄÄI 1,2,3,4,5 ªÄÄvÄÄÜ 6, PÄªÄÉA¥ÄÄ PÄ£ÄßqÄ CzsÄªAiÄÄ£Ä ,ÄÄ, ÉÜ, ªÉÄÉ, ÄÆgÄÄ «±Äé«zÄªª®AiÄÄ, ªÉÄÉ, ÄÆgÄÄ. 2014
3. qÄ. CgÄ«AzÄ ªÄAiÄ@UÄwÜ, ,Ä»vÄå ,ÄÄ, ÄlØw ªÄÄvÄÄÜ zÄ°vÄ ¥ÄæeÉÖ, ¥ÀæPÁ±ÀPÄgÄÄ PÄ£ÄßqÄ ,Ä»vÄå ¥ÄjµÄvÄÄÜ, "ÉAUÄ¼ÄÆgÄÄ. 2014
4. qÄ. F.J,i. DªÄÄÆgÄ, PÄ£ÄßqÄ PÄxÄ£Ä ,Ä»vÄå : PÄzÄÄSj, ¥ÀæPÁ±ÀPÄgÄÄ ,Äé¥Äß §ÄPi °É, i, "ÉAUÄ¼ÄÆgÄÄ. 2016
5. zÉÄ±Ä¥ÄAqÉ J,i.J-i., "ÉÄAzÉæ ±ÄjÄ¥ sÄgÄ PÄªÄªAiÄiÄ£Ä, ¥ÀæPÁ±ÀPÄgÄÄ zÉÄ¹ ¥ÄÄ, ÄÜPÄ, "ÉAUÄ¼ÄÆgÄÄ. 2013
6. QÄvÄð£ÄxÄ PÄÄvÄðPÉÆÄn, PÄ£ÄßqÄ ,Ä»vÄå ,ÄAUÄw, ¥ÀæPÁ±ÀPÄgÄÄ PÄÄvÄðPÉÆÄn ªÉÄªÉÆÄjAiÄÄ-i læ, iÖ, z sÄgÄªÄqÄ. 2009
7. ±ÄªÄÄgÄAiÄÄ vÄ, ÄÄ., PÄ£ÄßqÄ ,Ä»vÄå ZÄjvÉæ, ¥ÀæPÁ±ÀPÄgÄÄ vÄ¼ÄÄQ£Ä ªÉAPÄtÜAiÄÄª ,ÄÄgÄPÄ UÄæAxÄªÄiÄ-É, ªÉÄÉ, ÄÆgÄÄ 02014
8. ,ÄÄ. qÄ! 1. Dgï. ZÄAzÄæ±ÉÄRgï, ªÄÄÄAzÄ¼ÄÄvÄ£ÄzÄ ®PÄètUÄ¼Ä£ÄÄß "É¼É¹PÉÆ¼ÄÄiªÄÄzÄÄ °ÉÄUÉ?, ¥ÀæPÁ±ÀPÄgÄÄ £ÄªPÄ£ÄðIPÄ ¥Ä© èPÉÄµÄ£i i ¥ÉæöÉªÉmï°«ÄmÉqï. 2010
9. Dz sÄÄªPÄ PÄ£ÄßqÄ PÄªÄª " sÄUÄ02, PÄªÄªÉA¥ÄÄ PÄ£ÄßqÄ CzsÄªAiÄÄ£Ä ,ÄÄ, ÉÜ, ªÉÄÉ, ÄÆgÄÄ «±Äé«zÄªª®AiÄÄ, ªÉÄÉ, ÄÆgÄÄ. 2004
10. 2ªÄgÄÄzÄæ¥Äà f.J,i. PÄ£ÄßqÄ ,Ä»vÄå ,Ä«ÄPÉè, ¥ÀæPÁ±ÀPÄgÄÄ ,Äé¥Äß §ÄPi °É, i, "ÉAUÄ¼ÄÆgÄÄ. 201

Course Code	Course Title	Course	L	T	P	C	Hrs
B21AHH401	Language – IV: Hindi - IV	FC	1	1	0	2	3

Course description: अध्ययनवर्णन :

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

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 ।

### Learning 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 पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है ।
- साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है ।

### c) Pedagogy: शिक्षाशास्त्र :

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

### Prerequisites/Pre reading for the course: पूर्वपेक्षा:

- अध्येता को, हिन्दी खंड काव्य का संक्षिप्त ज्ञान आवश्यक है ।
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है ।
- हिन्दी व्याकरण का अवबोधन आवश्यक है ।

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHH401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

### Course Content: अध्ययन विषय सूची / पाठ्यक्रम

**इकाई-1:** खंड 0 काव्य – नहुष – मैथिली शरणगुप्त

7

hrs

कवि परिचय

काव्य परिचय

शचीसर्ग

नहुषसर्ग

**इकाई-2:** खंड 0 काव्य – नहुष – मैथिली शरणगुप्त

7

hrs

उर्वशीसर्ग

स्वर्गभोगसर्ग

**इकाई-3:** खंड0काव्य – नहुष – मैथिलीशरणगुप्त

6

hrs

सन्देशसर्ग

मंत्रणासर्ग

पतनसर्ग

**इकाई-4:**

6

hrs

**सिनिमारिव्यू :**

सूपर 30, मिशनमंगल, थप्पड़, आर्टिकल 15

**सूचना : प्रत्येकइकाई 25 अंककेलिएनिर्धारितहै।**

#### d) Suggested Text Books and References

**Text book/s: पाठ्यपुस्तक:**

1. खंड0काव्य – नहुष – मैथिलीशरणगुप्त

**References: सन्दर्भग्रन्थ:**

1. रस – छंद – अलंकर0 कृष्णदेवशर्मा&सुरेशअग्रवाल
2. हिन्दीसाहित्यकाइतिहास 0 डॉ. नागेन्द्र
3. आधुनिकहिन्दीसाहित्यकाइतिहास 0 डॉ. बच्चनसिंह
4. हिन्दीसाहित्यकानवीनइतिहास 0 डॉ. लालसाहबसिंह
5. शुद्धहिन्दीकेसेबोलेकेसेलिखे0 पृथ्वीनाथपाण्डे
6. मीडियाविमर्श – रामशरणजोशी

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHA401	Language IV: Additional English -BIV	FC	1	1	0	2	3

#### Course Description:

This 20credit course helps the learner explore various socio0cultural issues through literature. The course provides insight on matters like education and culture that are pertinent in the contemporary society. The course also offers multi0dimensional perspective in the genres of literature and contributes for language enrichment.

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

**Pedagogy:** Collaborative Method, Flipped Classroom, Blended Learning

**Course Objectives:**

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

<b>Course Outcome:</b>
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On completion of the course, learners will be able to:

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

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHA401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

<b>Course Contents:</b>
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**Unit I: Myths & Mythology** **6**  
**hrs**

John W. May – Narcissus

W.B. Yeats – The Second Coming

Devdutt Pattanaik 0 *Shikhandi and the Other Stories They Don't Tell you* (Extracts)

**Unit II: Family & Relationships** **6**  
**hrs**

Nissim Ezekiel – Night of the Scorpion

Langston Hughes – Mother to Son

Kate Chopin – The Story of an Hour

Henrik Ibsen – A Doll's House (Extract)

**Unit III: Horror & Suspense** **7**  
**hrs**

Edgar Allan Poe – The Raven

Bram Stoker – A Dream of Red Hands

Satyajit Ray – Adventures of Feluda (Extract)

**hrs**

The Dalai Lama – The Paradox of Our Times

Kamala Wijeratne – To a Student

Sudha Murthy – In Sahyadri Hills, a Lesson in Humility

Frigyes Karinthy – Refund

**Reference Books:**

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

Course Code	Molecular Biology and Genetic Engineering	Course Type	L	T	P	C	CH
B21BT0401		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

- The student should have knowledge of biomolecules, cellular structures
- The student should have basic knowledge of biochemistry

**Course Objectives:**

1. The objective of this course is to have a firm foundation in the fundamentals of Molecular Biology mainly about genetic materials, central dogma, replication and gene expression study
2. To acquaint students with the complete information about the mechanism of protein synthesis, post translational activity and gene regulation.
3. To familiarize the students with the basic concepts and molecular tools in genetic engineering and recombinant DNA technology.
4. To appraise the students about the techniques and application of genetic engineering.

**Course Outcome:****By the end of the course the student will be able to:**

1. Understand the various types of genetic materials and its replication and post replication process in prokaryotes and eukaryotes
2. To explores the mechanisms associated with translations and various posttranslational activity and the regulation of gene in prokaryotes and eukaryotes
3. Describe the function of the most common enzymes, different types of cloning and transformation studies used in genetic engineering.
4. Explain about the concept of gene libraries and the principles of different nucleic acid sequencing methods, amplification, protein detection and analysis.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BT0401	CO1	3	3	3	3		2	3		2	2	1	3	3
	CO2	3	2	3	3		3	3		2	2	1	3	2
	CO3	2	2	2	2		2	2		2	2	1	2	2
	CO4	3	3	3	3		3	3		2	3	3	3	3

### Course Contents

#### UNIT 1

12 hrs

**General outline of DNA and DNA replication:** History and experiments to prove DNA and RNA of genetic material, Nucleosides & Nucleotides (introduction, structure & bonding), Watson and crick model of BODNA, Types of DNA. DNA isolation and identification through electrophoresis technique. Concept of central dogma, Semi conservative nature of DNA, DNA replication in Eukaryotes and Prokaryotes, DNA polymerase and other major enzymes involved in replication, rolling circle model of replication, Fidelity of replication. Introduction to DNA Repair and recombination

#### UNIT 2

12 hrs

**Transcription and Translation:** Transcription in prokaryotes and eukaryotes. Post transcriptional modification and its significance: Capping, Polyadenylation, RNA splicing, Ribozymes, Alternative splicing and RNA editing. Genetic code and wobble hypothesis, tRNA and ribosome structure, Translation in prokaryotes and eukaryotes. Post translational modifications in detail, Overview of Gene regulation and concept in prokaryotes; Lactose and Tryptophan operons, Galactose operon in yeast.

