

## Director's Message



### Welcome to College of Commerce, Arts & Science, Patna

I am delighted to welcome you to this institution. Here we understand the challenges that are in store for our students. We, therefore, provide a rich learning environment. A balance of knowledge and application is what this institution provides to its students. Flexibility, breadth and depth are the hallmark of our learning pathways. We value and celebrate achievement and generosity.

Founded on 5th Sept., 1949, College of Commerce is renowned for its outstanding holistic education. Our students success cannot be defined by qualification alone. The students leave the college as dynamic and impactful citizens, equipped to play a leading role in which ever walk of life they choose. We have high class infrastructure with well-equipped computer/IT laboratories/Class room/Auditorium/ Seminar Hall, Modernised, Library etc. We are proud of our strong team of metiulously, dedicated and committed faculty and staff.

College of Commerce, Arts & Science is a challenging and exhilirating place to learn. I warmly welcome you to come and visit to experience all that this college has to offer.

With best wishes and blessings.

Prof. (Dr.) Indrajit Prasad Roy Principal-cum-Director College of Commerce, Arts & Science Patna - 800 020

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# Co-ordinator's Message



#### Dear Students,

The arena in which you are willing to enter is an intervention of human mind given by God into the world around you created by Him. To be precise, with the help of available technology you are supposed to struggle for all natural forces that shape the destiny of the Flora & Fauna as well as mankind on the earth. Biotechnology, thus, has become a state of art discipline to ensure a better living or the present and safe life for the coming generation. And that's why it has enough scope for job opportunities in the various fields of industrial, medical & genetic engineering.

We welcome you to pursue your career in this field and have your better lives dreams fulfilled. Our Cooperation is always available to you in the ways.

**COLLEGE OF COMMERCE, ARTS & SCIENCE, PATNA** 

## Prof. (Dr.) Manoj Kumar

Co-ordinator B.Sc. Biotechnology College of Commerce, Arts & Science Patna-800 020



## Jhe College of Commerce, Arts & Science : An Introduction

It was established in the year 1949 with only commerce course in the beginning, and hence its name was **College of Commerce**. In 1952, the college was affiliated to Bihar University; Application teaching was started in 1957 followed by Arts, Science in the Year 1960 and Law in 1963. Later the college became a constituent unit of Magadh University Bodh Gaya. Post Graduate Centres started here in 1984. The college is one of the oldest and widely acclaimed institutions in the field of education recognized under U.G.C. regulations. It has produced a number of scholars and has always imparting to its students terminal. In 2016, it becames name is **College of Commerce**, **Arts & Science**, **Patna**.



The College is located in Patna at Kankarbagh, just opposite to the Rajendra Nagar Terminal and is well connected by the city's transportation system. Transport for any part of the city is easily available to and from the college. Students coming from suburbs by local train find it very convenient to reach the college by coming to Rajendra Nagar Terminal. Almost all local trains have their stoppage at this station. It is about 10 kilometers by road from Jai Prakash Narayan International Air Port, Patna.

The College has larger campus area and has sufficient buildings and various departments inside the campus. Central Bank of India (with ATM), Post-Office and Police Monitoring are available inside the college campus to provide multiple facilities and security inside the college. Various kinds of scientific, cultural and Youth programmes are also colorfully conducted in the college.

Currently, the college is imparting undergraduate and postgraduate education to students in many subjects of Arts, Science, and Commerce with adequate infrastructure including well furnished lab, Library, and spacious classrooms, along with Vocational Courses like Computer Applications, Biotechnology, Bio-Chemistry, Office Management, Functional English, etc. The college offers environment for all round development of its students. Recently the college has gone technical savvy and has launched its own website on Internet and Wi-Fi facility. The web address of the college, http://www.cocaspatna.org, provides general information about the college and the courses offered by it.



## **Biotechnology : An overview**

Biotechnology is the amalgamation of biology and engineering to harness the ability of living cells of microbes, fungi, higher plants and animals to produce or to modify chemical substances or novel products at large scale Lo. at industrial level with a view to obtain improved food components, fodder, spices, flavours, drugs, vaccines of superior quality and an array of several life sustaining systems. Use of bacteria, Penicillium, Aspergillus and yeast to produce curd, yogurt, cheese, lactic acid, acetic acid, antibiotics, vitamins, digestive enzymes, alcohol, beer, wine etc, has been the classical application of biotechnology. With the advent of techniques of culturing tissues of higher plants and animals followed by sudden spurt in recombinant DNA techniques, biotechnology has taken multiple strides during the last two decades and industries producing drugs, food and chemicals started coming out in the open to lap up the technology Some modern achievements are production of human insulin (humulin) from genetically engineered bacterial cells in culture, developing transgenic crops and their seeds resistant to diseases and pests like Bt cotton, Bt maize, Bt soya etc. production of blood substitutes by transferring required genetic set up to easily manageable plant or microbe systems, production of alpha interferon from treatment of hairy leukemia, production of human growth hormone (hGH) from *E.coli* to treat dwarfism, production of monoclonal antibodies through hybridum techniques, development of recombinant vaccine for hepatitis B, production of secondary metabolites of medicinal importance in suspension cultures of plant cells, development of techniques for desirable modifications in proteins (protein engineering), drug designing and GRT (Gene Replacement Therapy).

Students taking course in biotechnology are supposed to learn basic as well as sophisticated techniques and develop their own acumen and aptitude to think beyond the usual availability of natural products, besign novel applications and devise methods of transfer of techniques to industries so that they can be able to exploit their knowledge in pharmaceutical firms, chemical industries or at research establishments. A person learning and improvising these techniques prove to be invaluable asset to the entire mankind, which is looking to the future of biotechnology with awe and great expectations. In terms of global industrial growth, the area of biotechnology is at present referred as the sunrise sector.

### Meaning of vocational course

The English word 'vocation' means inclination / urge (natural desire) of a person. Hence, vocational course in a subject is basically a training course for such students who are genuinely interested in that subject. In context of students, it means that he/she decided conscientiously to pursue the subject as career for his/her life. Applicants for such a course must set out his/her priorities before finally deciding for admission into the course. This guideline is relatively more noteworthy if a vocational course a student is opting for is highly skill-oriented, research based and challenging. Biotechnology is such a vast and ultramodern subject field. Obtaining a degree in this area would not be of any use unless the student orientates himself/herself appropriately to learn different sophisticated techniques and develop skills associated with it to use them later in life. Primary purpose of the U.G.C. sponsored vocational courses run in different colleges of the country is to prepare students for self-employment/entrepreneurship in life. In entrepreneurial arena, in-depth knowledge of the subject is necessarily required to be fortified with the skills to use that knowledge. That is why we lay a bit more stress on practical classes in comparison to



theory classes here in the class routine for 3-year degree vocational course in biotechnology as we try our best to inculcate the complete know-how of the desirable techniques into the minds of the learners as per the recommendations of University Grants Commission.

## U.G.C. sanction of vocational course

University Grants Commission, New Delhi, sanctioned 3-year degree vocational course in biotechnology to College of Commerce, Patna by letter no. F-4-138/2001 (desk-VE) dated 23 July 2001. The course was launched in the Department of Botany from the same session.

### Course structure

Three year degree (vocational) course in B.Sc. Biotechnology in the Department of Botany, College of Commerce, Arts & Science, Patna under Patliputra University awards B.Sc. (Hons.) degree to students in Biotechnology under the vocational education scheme of University Grants Commission, New Delhi. This is at par with the curricula in other B.Sc. (Hons.) subjects adopted by Patliputra University, Patna. A student admitted to the three year degree (Hons.) vocational course in Biotechnology is required to opt for two subsidiary subjects (Chemistry and Botany) along with a Hindi composition paper in addition to the Honours papers during first two years of the course. In B.Sc. Part-III, the students are required to study a compulsory paper of General Science along with Honours papers instead of subsidiary papers or Hindi. The course structure as adopted by Patliputra University is as follows :