#### UNIT 3

12 hrs

**Molecular Tools in Genetic Engineering:** Scope of genetic engineering; Endo Nucleases and Exonucleases; Restriction Enzymes 0Type I, Type II, Type III, Type IV; Invitro restriction digestion; Ligases0 *E.coli* Ligase and T4 DNA Ligase.

Other DNA Modifying Enzymes0 Terminal Transferase, Alkaline Phosphatases, Klenow Fragment. Introduction to cloning vectors 0 Prokaryotic & Eukaryotic; Plasmid Vectors (pBR, PUC); Phage Vectors (Bacteriophage lambda and Cosmid); Bacterial vectors (BACs); Yeast Vectors (YACs); Plant Vectors (Ti plasmid); Animal vectors (SV40, Retro virus).

**UNIT 4**

**12 hrs**

**Techniques in Genetic Engineering**

Screening and selection of recombinants, Gene transformation (Physical & Chemical Transformation) plant transformation (*Agrobacterium*). Genomic library construction cDNA library construction (screening of gene libraries)

DNA sequencing (Dideoxy method, Maxam and Gilbert method, Polymerase Chain Reaction (PCR); Gel electrophoresis; AGE and PAGE; DNA hybridization (Southern blotting); Protein detection (Western blotting). Molecular Markers. Recent Trends in Genetic Engineering

**Reference Books:**

1. Cooper, G.M., Hausman, R.E. The Cell: A molecular approach. (2009) ASM Press and Sinauer Associates (Fifth Edition).
2. DeRobertis, E.D.P. Cell and Molecular Biology.(2008) Lippincott Williams and Williams (Sixth Edition).
- 3.Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Principles of Gene Manipulation and Genomics – 7th Edition – Sandy B. Primrose, Richard Twyman – Blackwell Publishing
5. Gene Cloning and DNA Analysis: An Introduction 0 6th Edition 0 T. A. Brown 0 John Wiley & Sons
6. An Introduction to Genetic Engineering 0 3rd Edition 0 Desmond S. T. Nicholl 0 Cambridge University Press.

Course Code	Biochemical Techniques	Course Type	L	T	P	C	CH
B21BC0401		HC	2	1	0	3	4

**Course Objective:**

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

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

1. Develop knowledge about the isolation, separation and characterization of various biological samples.
2. Acquire knowledge about the interaction of electromagnetic radiations with matter and apply analytical techniques to determine accurately the elements present in the biological samples.

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

B21BC0402	CO2	2	2		2		2		1	1	1			
	CO3	2		1	2	1	1	1		2	1	2	1	
	CO4	2		2	2		2	2		2	1	1		1

**Course content:**

**UNIT I**

**12hrs**

Chromatography: General Principles of chromatography, Classification, principle, operation procedure and applications of paper chromatography, thin layer chromatography, ion exchange chromatography, molecular sieve chromatography, affinity chromatography. Column chromatography – Principle, procedure and applications of Gel filtration, HPLC and GLC

Microscopic Techniques: Review of light microscope, resolution of microscopes, phasecontrast, and dark field microscopy, preparation of specimen for biochemical investigations. Electron microscopy; Working principle and applications, specimens for electron microscopy.

**UNIT II**

**12 hrs**

Centrifugation0 Principle of centrifugation, types of centrifuges and rotors. Density gradient centrifugation0 Caesium chloride and sucrose density gradients and applications. Principle, procedure and applications of differential centrifugation and ultracentrifugation. Sub0cellular fractionation. Ultra0filtration: Principle, instrumentation and application. Dialysis, principle and uses of equilibrium dialysis. Precipitation: methods and applications Electrophoresis: Principle of electrophoresis, Paper and gel electrophoresis (Agarose and SDS PAGE).

**UNIT III**

**12 hrs**

Radio isotopic techniques 0 Atomic structure, radiation, type of radioactive decay, half0life, units of radio activity, detection and measurement of radio activity – methods based on ionization (GM0 counter) application of isotope dilution technique. Biological hazards of radiation and safety measures in handling radio isotopes. Spectroscopic methods Principle, instrumentation and applications of UV0 Visible, IR, AAS, Flame emission, HRMS and GC0MS, ESR and NMR spectroscopy

**UNIT IV**

**12 hrs**

Molecular Techniques: Primer design, Polymerase chain reaction, RFLP, RAPD. Cloning, Cre/lox genetic recombination, Hydrolysis probe0based qPCR, RNA preparation and cDNA synthesis, SYBR based RT0qPCR, Immunoprecipitations, Protein Sequencing, Cell culture, hybridoma technology and Microarray

**Reference Books:**

1. Biophysical Chemistry, Principles & Techniques –Himalaya Publ. House.
2. Principles & Techniques of Practical Biochemistry – Wilson, Walker Cambridge Univ. Press.
3. G. Abbott 0 Chromatography.
4. Friefelder D. WH Freeman and Company. Physical Biochemistry0 Application to Biochemistry and Molecular Biology.

<b>Course Code</b>	<b>Developmental Genetics</b>	<b>Course Type</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CH</b>
<b>B21GN0401</b>		<b>HC</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>4</b>

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

The objective of this Course is to

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

**Course Outcomes:**

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

1. Differentiate the developmental stages.
2. Compare the developmental milestones of different organisms.
3. Illustrate the phenomenon of organogenesis and metamorphosis.
4. Outline the characteristics of developmental disorders.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0401</b>	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3				2				3	3		
	CO3	3	3	3	3	3	2				3	3	2	
	CO4	3	3	3			3	3	2		3	3	2	

**Course Contents:**

**UNIT I**

**12 hrs**

**Essential Concepts in Developmental Biology**

Early embryonic development in Frog, Gametogenesis, fertilization, cleavage, blastula and gastrula. Nuclear transplantation experiments in Amphibians and *Acetabularia*. Epigenesis and preformation 0 Generating new cells and organs — Cell0cell communication in development — Fate Maps.

**UNIT II**

**12 hrs**



**Embryonic Development and Germ Layer Specification**

Genetics of development in plants – *Arabidopsis*: Flower development (Floral morphogenesis and Homeotic gene expression).

Genetics of development in Animals 0 *Drosophila*: Early development; Origin of anterior0posterior and dorso0ventral polarity: Role of Maternal genes, Zygotic genes0 Segmentation genes (gap, pair rule and segment polarity genes) and Homeotic selector genes. d. Switching genes on and off during development0 Ex. Differential expression of haemoglobin *C. elegans* – Early development in Vertebrates – Early mammalian development – Origin and emergence of Ectodermal, Mesodermal and Endodermal cell layers

**UNIT III**

**12 hrs**

**Organogenesis and Sex Determination**

CNS and epidermis –Neural crest cells – The Somites and their derivatives – Development of tetrapod limb –Development of gonads0– Sex determination.

**UNIT IV**

**12 hrs**

**Metamorphosis, Regeneration and Ageing**

Insect and amphibian metamorphosis – Stem Cell mediated regeneration – Regeneration in planaria and zebrafish – Biology of senescence – Role ofmTOR pathway and telomeres in ageing (gerontology).

**Developmental Disorders**

Embryonic origins of adult disease 0 Genetic errors of human development – Teratogenesis – Transgenerational inheritance of developmental disorders – Cancer as a disease of development – Disease models and mechanisms.

**Reference Books:**

1. Balansky, Text book of embryology.
2. Principles of Development by Lewis Wolpert et al. 5th Edition. oxford University press 2015.
3. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (2002) Genetics, 4th edition, Viva Books
4. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2014),
5. Genes XI, Jones and Bartlett Learning.
6. Brown, T.A., Chapman and Hall (2011) Genetics a Molecular Approach, 2nd edition, Garland science.
7. Gilbert. (2013) Developmental biology. 10th edition.

Course Code	Animal Biotechnology	Course Type	L	T	P	C	CH
B21BTS411		SC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

- The student should be familiar with knowledge of zoology
- The student should have the basic knowledge of molecular biology and genetic engineering

**Course Objectives:**

1. To Identification and characterization of animal breeds.
2. To develop DNA 0 based diagnostics and genetically engineered vaccines for animals.
3. To study animal genomics and its varied applications.
4. To develop embryo 0 transfer technology, cloning, transgenic animals.

### Course Outcomes:

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

1. Implment tissue culture techniques in th lab .
2. Know the technology for the production of transgenic animals.
3. Implement the transgenic technology for the production of Vaccines and biotehrapeutics.
4. Understand the ethical issuess and policies regard to transgenic technology.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BTS411	CO1	2	3	3	2	2	2	2	1	2	3	2	3	2
	CO2	2	3	3	2	2	1	2	1	2	3	2	3	2
	CO3	2	3	3	2	2	1	2	1	2	3	2	3	2
	CO4	2	3	3	2	2	1	2	1	2	3	2	2	2

### Course Contents

#### UNIT I: Animal tissue culture and cell lines

12 Hrs

Cell culture technique: cell culture media, sterilization techniques, Types of Animal cell culture; Organ culture; Primary cellcultures; Secondary cultures, Cell lines: characteristic feature of cell lines and maintenance, established cell lines; commonly used cell lines, Methods of separation of various cell types (physical and enzymatic methods), Commercial applications of cell culture: Cell based manufacturing (vaccines),

#### UNIT II: Specialized Cell CultureTechniques

12 Hrs

Transfection in animal cells, Production of special secondary metabolites/ products (insulin, growth hormone, interferon, t – plasminogen activator, factor VIII etc), processing of chosen protein; Growth of cells in suspension and bioreactors for large scale culture of cells, various downstream processes

#### UNIT III: Transgenic animals, Vaccines and Tissue Engineering

12 Hrs

Transgenic animals: Mice, Sheep, Fish; use and applications. Production and applications of monoclonal antibodies; Production of vaccines using animal cell culture: Polyclonal, monoclonal antibodies and humanized vaccines, recombinant vaccines, DNA vaccines. Tissue engineering: Elementary idea of tissue engineering, Xenotransplantation.

#### UNIT IV: Applications of Animal Biotechnology

12 Hrs

Stem cell culture, Embryonic and adult stem cell culture and its applications, Somatic gene therapy, Application of transgenic animals as models of human diseases. Embryo transfer technologies in cattle and its application, Ethical issues in relation to animal biotechnology.

#### Reference Books:

1. Text book of Animal Biotechnology by B.Singh, S.K.Gupta and S.K Gautam Teri publishers
2. Culture of Animal cells by R.Ian Freshney seventh edition Wiley publisher
3. Animal Biotechnology and Ethics | Alan J. Holland | Springer
4. Animal Biotechnology: Models in Discovery and Translation, Second Edition, Anchal Singh, Ashish Verma.
5. Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies Book by Richard Twine
6. Transgenic Animal Technology: A Laboratory Handbook Book by Carl A. Pinkert
7. Transgenic Insects: Techniques and Applications, by Mark Q. Benedict 2014.
8. The Role of Biotechnology in Improvement of Livestock: Animal Health and Biotechnology by Muhammad Abubakar, Ali Saeed, Oguz Kul

Course Code	Bioinformatics & Biostatistics	Course Type	L	T	P	C	CH
B21BCS412		SC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

- The student should have knowledge of molecular biology and biochemistry.
- The student should have basic knowledge of computers and mathematics.

**Course Objectives:**

1. To acquire various principles of biostatistics.
2. To understand the importance of statistics in biological sciences.
3. To understand the importance of computer science in biological sciences.
4. To understand the tools, databases and softwares used in biological data understanding and interpretation.

**Course Outcomes:**

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

1. Analyse the different statistical measures required for studying the biological events.
2. Understanding the concepts of statistics which can be implemented in research purposes.
3. Explain the basic principles and concepts of biology, computer science and Mathematics.
4. Apply existing software effectively to extract information from large databases and to use this information in computer modeling.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BCS412	CO1	2	3	3	3	1	2	3		3	2	3	3	2
	CO2	2	3	3	3	1	2	3		3	2	2	3	2

CO3	2	3	3	3	1	2	3		3	2	2	2	2
CO4	2	3	3	3	2	2	4		3	2	3	3	2

### Course Contents:

#### UNIT I

12 hrs

**Introduction to Biostatistics:** Population and sample, Types of Variables, Variables in biology; Collection of data: Classification of Data, Primary and Secondary Data, Diagrams and Graphs; Frequency Distribution: Relative and Percentage Relative Frequency, Discrete and continuous frequency, Frequency Graphs, Concept of MS0Excel in statistics

#### UNIT II

12 hrs

**Descriptive Statistics:** Measures of Central Tendency: Mean, Median and Mode, Measures of Dispersion0Variance andStandard deviation, Test of Hypothesis 0Students Test, Chi square Test, Probability0 Definition and rules Distribution 0 Normal, Binomial and Poisson.

#### UNIT III

12 hrs

**Fundamentals of Bioinformatics:** Introduction to Bioinformatics, Goal, Scope, Applications, Limitations; Biological Databases: Types of Databases, Biological databases; Literature databases; Genome browsers; Sequence Analysis: Basic concepts of sequence similarity, identity and homology; Scoring matrices: basic concept of a scoring matrix PAM, BLOSUM series; Sequence alignment: Basic concepts of sequence alignment, 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.

#### UNIT IV

12 hrs

**Multiple sequence alignments (MSA):** The need for MSA, basic concepts of various approaches for MSA; Phylogenetic Analysis: Definition and description of phylogenetic trees and various types of trees; Structure Predictions: Gene structure prediction, protein structure prediction; **Drug design:** Drug discovery process. Target identification and validation, lead optimization and validation. Methods and Tools in Computer0aided molecular Design.

#### Reference Books:

1. Edwards David, Stajich Jason, Hansen David, Bioinformatics: Tools and Applications, Springer0Verlag 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.
5. An Introduction to Biostatistics: N Gurumani, MJP Publishers, Chennai. ISBN 8108094000603 (pbk)
6. Text Book of Biostatistics I: A.K Sharma, Discovery Publishing House, 2005 0 Biometry 0 480 pages

Course Code	Molecular Biology & Genetic	Course Type	L	T	P	C	CH
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<b>B21BT0402</b>	<b>Engineering Lab</b>	<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>
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**Prerequisites/Pre reading for the course:**

The student should have knowledge of cell biology and basic biochemistry

**Course Objectives:**

1. To study the identification of nucleic acid and its amplification by PCR
2. To estimate genomic and plasmid DNA and RNA and to confirm by electrophoresis
3. To study the activity of bacterial transformation
4. Introduces students with the basic concepts in genetic engineering
5. Demonstrates different versatile tools and techniques employed in genetic engineering and recombinant DNA technology.

**Course Outcomes:**

After completion of the course the candidate should be able to:

1. Understand, and perform, the most important methods in molecular biology like DNA isolation, Protein estimation, Gel electrophoresis, PCR amplification
2. Understand the concept of bacterial transformation and its interpretation for confirmation using blue white colony.
3. Understand the concept of DNA digestion and ligation and analyze the result.
4. Prepare competent cells and transformation.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BT0402</b>	CO1	3	3	3	3	3			3	3		2	3	3
	CO2	2	2	2	2	1			3	3		2	3	3
	CO3	3	3	3	3	3			3	3		2	3	3
	CO4	2	2	2	2	2			2	2		2	3	3

**Course Contents:**

1. Competent cell preparation, Bacterial Transformation and blue and white screening+
2. GFP Cloning
3. Isolation and purification of Genomic and Plasmid DNA from bacteria; confirmation by Agarose gel electrophoresis
4. Estimation of DNA by Diphenylamine (DPA) method
5. Restriction Digestion of DNA
6. Ligation of DNA
7. Amplification of DNA by PCR method
8. Electrophoresis of Proteins by SDS PAGE

**Reference Books:**

1. J Sambrook & D. W. Russell (2001). Molecular cloning: a laboratory manual Vol 1, 2 & 3, CSHL Press.
2. Molecular Cell Biology, 3rd edn. (1995) W.H.H. Lodish, A. Berk, and C. A. Kaiser, Freeman & Co Ltd.
3. Sam brook al (2000) Molecular cleaning Volumes I, II, & III, Cold spring Harbor Laboratory Press, New York USA
4. Glick, B.R. and Pasternak J.J (196) Molecular biotechnology, Principles and application of recombinant DNA, American Society for Microbiology, Washington D.C.

Course Code	Laboratory course IV (Biochemistry)	Course Type	L	T	P	C	CH
B21BC0402		HC	0	0	2	2	3

**Prerequisites:**

Requires skills in handling of biological sample for tests

**Course Objective:**

1. To gain knowledge of handling biological sample.
2. To understand the composition of biological sample.
3. To understand how to handle colorimetric instrument.

**Course Outcomes:**

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

1. Analyze normal compositions present in the urine.
2. Evaluate abnormal constituents present in the urine.
3. Identify the different methods available to estimate different constituents present in the biological sample.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO 0	PSO 1	PSO 2	PSO 3
B21BC0402	CO1	2	1	1				1	1		2	1	1	
	CO2	1	2	1	2			1	1		3	2	1	
	CO3	2	2	2	3			2	2		3	2	1	
	CO4													

**Course Contents:**

1. Determination of titrable acidity of urine and Blood Clotting time.
2. Determination of A/G ratio in serum by biuret method.

3. Qualitative analysis of organic, inorganic & abnormal constituents of urine.
4. Colorimetric Estimation of bilirubin, Cholesterol,
5. Estimation of Creatinine
6. Estimation of haemoglobin, Iron, Transferrin Binding Protein.
7. Estimation of Urea, Uric acid.
8. Estimation of Inorganic Phosphate.

### Reference Books:

1. Text book of Clinical Chemistry Teitz
2. Clinical chemistry in Diagnosis and Treatment by P.D Mayne/ Arnold. New Delhi
3. Medical Laboratory technology Kanai L. Mukherjee, Tata Mc Graw Hill Publication and Co. Ltd; Vol I, II, III
4. Practical Clinical Biochemistry Harold Varley CBS, 6th ed. New Delhi 2002
5. Medical Laboratory Science, theory and practice. J. Ochei & A. Kolhakar, Tata Mc Graw Hill.
6. Modern Experimental Biochemistry R.F. Boyer [Ed.] (1986) Addison Wesley.
7. Experimental Biochemistry: A Student Publisher: I.K. International Publishing House Pvt. Ltd. (Deshpande)
8. Biochemical methods S. Sadasivam A Manickam, New Age International Pvt Ltd Publishers; Third edition
9. Introductory practical Biochemistry, Sawhney, Randhir Singh, 11<sup>th</sup> Edition (2015)

Course Code	Developmental Genetics Lab	Course Type	L	T	P	C	CH
B21GN0402		HC	0	0	1.5	1.5	3

### Prerequisites/Pre reading for the course:

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

### Course Objectives:

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

### Course Outcomes:

After the course, student will be able to

1. Outline the patterns of the development.
2. Correlate the gene expression and development.
3. Analyse the development of organs from pre-determined mass of cells.
4. Involve in project-based learning.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0402</b>	CO1	3	3			3	2				3	3	2	
	CO2	3	3			3					3	2	2	
	CO3	3	3			3					3	3		
	CO4	3	3	3	3	3	3	3	3	3	3	3	3	3

#### Course Contents

1. Early embryonic development in Frog Egg, cleavage, blastula and gastrula.
2. Genetics of development in Arabidopsis – ABC model Homeotic gene expression (Slide/Chart)
3. Genetics of development in Drosophila Anterior & posterior/dorso ventral polarity (Slide/Chart)
4. Study of imaginal discs in *Drosophila*
5. Effect of toxins on development
6. Study of development in *Drosophila*.
7. Study of developmental disorders.
8. Study of development of chick embryo.

#### Reference Books:

1. Balansky, Text book of embryology.
2. Developmental biology by Scott.F. Gilbert. Sinauer Associates, Sunderland. 2000.
3. Principles of Development by Lewis Wolpert et al. 5th Edition. oxford University press, 2015.
4. Winter, P.C., Hickey, G.I. and Fletcher, H.L.(2002) Genetics, 4th edition, Viva Books
5. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2014),
6. Genes XI, Jones and Bartlett Learning.
7. Brown, T.A., Chapman and Hall (2011) Genetics a Molecular Approach, 2nd edition, Garlandscience.
8. Gilbert. (2013) Developmental biology. 10th edition.

### FIFTH SEMESTER

Course Code	Immunology	Course Type	L	T	P	C	CH
<b>B21BT0501</b>		<b>HC</b>	2	1	0	3	4

#### Prerequisites/Pre reading for the course:

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

#### Course Objective:



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

<b>Course Outcome:</b>
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**After the end of the Course students will be able to:**

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

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0501</b>	CO1	1									1	1	1	1
	CO2	2	3								2	3	1	2
	CO3			2							2	3	1	
	CO4			2	3		2				2	3	3	

<b>Course Contents:</b>
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**UNIT 1 Basics of Immunology**

**12 Hrs**

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

**UNIT 2: Regulation of Immune Cells**

**12 hrs**

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

**UNIT 3: Immuno Techniques**

**12 hrs**

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

**UNIT 4: Autoimmunity and Autoimmune diseases****12 hrs**

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

**Reference Books:**

1. William, E. Paul, (1989) Fundamental immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark (191) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley, and Sons, New York.
3. Ivan, M. Roitt (194) Blackwell Scientific Publications, London.
4. Kubay, Kindt, Goldsby & Osborne (6th edition).
5. Delves, Martin, Burton and Roitt (11th edition). Essential Immunology.
6. Stites, Stobo, H. H. Fudenberg (5th edition). Basic and Clinical Immunology.
7. S. K. Gupta. Essentials of Immunology.

Course Code	Metabolism – I	Course Type	L	T	P	C	CH
B21BC0501		HC	1	1	0	2	3

**Course Objective:**

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

**Course Outcomes:**

1. Know about the basic principle of enzyme activity and their role in metabolism
2. Find out the various intermediate pathways and basic energy generation of synthesis and degradation of carbohydrates, lipids and biological oxidation.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BC0501	CO1	2		2		2		1		3		2		1
	CO2	1		2		2	2		1		1		2	
	CO3	2	2			1	1			2	2		2	
	CO4	2	2		2	2		1	1	1	2	1	2	

**Course Contents:****UNIT01****12 hrs**

**Enzymes:** Definition, General characteristics, Co factors – coenzymes and metal ions. Nomenclature and classification of enzymes based on IUB with examples. Enzyme specificity. Concept of active site. Factors affecting rate of enzyme catalysed reaction. Effect of substrate, enzyme, product concentration, pH, temperature. Michaelis–Menten equation. Lineweaver Burk plot. Determination of Vmax and Km from L B plot and its significance. Enzyme Inhibition: Competitive, non competitive and uncompetitive inhibition. Graphical representation of enzyme inhibition by L B plot. Application of competitive inhibitors in chemotherapy. UNIT of enzyme activity – definition of IU, enzyme turn over number and nature of non enzymatic and enzymatic catalysis. Specific activity.

Theories of Enzyme catalysis: Lock and key model, Koshland's induced fit theory. Types of enzyme catalysis Acid base, covalent, substrate strain.

Regulation of enzymes: Allosteric enzyme – Definition, Sigmoidal curve, positive and negative modulators, with AT Case, phosphofructokinase as an example.

Isoenzymes0 LDH, Multienzyme complex pyruvate dehydrogenase complex. Ribozyme. Clinical and Biotechnological application of enzymes.

## **UNIT0II** **hrs**

**12**

**Metabolism of Carbohydrates:** Definition, phases of metabolism, Anabolism and Catabolism definition, schematic representation of metabolism.

Glycolysis; definition, individual reactions with energetic. Irreversible reactions/ATP dependent reactions. Entry of lactose, sucrose and glycogen into glycolysis. Fate of pyruvate formation of Acetyl CoA, Ethanol and Lactate. Regulation of Glycolysis and Inhibitors.

Pyruvate dehydrogenase enzyme. TCA cycle Individual reactions. Net reaction of TCA cycle. Number of ATP molecules production. Functions of TCA cycle Amphibolic roles (Anapleorosis). Regulation of TCA cycle, Energetics of TCA cycle.

Gluconeogenesis Definition and significance, flow chart of gluconeogenesis. CORI cycle0explanation, diagram, purpose.

Glycogen metabolism Glycogenolysis definition, reactions. Glycogenesis definition, reaction, Cori diseases. Glycogen synthetase and phosphorylase and their regulation, Glycogen Storage diseases.

Pentose phosphate pathways (PPP/ HMP) 0Significance, reactions. Synthesis of starch, cellulose and peptidoglycan.

Substrate level phosphorylation in carbohydrate metabolism. Stoichiometry and energetics of all pathways.

Regulation of blood glucose level; role of Insulin and Glucagon.

## **UNIT III**

**12 hrs**

**Lipid metabolism:**  $\beta$  oxidation of saturated fatty acids; individual reactions, enzymes, coenzymes. Energetics of  $\beta$  oxidation of palmitic acid and stearic acid role of carnitine, Oxidation

of fatty acids with odd number of carbon atoms, fate of propionyl coA, oxidation of unsaturated fatty acids.

Fatty acid synthetases; structure and functions. Biosynthesis of fatty acids0general flow chart, fatty acid oxidation v/s fatty acid synthesis.

Cholesterol structure and functions. Cholesterol biosynthesis and regulation. Atherosclerosis causes, blood cholesterol levels. Ketone bodies Synthesis and degradation. Abnormalities of Ketone bodies.

#### UNIT IV

12 hrs

**Bioenergetics and Biological Oxidation:** Laws of thermodynamics. Definition of bioenergetics, stages of energy transformation photosynthesis, respiration and utilization of energy.

Free energy concepts: free energy change, exergonic and endergonic reactions, meaning of  $\Delta G, \Delta G^\circ, \Delta G^\circ'$ ; Biochemical standard state and  $\Delta G^\circ', \Delta G$  and  $K_{eq}$ (relationship).

High energy compounds: Definition and examples; energy coupling. Biological oxidation: Calculation of thermodynamic efficiency of biological oxidation for a mole of glucose; Redox potential of some biologically important half reactions. Calculation of energy yields from biological Redox reaction; Electron transport chain: components sequence ubiquinone, coenzyme Q, NAD, FMN and FAD, cytochromes and Iron Sulphur proteins and their arrangement of 4 complexes and their functions. Sites of energy conservation; Oxidative phosphorylation definition, salient features of chemiosmotic theory, P: Oratio.

#### Reference Books:

1. Biochemistry; Voet, D. and Voet, J.G. [Eds.] 5 Ed. Jhon Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., [Eds.] 7th Edn. Worth Publishers.
3. Principles of Biochemistry; Smith et al., [Ed.] 19<sup>th</sup>EdnMcGarw Hill.
4. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [7th Ed.], Wiley0Liss.
5. P.K. Stump, Outlines Of Biochemistry, 5th edn. , Wiley Eastern, New Delhi,
6. L. Stryer Biochemistry 8th Ed. W.H. Reeman Co., San Francisco, US

Course Code	Human Genetics	Course Type	L	T	P	C	CH
B21GN0501		HC	2	1	0	3	4

#### Prerequisites/Pre reading for the course:

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

#### Course Objectives

The objective of this Course is:

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

<b>Course Outcomes:</b>
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After completing the course, the student should be able to:

1. Outline the different patterns of inheritance of allosomes and autosomes.
2. Analyze the aberrations by karyotypes and Flow cytometry.
3. Interpret the inheritance by analysing pedigree tree.
4. Familiarize with the prenatal diagnosis, genetic counseling and dermatoglyphics.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21GN0501</b>	CO1	3	3	3				3	3		3	3		2
	CO2	3	3	3	3		3	3	3		3	3		2
	CO3	3	3	3			2	2	2		3	3		2
	CO4	3	3	3	3	3	3	3	2	2	3	3		2

<b>Course Contents:</b>
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**UNIT I**

**12 Hrs**

History of Human Genetics.

Paris Nomenclature, Flow karyotyping (Quantification of DNA of individual chromosomes)  
FACS Fluorescence Activated Cell Sorter.

Human chromosomes and karyotyping: G0banding, nomenclature of banding  
Nomenclature of aberrant karyotypes

Common syndromes due to numerical chromosome changes

Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites)

**UNIT II**

**12 Hrs**

Genetic Diseases and Inheritance Pattern: Autosomal inheritance0 Dominant (Ex. Adult polycystic kidney, Achondroplasia and Neurofibromatosis) Autosomal inheritance0 Recessive (Ex. Albinism, Sickle cell anaemia, Phenylketonuria) X0linked – Recessive: (Ex. Duchenne muscular dystrophy0DMD) X0linked0 Dominant: (Ex. Xg blood group) Y0linked inheritance: Holandric gene (Ex. Testes determining factor 0 TDF) Multifactorial inheritance: (Ex. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Ex. Leber's hereditary optic neuropathy )

**UNIT III**

**12 Hrs**

Pedigree studies and Genetic Counselling: Symbols used in pedigree studies, Pedigree analysis and construction, Pedigree analysis for the inheritance pattern of genetic diseases, Genetic Counselling.

Stage 1: History and pedigree construction

Stage 2: Examination

Stage 3: Diagnosis

Stage 4: Counselling

Stage 5: Follow up.

Problems and case studies.

#### UNIT IV

12 Hrs

- a. Dermatoglyphics: Introduction and Patterns. Dermatoglyphics in clinical disorders Down's syndrome, Turner's syndrome, Klinefelter's syndrome and Cri du chat syndrome. Clinical applications, Advantages and Limitations.
- b. Prenatal Diagnosis: Introduction and types Invasive Prenatal diagnosis 0 Amniocentesis, Chorionic villus sampling. Non – Invasive Prenatal diagnosis – Ultrasonography.
- c. Genetics and Society: Eugenics: Positive and negative, Euthenics, Euphenics Human genome project – introduction and significance Gene therapy with reference to SCID Stem cells Properties, types and sources. A brief account on Cord blood banking and Stem cell therapy.

#### Reference Books:

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics0 Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R. Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston. Human Genetics by S.D. Gangane (2nd edition0Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
9. Medical Genetics. Lynn Jorde John CareyMichaelBamshad. 2015.
10. Mendelian inheritance in Man by0Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
11. Molecular Basis of Inherited Diseases, (6th Edition01989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (EdsOMcGrawHill, New York.

Course Code	Medical Genetics	Course Type	L	T	P	C	CH
B21BGS511		SC	2	1	0	3	4

#### Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge about pathology.
2. They should have knowledge of cancer biology.

#### Course Objectives:

The Objective of this Course is:

1. To teach the basics of medical genetics and learn the patterns of heredity
2. To categorize the genetic disorders.
3. To explore the molecular therapeutics for disease management
4. To understand the mechanism of carcinogenesis.

**Course Outcomes:**

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

1. Predict the patterns of heredity.
2. Analyze the molecular reason of genetic disorders and therapeutic methods.
3. Illustrate the process involved in recombinant protein production.
4. Understand the characteristics and categories of cancer

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO 3
<b>B21GNS511</b>	CO1	3	3	3			3		3		3	3	2	
	CO2	3	3	3			3		3		3	3	3	2
	CO3	3	3	3	3		2		0		3	3	3	3
	CO4	3	3	3	3		3		3		3	3	3	

**Course Contents:**

**UNIT I**

**12 Hrs**

Genetics in medical Practice:

Genetic Principles and their application in medical practice, Case studies (Interacting with patients, learning family history and drawing pedigree chart), Syndromes and disorders: Definition and their genetic basis. Genetics of diseases due to inborn errors of metabolism: Phenylketonuria, galactosemia.

**UNIT II**

**12 Hrs**

Human Genetic Disorders of Nervous system and Eye : Neurogenetic disorders 0 Charcot0Marie tooth syndrome, Spino0muscular atrophy, Alzheimer's disease & Syndromes due to triplet repeat expansion, Parkinson's disease, Prion diseases, Colour Blindness, Retinitis pigmentosa, Glaucoma & Cataracts.

**UNIT III**

**12 Hrs**

**Oncogenetics:** A brief account of cancer definition, types Benign and Malignant; Sarcoma, Carcinoma, Lymphoma and Leukaemia Properties of malignant cells.

Types of genes Proto oncogenes, Oncogenes, Difference between V and C oncogenes, Tumor Suppressor genes p53, pRb.

Chromosomal abnormalities associated with the specific malignancies Acute Promyelocytic Leukaemia(APL),Chronic Myeloid Leukaemia(CML) and Acute lymphoblastic leukaemia (ALL)

**UNIT IV**

**12 Hrs**

Patterns of Single Gene Inheritance: Haematopoietic systems, Sickle cell Anemia, Thalassemias and Haemophilias, Muscle genetic Disorders Duchenne Muscular Dystrophy, Becker Muscular Dystrophy, Cystic Fibrosis, Tay Sach's Syndrome & Marfan syndrome.  
Gene therapy, molecular therapeutics, Production of recombinant insulin, interferon and human growth hormone (HGH) Vaccines: Hepatitis B vaccine Preparation of molecular probes, Monoclonal antibodies and diagnostic kits, Microarray

**Reference Books:**

1. Human Genetics by S.D. Gangane (2nd edition, Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
2. Medical Genetics. Lynn Jorde John Carey Michael Bamshad. 2015.
3. Mendelian inheritance in Man by Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
4. Molecular Basis of Inherited Diseases, (6th Edition, 1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds, McGrawHill, New York.

Course Code	Applicative Genetics	Course Type	L	T	P	C	CH
B21GNS512		SC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

1. Students should have basics of Recombinat DNA technology.
2. They should have knowledge about sequencing.

**Course Objectives:**

The Objectives of this course is to:

1. To understand the process of recombinant DNA technology and its applications.
2. To learn the methodology of DNA fingerprinting and its applications.
3. To explore the world of genomics and proteomics.\
4. To study the basics of bioinformatics.

**Course Outcomes:**

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

1. Outline the process involved in the production of molecular therapeutics.
2. Design the sequencing process and analyse the data.
3. Align the sequences and interpret them in constructing phylogeny.
4. Apply the knowledge of genetics in pharmacogenomics and transgenic technology.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GNS512	CO1	3		3					3		3	3	3	
	CO2	3	3	3	3	2	2				3	3	3	



CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CO4	3	3	3	3	3	3				3	3	3		

## Course Contents:

### UNIT0I CRYOBIOLOGY: CRYOGENETICS

12 Hrs

Cryogenetics: Stem cell bank, cell bank, gene bank, cDNA library, embryo bank, sperm bank, pollen bank,

DNA fingerprinting and Methodology

Molecular markers –RAPD, RFLP, Microsatellite, SNPs, STR

### UNIT0II Genomics and Proteomics

12 Hrs

#### Genomics:

Structural and functional genomics. Whole genome sequencing – Maxam0Gilbert sequencing, Sanger sequencing, Pyrosequencing, Next generation sequencing.

#### Protein engineering and proteome analysis:

Insertional and deletion mutagenesis, Site directed mutagenesis, Proteome analysis, Protein arrays and their applications.

### UNIT0III Bioinformatics

12 Hrs

**Biological databases:** Overview, modes of database search, mode of data storage (Flat file format, db0tables), flat0file formats of GenBank, EMBL, DDBJ, PDB.

#### Sequence alignment:

Concept of local and global sequence alignment, pairwise sequence alignment, scoring an alignment, substitutional matrices, multiple sequence alignment.

#### Phylogenetic analysis:

Basic concept of phylogenetic analysis, rooted/unrooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbor joining, Maximum parsimony, Maximum likelihood).

### UNIT0IV Applicative Genetics

12 Hrs

**Transgenic plants and animal:** Creating transgenic animals and plants. Plant tissue culture. Animal cloning. Restriction and regulation for the release of GMOs into environment. Ethical, legal, social and environmental Issues related to rDNA Technology. Biosafety and Bioethics.

Pharmacogenetics: History, Early evidence; Clinical determinants; Molecular insights (genes involved in pharmacokinetics and pharmacodynamics of drugs); Applications in pre0prescription testing. Pharmacogenomics, Clinical trials.

### Reference Books:

1. Gene cloning and DNA analysis, T.A. Brown (2010) 6th edition, Wiley0Blackwell publication
2. Human Molecular Genetics, Peter Sudbery (2002) 2nd Edition, Prentice Hall
3. Human Molecular Genetics, Tom Strachen and Andrew P. Read (1999) 2nd edition, John Wile and sons.
4. Molecular Biotechnology, Principles and application of recombinant DNA Glick and Pasternak. 2010.
5. Introduction to bioinformatics Arthur M Lesk\

<b>Course Code</b>	<b>Immunology Lab</b>	<b>Course Type</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CH</b>
<b>B21BT0502</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

1. To understand the basic concepts of immune system
2. To famarilize the students in the immunotechnology
3. To explore various aspects of immunology in the other field
4. To exploit the immunological methods for commercial needs

**Course Outcomes:**

After completing the course the student shall be able to:

1. Understand the importance and scope of immunology
2. Handle immunological techniques for mankind
3. Explore various methods and new techniques in immunology
4. Take small research project in the field of immunology

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BT0502</b>	CO1	2	3	3					2		3	2	1	1
	CO2	2	3	3	3				2		3	2	3	2
	CO3	2	3	3		2			2		3	2	3	2
	CO4	2	3	3					2		3	2	3	3

**Course Contents:**

1. Blood Typing
2. Separation of Blood and Serum
- 3.Counting of RBCs
4. VDRL
5. WIDAL
6. Oucterlony Double Diffusion
7. Dot ELISA
8. Rocket Electrophoresis

**Reference Books:**

1. Keith Wilson and John Walker, Practical Biochemistry0 5th edition, Cambridge University Press, UK 2000

- Bertram G. Katzung, Basic and Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications 2004
- Devlin TM, Text book of biochemistry with Clinical Correlations 5th edition 2002
- Warren Levinson, Ernest Jawetz, Medical Microbiology and Immunology: Examination and Board Review 7th edn. McGraw Hill Publications 2003
- Jawetz, Melnuk and Adelgerg, Medical Microbiology, Appleton and Lange

Requires knowledge of enzymology.

**Course Objectives:**

**Prerequisites**

- To gain thorough practical knowledge on enzymekinetics
- To determine biochemical metabolites by colorimetricmethod.
- To acquire the method of analysis of biochemical constituents inurine.

**Course Outcomes:**

Course Code	Laboratory Course -V (Biochemistry)	Course Type	L	T	P	C	CH
B21BC0502		HC	0	0	2	2	3

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

- Understand the assay of enzyme activity using their respective standards.
- Avail the practical knowledge of factors influencing enzyme activity.
- Interpret the biochemical metabolites SGOT and SGPT by quantitative determination.
- Understand the Creatine kinase by quantitatively

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BC0502	CO1	1	2	1	1			1	1		2	1	1	
	CO2	2	1	1	2			1	1		1	1	1	
	CO3	2	1	2	1			1	1		2	1	1	
	CO4	1	1	1					1		2	1	1	

**Course Contents**

- Determination of total activity through preparation of standard curves, optimum temperature and pH of the following enzymes
  - $\alpha$  amylase (using Standard curve of maltose)
  - Acid phosphatase (using Standard curve of p0nitrophenol)

- c. Urease (using Standard curve of ammoniumsulfate)
2. Determination of activity of SGOT, SGPT&Creatinekinase

**Reference Books:**

1. An Introduction to practical Biochemistry—PlummerD.T, Tata McGrawHill
2. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry: Trevor Palmer, Horwood, (2001).
3. Methods in Enzymology; Colowick, S.P. et al., [Eds.] (1987) Vol. 152, AcademicPress.
4. Methods of Enzymatic Analysis; Berg Meyer (1974) Vol.10X,
5. Experimental Biochemistry: A Student Publisher: I.K. International Publishing House Pvt. Ltd.(Deshpande)
6. Biochemical methods S.Sadasivam A Manickam, New Age International Pvt Ltd Publishers; Thirdedition
7. Introductory practical Biochemistry, Sawhney, Randhir singh,11<sup>th</sup>Edition (2015)

Course Code	Human Genetics Lab	Course Type	L	T	P	C	CH
B21GN0502		HC	0	0	1.5	1.5	3

**Prerequisites/Pre reading for the course:**

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

**Course Objectives:**

The Objectives of this course is to:

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

**Course Outcomes:**

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

1. Analyse the karyotypes and interpret the disorder.
2. Visualize Barr body in epithelial cells and drumsticks in neutrophils.
3. Diagnose genetic diseases.
4. Compare the fingerprints in forensic investigation.

**Mapping of Course Outcomes with programme Outcomes**

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

<b>B21GN0502</b>	CO3	3	3	3	3		3				3	3	2	3
	CO4	3	3	3	3		3	3	3		3	3	3	3

**Course Contents:**

1. Study of Karyotypes I: Normal Karyotyping in Human 1Prc. Male (46, XY) Female (46, XX).
2. Study of Karyotypes II: Abnormal Karyotypes 1 Prc. Down's syndrome (autosomal). Turner's syndrome (sex chromosomal), Klinefelter's syndrome (sex chromosomal)
3. Study of banding techniques (G0banding technique).
4. Study of drum sticks in Neutrophils of Blood smear.
5. Blood Cell counting using Haemocytometer (RBC and WBC).
6. Pedigree analysis and construction: Symbols used and problems associated with autosomal recessive disorder, autosomal dominant disorder, Sex linked inheritance (X and Y)
7. Dermatoglyphics: Recording of print of fingertips and palm. Classifying ridges on the Finger tips: arch, loop, and whorl. Palm print area demark as hypothenar, thenar and inter digital areas, Recording presence or absence of Simian crease. Ridge Counting and angle calculation.

**Reference Books:**

1. Basic Human Genetics by EJ. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics0 Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R. Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston.
9. Human Genetics by S.D. Gangane (2nd edition0Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
10. Medical Genetics. Lynn Jorde John CareyMichaelBamshad. 2015.
11. Mendelian inheritance in Man by0Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
12. Molecular Basis of Inherited Diseases, (6th Edition01989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds0McGrawHill, New York.

**SIXTH SEMESTER**

Course Code	Plant Biotechnology	Course Type	L	T	P	C	CH
<b>B21BT0601</b>		<b>HC</b>	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

- The student should be familiar with the basic concepts in botany and plant physiology
- The student should know basics in molecular biology and genetic engineering

**Course Objectives:**

To enable the students

1. To introduce the underlying principles involved in plant tissue culture.
2. To familiarize the students with the concepts and techniques in plant genetic engineering.
3. To understand the significance of transgenic plants in molecular farming.

**Course Outcomes:**

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

1. Describe the various plant tissue culture techniques with the associated advantages and disadvantages.
2. Explain the significance of somatic hybridization in creating new varieties through tissue culture.
3. Choose alternative plant biotechnology tools in place of genetic modification by engineering.
4. Comprehend the process of production of commercially important compounds through molecular farming.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BT0601</b>	CO1	2	3	2	1	2	2	2	3	1	3	2	3	3
	CO2	2	3	2	1	2	1	2	1	1	3	2	2	3
	CO3	2	3	2	2	1	1	2	1	1	3	2	2	2
	CO4	2	3	2	2	1	1	2	1	1	3	2	3	3

**Course Contents:****UNIT 1****Introduction to Plant tissue culture****12 hrs**

Laboratory organization, Aseptic techniques, plant tissue culture media and growth regulators. Concept of totipotency. Micropropagation: Shoot tip and Axillary bud proliferation, Organogenesis and Somatic embryogenesis. Organ culture: Anther, embryo and endosperm culture. Ovary and ovule culture. Secondary metabolite production through cell culture and hairy root culture.

**UNIT II****Somaclonal Variation and Somatic Hybridisation****12 hrs**

Concept and Screening of somaclonal variants. Applications of variants. Protoplast culture  
Isolation of protoplast mechanical and enzymatic methods, viability of protoplast, protoplast

fusion0 PEG mediated and electrofusion, selection, culture of protoplasts, regeneration, screening and applications. Cybridisation and its applications.

### UNIT III

#### Production of transgenic plants

12 hrs

Methods of plant transformation: *Agrobacterium* mediated gene transfer. Selectable and reporter genes. rDNA approaches for introducing herbicide tolerance, pest resistance *Bt* cotton production, plant disease resistance0bacterial and viral resistance. Ethical issues associated with genetically modified plants. Transgenic models in plants.

### UNIT IV

#### Molecular Farming

12 hrs

Edible vaccines from plants water melon and banana as the host plant, Plantibodies Various approaches, Production of PHB targeted and non targeted approach, Therapeutic protein production: production systems and strategies Hirudin production, Industrial enzymes Amylase, cellulase, phytases and Proteases.

### References

1. Adrian Slater, Nigel W. Scott, Mark R. Fowler. (2008). Plant Biotechnology: An Introduction to Genetic Engineering by Oxford University Press.
2. Adams, Food Microbiology Bhojwani. S.S and Razdan by M.K (2004). Plant tissue culture, Oxford and IBH Publishing Co, New Delhi.
3. Gamborg O.L. and Philips G.C. (1998) Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. New Delhi.
4. Razdan. M.K. (2003). An introduction to Plant Tissue Culture. Oxford and IBH Publishing Co, New Delhi.
5. Singh B D (2006). Plant Biotechnology. Kalyani Publishers.
6. Chawla H S (2000). Introduction to Plant Biotechnology. Science Publishers.

Course Code	Metabolism II	Course Type	L	T	P	C	CH
B21BC0601		HC	1	1	0	2	3

### Course Objectives:

1. Understand about the metabolism of amino acids.
2. Understand the metabolism of purine and pyrimidine nucleotides.
3. To know about the biochemical constituents related with diagnosis of diseases.
4. Understand the microbial pathogenicity and immune response.

### Course Outcomes:

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

1. Understand the general and various synthesis, degradation and diseases of amino acids.
2. Know biochemical constituent related with kidney, liver and other organ function tests.

- Learn about different components required for the microbial growth. Also, about the pathogenic virus and bacterial life cycle.
- Know about the Cellular, humoral immunity, organ and different type of immune responsive cells

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BC0601</b>	CO1	3		1	2			2		3		2	1	
	CO2	3	1	2		3		3		2	3		2	2
	CO3	2		3		3		3	2		3	2		
	CO4	3		3	2	3		1		3	2	2	1	2

### Course Contents

#### UNIT I

12 hrs

**Amino acid metabolism:** General reaction transamination definition, reactions catalysed by SGOT and SGPT, importance of transamination; Deamination definition, oxidative and non

oxidative, examples for oxidative deamination 0 L0glutamate and non0oxidative0 serine, aspartic acid and glutamine.

Decarboxylation 0 definition, decarboxylation of glutamic acid, Histidine.

Urea cycle0 individual reactions, importance of urea cycle, hyperammonaemia, regulation of urea cycle. Interrelationship between urea cycle and TCA cycle. Biosynthesis of glycine from serine and choline.

Biosynthesis of alanine from transamination reaction. Biosynthesis of cysteine from L0 serine.

Epinephrine and Nor0epinephrine0 importance and biosynthesis from tyrosine. Histamine; biological importance and synthesis. Glucogenic and ketogenic amino acids.

Biosynthesis of non0essential amino acids; biosynthesis of Essential amino acids (Only overview0in plants) and their regulation.

**Disorders of amino acid metabolism:** Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Methylmalonic aciduria, Parkinson's disease, Homocystinuria, and Hartnup disease Porphyrin biosynthesis and disorders of porphyrin metabolism.

#### UNIT II

12 hrs

**Nucleic acid metabolism:** Biosynthesis of purine and pyrimidine nucleotides0 sources of nitrogen and carbon atoms of purine and pyrimidine ring. Precursors of purine and pyrimidine biosynthesis. Reactions involved in the biosynthesis.

Conversion of nucleotides to deoxynucleotides. Orotic aciduria0 general features. Gout; general features.



Biosynthesis of IMP; pathways from IMP to AMP and GMP; conversion to triphosphates; regulation of purine nucleotide biosynthesis, salvage pathways; synthesis of coenzymes (NAD<sup>+</sup>, FMN, FAD, CoASH)

Biosynthesis of UMP, conversion of triphosphates and regulation. Biosynthesis of pyrimidine nucleotide synthesis;

Deoxyribonucleotides and synthesis of dTTP0 inhibitors of nucleotide metabolism and their use as anti0bacterial / anticancer drugs

Degradation of purine and pyrimidine nucleotides.

Disorders of nucleotide metabolism: Lesch Nyhan syndrome, Gout, SCID, Adenosine deaminase deficiency.

### **UNIT III**

**12 hrs**

#### **Urine:**

Normal composition of urine0 volume, specific gravity. Constituents0 urea, uric, acid, creatinine, pigments and their clinical significance in brief. Kidney disorder.

#### **Blood:**

Normal constituents of blood. Urea, Uric acid, Creatinine, Glucose, Bilirubin, Total protein, Albumin/ globulin ratio0 Variation in pathological conditions. Lipid Profile0 Cholesterol, Triglycerides, lipoproteins, HDL and LDL.

#### **Diagnostic enzymes:**

SGOT, SGPT, Alkaline Phosphatase. Cardiac injury profile0 CPK and LDH.

**Inborn errors of metabolism:** Sickle cell anaemia, Glycogen storage disease, Nieman0pick disease, Lesch Nyhan syndrome.

### **UNIT IV**

**12 hrs**

#### **Study of Micro0organisms:**

Staining micro0organisms – principle and procedure of gram stain and acid0fast stain.

#### **Microbial nutrition:**

Growth of micro0organisms, measurement of growth, factors influencing growth – Nutrition, carbon source, Nitrogen source, Temperature, pH and oxygen. Batch and Continuous culture. Growth curve, phases of growth curve. Concept of synchronous Cultures.

#### **Antibiotics:**

Definition, Mechanism of action of penicillin streptomycin, and chloramphenicol, Antibiotic resistance in brief.

#### **Viruses:**

Classification based on genetic material with examples.

Plant viruses – TMV, morphology, general characteristics and its replication.

**Bacteriophages:**

Morphology, general characteristics, life cycle (lysogeny and lytic cycle) of T0even

Bacteriophage.

Definition of Haptens, Epitopes, General features. Antigenicity. Primary lymphoid organs.

Immunoglobulin: Definition, types and structure.

Antigen0antibody reaction invitro: Formation of antigen0antibody complex. Precipitation reactions0 Immunodiffusion0 single, double diffusion, immune electrophoresis. ELISA, RIA.

**Immunity:**

Cellular and humoral immunity. Role of immunologically important organs and cells0 bone marrow, thymus, spleen and lymphocytes. Formation and functions of T and B lymphocytes and macrophages. Helper T0cells and Killer T0cells. Allergy0 definition, types. AIDS.

**Reference Books:**

1. Fundamentals of Biochemistry0JL Jain, S. Jain and N.Jain (2000), S.Chand.
2. Text Book of Microbiology 0 R.Ananthanaryan and CKJ Pannikar (2005) CBS Publishers.
- 3.Immunology: Introductory text book0 NandiniShetty(2008) .New AgePublications
4. M. Pelczar, E.C.S. Chan and M.R. Krieg, MICROBIOLOGY, McGraw Hill Inc., Singapore (1997).
5. Powar, Daginawala – Himalaya Publishing House. General Microbiology, Vol. I& II.
6. Stanier, Adelberg, Ingraham – The Macmillan Press – London. General Microbiology.
7. NandiniShetty. Introduction to Immunology.
8. J. Kuby “Immunology” 3rd edn., Mosby Year Book Co., England

Course Code	Evolutionary & Biometrical Genetics	Course Type	L	T	P	C	CH
B21GN0601		HC	2	1	0	3	4

**Prerequisites/Pre reading for the course:**

1. Students should have the knowledge of theories of evolution.
2. Students should be aware Basic mathematical concepts.

**Course Objectives:**

The Objectives of this course is to:

1. To explain the concept of population genetics and its application in studying the evolution of the species.
2. To discuss the inheritance involving quantitative characters.

- To study the basics of statistics and its applications.
- To apply the knowledge of biometry in genetic variation.

### Course Outcomes:

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

- Characterize the genetic variations observed in population.
- Explore the mechanism of transposition.
- Discuss the inheritance of quantitative characters.
- Apply the knowledge of biometry in the phenotypic variation of traits.

### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0601	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3	2							3	3	2	
	CO3	3	3	3		3	2				3	3	2	
	CO4	3	3	3	3	3	2				3	3	2	

### Course Contents:

#### UNIT0I

12 hrs

Darwinism, Neo Darwinism and Synthetic Theory.

Population genetics: Gene pool, Gene and genotype frequencies: Hardy0Weinberg principle, Evolutionary agents: Selection – differential selection, gametic selection, zygotic selection, fitness; Migration; Mutation and Random drift.

Speciation: Methods of speciation, 0 Isolating Mechanisms0Pre0mating and Post mating. Evolution at molecular level: 0 Nucleotide sequence.

**Transposable elements:** Bacteria, Yeast, Maize and *Drosophila*, humans.

#### UNIT0II

12 hrs

##### Quantitative Characters and Inheritance:

Quantitative Characters: 0Types0 Continuous, meristic and threshold characters with examples.

Quantitative inheritance: 0Features of polygenic traits in relation to oligogenic traits. Inheritance of Kernel color in wheat and Skin colour in human.

Transgressive inheritance in Poultry.

Environmental effects–IQ in Humans

Significance of polygenic inheritance0Twin study

#### UNIT0III

12 hrs

##### Elements of Biometry

Measures of Central Tendency – Mean, Median and Mode

Measures of Dispersion – Variance and Standard deviation

Test of Hypothesis – Student's 't' Test, Chi square Test.

Probability – Definition and rules.

Distribution – Normal, Binomial and Poisson.

**UNIT0IV****12 hrs****Biometrical Genetics:**

An introduction to Correlation, Regression and ANOVA (Analysis of Variance)

Genetic analysis of quantitative trait: 0 Ear length in Corn

Variances in polygenic traits: 0 Phenotypic, genotypic, environmental, additive, dominance and Epistatic variance; Genotype and environmental interaction.

Heritability: 0 Broad sense and Narrow sense heritability, Quantitative trait loci (QTL). Problems related to Variance and Heritability.

**Reference Books:**

1. Evolution –Stickberger, M. W (1990) Jones and Bartlett, Boston.
2. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
4. Introduction to Quantitative Genetics by Falconer, D (1995) 4<sup>th</sup> edition Longman, London.
5. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.

Course Code	Biochemistry of Plant Sciences	Course Type	L	T	P	C	CH
<b>B21BCS611</b>		<b>SC</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>

**Course Objectives:**

1. To understand basic plant cell development, structure, function and plant physiology.
2. To know plant hormones and secondary metabolites.
3. To understand the biological nitrogen fixation by microorganisms and photosynthesis in plant.
4. To understand recombinant technology for transgenic plant development.

**Course Outcomes:**

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

1. Understand the plant cell and physiology.
2. Learn about the plant hormones and secondary metabolites
3. Gain an understanding on about the biological nitrogen and photosynthesis in plant.
4. Understand the concepts in vector, gene cloning, biofertilizers and pesticide management.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>B21BCS611</b>	CO1	<b>2</b>	<b>2</b>	<b>3</b>		<b>2</b>	<b>2</b>		<b>3</b>		<b>3</b>	<b>1</b>		<b>1</b>
	CO2	<b>3</b>		<b>2</b>	<b>3</b>		<b>2</b>		<b>2</b>		<b>2</b>		<b>2</b>	<b>2</b>
	CO3	<b>1</b>	<b>3</b>		<b>2</b>		<b>3</b>	<b>2</b>		<b>2</b>	<b>3</b>	<b>3</b>		<b>1</b>
	CO4	<b>3</b>		<b>3</b>		<b>3</b>		<b>2</b>		<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>

## Course Contents

### UNIT I

12 hrs

**Plant Structure and development:** Structure and biochemical aspects of specialised plant cell organelles cell plate, primary and secondary cell walls, plasmodesmata, importance of vacuoles, characteristics of meristematic cells. Cell division Mitosis, Meiosis, extension, differentiation and their controls.

**Plant Physiology:** General features of Photosynthesis, Respiration and photorespiration, Nitrogen metabolism, Plant hormones, Sensory photobiology, Stress physiology. Solute transport role of water, absorption, adsorption, conduction and transpiration, guttation water balance and stress. Photo assimilate translocation. Defence system in plants.

Mineral metabolism role of different minerals absorption and translocation of inorganic and organic substances.

### UNIT II

12 hrs

**Secondary Metabolites:** Classification, isolation, characterization, Biosynthetic pathway of secondary metabolites, tracer techniques. Special features of secondary plant metabolism formation and functions of phenolic acids, tannins, lignin, flavonoid pigments, surface waxes, cutin and suberin the plant protective waxes, terpenes.

Plant Hormones Growth regulating substances and their mode of action. Role of auxins, gibberellic acid, abscisic acid and cytokinin in the regulatory cell extension, germination, embryogenetic growth and development.

### UNIT III

12 hrs

#### **Biological Nitrogen Fixation:**

Nitrogen cycle, components of nitrogenase complex, stoichiometry of nitrogen fixation, nif genes.

**Photosynthesis:** Photosynthetic pigments and Photosynthetic unit. Light reactions – photosystem I and II and their interactions. Synthesis of NADPH, photolysis of water, synthesis of ATP in cyclic and non cyclic photophosphorylation. Dark reactions chemical reactions up to the synthesis of fructose 6 phosphate. Trans ketolation and aldolation reactions (shall be given in the form of flow chart). Interdependence of light and dark reactions. C<sub>3</sub> and C<sub>4</sub> plants definition and C<sub>4</sub> pathway (HSK pathway). Bacterial photosynthesis.

### UNIT IV

12 hrs

**Agricultural Biotechnology:** Biopesticides, integrated pest control, sericulture, biofertilizers, Bio0communication, bioremediation, bio0catalysis, phytomedicine. Tissue culture Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector0mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc.

#### **Reference Books:**

1. Plant Biology. Allison Smith et al. Garland Science, 2010.
2. Organic Chemistry Finar Natural Product Chemistry at a Glance by S P Stanforth.

4. Plant Biochemistry Hans0Walter Heldt in cooperation with Fiona Heldt
5. Plant Physiology TaizZeiger
6. Biochemistry & Molecular Biology of Plants. Bob Buchanan, Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.
7. Phytochemical Methods A Guide to Modern Techniques of Plant Analysis by JB Harborne. Springer, 1998.
8. Plant Biochemistry by P. M. Dey and J. B. Harborne, Harcourt Aria PTE Ltd. Singapore.
9. Plant Physiology by Salinbury.
10. Plant Physiology by Davin.
11. Plant Physiology by Srivastava.

Course Code	Biochemistry of Animal Sciences	Course Type	L	T	P	C	CH
B21BCS612		SC	2	0	0	2	2

#### Course Objective:

- Understand the scope of biochemistry and molecular biology in animal sciences.
- Learn about the maintenance of cell culture, growth kinetics and type of media.
- To know about biochemical constituents in various tissues and their related disorders.
- To gain knowledge in clinical biochemistry

#### Course Outcomes:

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

1. Understand the scope of biochemistry and molecular biology in animal sciences.
2. Learn about the cell culture, growth of cell culture and different types of media.
3. Know various metabolic disorders concerned with deficiency and excess of biochemical constituents.
4. Acquire practical skills in clinical diagnostics of various diseases.

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21BCS612	CO1	2	1	3		3		2		2	2	1	2	
	CO2	2		2		1			3		1	1		2
	CO3	2	2	2	2	3	3	2		2	3		1	2
	CO4	2		3		3		2		2	3	1	2	

#### Course Contents

##### UNIT I

12 hrs

Scope of Biochemistry and molecular biology in animal sciences. Structural and functional organization of prokaryotic and eukaryotic cells, viruses and bacteriophages. Compartmentalization of metabolic processes within the cell and fractionation of subcellular components. Structure and functions of bio membranes with special reference to active transport of ions and metabolites. Extra and intracellular communication. General description of cell culture, hybridoma and animal cloning techniques.

**UNIT II**

**12 hrs**

Culture techniques of cells Disaggregation of cells, cell viability and preparation of substrate. Primary cell culture, Sub culture and cell lines Characteristics of cell line and their maintenance, kinetics of cell growth and applications of cell line. Culture media – Type of media (Serum, Serum free and chemically defined media). Tissue and Organ culture – Different methods of tissue and organ culture. Embryo – culture and transfer in farm animals.

**UNIT III**

**12 hrs**

Blood composition and their biochemical constituents of erythrocytes, leucocytes and platelets. Important plasma proteins and their functions. Haemoglobin in oxygen and carbon dioxide transport. Composition and metabolism of muscle, connective, tissue, cartilage, bone, nervous, tissue, adipose tissue and mammary tissue.

Clinical significance of iron, iodine calcium and phosphorus metabolism in domestic animals and human metabolic functions, Deficiencies and nutritional significance of water soluble , lipid soluble vitamins B and Trace elements in animals, human, nutraceuticals & probiotics.

Metabolic function of different hormones and associated disorders.

**UNIT IV**

**12 hrs**

Approaches to clinical biochemistry: Concepts of accuracy, precision, sensitivity and reproducibility; Quality control, fixation of normal range. Collection and processing of blood and urine samples, Anticoagulants, Preservative for blood and urine, Transport of biological samples Disorders of carbohydrate, protein, lipid and nucleic acid metabolism.

Clinical significance of nonprotein nitrogenous compounds. Liver, Kidney and Gastric function tests.

**Reference Books:**

1. Modern Biotechnology Primrose, S.B. Blackwell Scientific Pub., London, England
2. Genetic Engineering SandhyaMitra Macmillan India Ltd. Principles and Practice
3. Elements of Biotechnology Gupta, P.K. Rastogi& Company Meerut
4. Animal Cell Culture Fresheny, R. I.
5. Practical Biochemistry Wilson, Kand walker, J
6. Instrumental methods of Analysis Willard
7. Practical Clinical Biochemistry Harold Varley, Fifth edition, CBS Publication and Distributors, New Delhi.
8. Medical BiochemistryDr.M.N. Chatterjee III Edition,1998JAYPEE BROTHERS, Medica Publishers (p) LTD, NewDelhi.
- 9.Essentials of Medical Physiology 7th Edition 2016 by KSemblingam Prema Sembulingam.
10. Textbook of Biochemistry for Medical Students by VasudevanDM

Course	Plant	Course	L	T	P	C	CH
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<b>Code</b>	<b>Biotechnology Lab</b>	<b>Type</b>					
<b>B21BT0602</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>1.5</b>	<b>1.5</b>	<b>3</b>

**Prerequisites/Pre reading for the course:**

The student should have basic knowledge of botany, plant anatomy and histology

**Course Objectives:**

1. Introduce the basic techniques in plant tissue culture.
2. Familiarize the students with the techniques in plant regeneration.
3. Understand the significance of artificial seed production for propagation.

**Course Outcomes:**

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

1. Acquire the knowledge about the techniques of Plant Tissue Culture, Lab, organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
2. Explain the techniques of culturing tissues protoplasts & anther culture.
3. Apply the large scale clonal propagation of plants through various micropropagation techniques.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
<b>B21BT0602</b>	CO1	2	3	3	2	2	2	2	1	1	3	2	3	3
	CO2	2	3	3	2	2	1	2	1	1	3	2	3	3
	CO3	2	3	3	2	1	1	2	1	1	3	2	3	3
	CO4	2	3	3	2	1	1	2	1	1	3	2	3	3

**Course Contents:**

1. Organisation of Tissue culture lab
2. Preparation of Murashige and Skoog's Medium
3. Single node culture
4. Shoot tip culture
5. Callus culture and initiation of suspension culture
6. Anther culture for haploid plant production
7. Isolation of Protoplast from various sources
8. Preparation of synthetic seeds

**Reference Books:**

1. Christou P and Klee H. (2004). Handbook of Plant Biotechnology. John Wiley and Sons.
2. Dixon RA. (2003). Plant Cell Culture. IRL Press.
3. George EF, Hall MA and De Klerk GJ. (2008). Plant Propagation by Tissue Culture. Agritech Publ.
4. Gamborg O.L. and Philips G.C. (1998) Plant cell, tissue and organ culture (2nd Ed.) Narosa



Publishing House. New Delhi.

5. Hammond J, P McGravey and Yusibov.V (2000). Plant Biotechnology, Springer verlag.
6. Kirakosyan A and Kaufman P.B. (2009) Recent Advances in Plant Biotechnology
7. Razdan. M.K. (2003). An introduction to Plant Tissue Culture. Oxford and IBH Publishing Co, New Delhi.
5. Blood group typing using haemagglutination tests and calculation of allele frequencies.
6. To test for colour blindness using Ishihara charts and calculation of allele frequencies
7. Study of frequency of twins in the local population.

#### Reference Books:

1. Evolution –Stickberger, M. W (1990) Jones and Bartlett, Boston.
2. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
4. Introduction to Quantitative Genetics by Falconer, D (1995) 4<sup>th</sup> edition Longman, London
5. Introduction to Quantitative Genetics by Falconer, D (1995) 4<sup>th</sup> edition Longman, London.
6. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.

Requires knowledge of pre-university, Need the basic concept of Microbiology and Immunotechniques.

#### Prerequisites:

Course Code	Laboratory Course	Course Type	L	T	P	C	CH
B21BC0602	(Biochemistry VI)	HC	0	0	2	2	3

#### Course Objective:

To learn microbiology, molecular and immunological experiments.

#### Course outcomes:

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

1. Prepare the microbial culture.
2. Isolate and characterize microbes.
3. Identify antigens by immunological methods.
4. Separate and quantify DNA from different sources.

#### Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21BC0602	CO1	3	1	2		2		3		2	2	2	2	
	CO2	2		2	3				2			2		1
	CO3	2	2			2	2	3	3		3	2	2	
	CO4	2		2	3			2	2	3		2	2	1

1. Preparation of microbial culture media. Sterilization and staining methods (Gram and endospore staining)
2. Isolation and characterization of microorganisms from soil, sewage water and fermented foods.
3. Alcoholic and Sugar fermentation in Microorganisms
4. Identification of antigen by Ouchterlony Immuno diffusion technique.
5. Immunoelectrophoresis of serum & Complement fixation test.
6. Isolation, digestion (restriction enzymes), separation (by agarose gel electrophoresis) & quantification of DNA (by DP method).
7. Separation of isoenzymes of LDH by electrophoresis.

#### Reference Books:

1. Text book of Clinical Chemistry Teitz
2. Practical Clinical Biochemistry Harold Varley CBS, 6th ed. New Delhi 2002
3. An Introduction to practical Biochemistry—Plummer D.T, Tata Mc Graw Hill
4. Lab manual of Biochemistry, Immunology and BioTechnology, Arinagam and Archana Ayyagiri Tata McGraw Hill.
5. Principles and techniques of Biochemistry and Molecular Biology; Keith Wilson and John Walker; 6th Edn. (2005) Cambridge University Press.
6. Experimental Biochemistry: A Student Publisher: I.K. International Publishing House Pvt. Ltd. (Deshpande)
7. Biochemical methods S. Sadasivam A Manickam, New Age International Pvt Ltd Publishers; Third edition
8. Introductory practical Biochemistry, Sawhney, Randhir Singh, 11<sup>th</sup> Edition (2015)

Course Code	Evolutionary & Biometrical Genetics Lab	Course Type	L	T	P	C	CH
B21GN0602		HC	0	0	1.5	1.5	3

#### Prerequisites/Pre reading for the course:

1. Students should have the knowledge of evolution.
2. Students should be aware of the basic mathematical concepts.

#### Course Objectives:

The Objectives of this course is to:

1. To study various inheritance involving quantitative traits.
2. To compute the statistical analysis for biological data.
3. To calculate the allelic and genotype frequencies with different inheritance data.

**Course Outcomes:**

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

1. Understand the pattern of quantitative inheritance.
2. Learn the statistical concepts used for data collection.
3. Analyze the data statistically.
4. To predict the allelic variations in the population.

**Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO 3
<b>B21GN0602</b>	CO1	3	3		3	3	2	3		3	3	3	2	
	CO2	3	3	3	3		3	3	2	3	3	3	2	
	CO3	3	3	3	3		3	3		3	3	2		
	CO4	3	3	3		3	3	3		2	3	3	2	

**Course Content:**

1. Study of Quantitative inheritance in Kernel colour in Wheat/Skin colour in man .
2. Genetic problems on polygenic variance, Heritability and ANOVA
3. Biometrical Computation of:
  - a. Mean, Median and Mode
  - b. Variance, Standard Deviation
- c. Problems on: Student's 't' test and Chi square test
4. Biometrical problems (Minimum 3 problems in each topic)
8. Hardy Weinberg Genetic equilibrium: Study of gene & genotype frequencies. (PTC Tasters & nontasters)

Course Code	Project	Course Type	L	T	P	C	CH
<b>B21SB0601</b>		<b>HC</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>6</b>

**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. Team work
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. Roleplay
11. Group discussion, and soon

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 Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes 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, Biochemistry, Genetics is not only the knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised 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 centre, the students shall compulsorily complete at least two skills / certification-based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOUs with Multi0National Companies, researchinstitutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certificationprograms.

Rukmini Knowledge Park  
Kattigenahalli, Yelahanka,  
Bengaluru – 560064, INDIA

Tel : +91 80 4696 6966  
Fax : +91 80 4696 6998

[www.reva.edu.in](http://www.reva.edu.in)