Year	Honours Papers with marks	Subsidiary Papers with marks	Compulsory Paper with Marks	
B.Sc. Part-I	<ol> <li>Paper - I (75)</li> <li>Paper - II (75 {40+35})</li> <li>Practical in Biochemistry and Microbiology (50)</li> </ol>	I Botany - I (75+25) II Chemistry - I (75+25)	Hindi composition (100)	
B.Sc. Part-II	<ul> <li>4. Paper - III (75)</li> <li>5. Paper - IV (75)</li> <li>6. Practical in Immunology and cellular biology (50)</li> </ul>	I Botany - II (75+25) II Chemistry - II (75+25)	Hindi composition (100)	
B.Sc. Part-III	<ul> <li>7. Paper - V (100)</li> <li>8. Paper - VI (100)</li> <li>9. Paper - VII (100)</li> <li>10. Paper - VIII <ul> <li>(Practical) : Cellular &amp;</li> <li>Molecular Biology an</li> <li>Culture methods (100)</li> </ul> </li> </ul>	None	General Science	

## **Course structure adopted by Patliputra University**



## **Teaching and Training**

We believe in upward mobility and modernity in teaching. Hence, we follow modern trends in teaching and training methods. The department is always in a mode to apply modern techniques of teaching to students. Extensive use of audio-visual aids like still and video camera, film projector, 35 mm slide projector, LCD projector, computer etc, is the norm. apart from these teaching aids, we induce new techniques of classroom teaching such as hierarchical teaching personalized tutorials, detached and stylized method, student-based guided teaching method, self-assessment based procedural teaching method etc. as and when required.

### Exams

As the college is a constituent unit of Patliputra University, Patna, all three annual examinations of the vocational biotechnology course are conducted by Patliputra University together with other vocational subjects taught at different colleges of the university. The university has constituted a separate board named "Vocational Education Board" for the management and examinations of vocational courses so that examinations are conducted on schedule and results are published on time. Department of Biotechnology College of Commerce conducts periodical tests to assess the progress of the students and get the proper feedback so that required attention may be provided to students individually to make them able to come upto mark.

## Workshops & seminar

Workshops are arranged to instill knowledge of proper practical techniques into learners of the course from time to time. These workshops would be conducted by experts invited from other institutions or from our own pool. Some workshops will be held by students themselves to demonstrate their skill. Seminar and symposia will also held to organize lectures by invited experts of the field once or twice every year for the benefit of our students.

Every year, towards the year end, our students organize a demonstration cum extension camp called "STRIDE" for the benefit of students and general mass of the society.

## **On-the-job training**

The syllabus of the vocational course in Biotechnology, prepared and circulated by University Grants Commission, New Delhi for adaptation by the colleges, makes it compulsory for students to attend suitable industries or institutions or laboratories to have a real on-the-spot knowledge of technological applications of biotechnological skills. The course will arrange such on the job training for them after 1st and IInd years at suitable places as and when required for. It would be mandatory for students to attend these training schedules and obtain a grading certificate from regulatory bodies.

## Library

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Apart from general library of the college, the department of botany and biotechnology has its own separate library and library and seminar where text and reference books for undergraduate & post-graduate students are available and where students can discuss curriculum with teachers.



## **Biochemistry**

- Introduction to Biochemistry.
- Nature of biological material.
- Brief mention of various micro and macro biomolecules.
- General properties of organic and inorganic compounds.
- Molecules involved in generation of mechanical stability : peptidoglycans, polysaccharides and membrane lipids.
- Molecules involved in information storage and retrieval : nucleic acids.
- Molecules executing mediator and catalytic functions : the proteins.
- The signal molecules.
- Enzymes : Introduction, classification, protein and non-protein enzymes, role of enzymes in biosynthetic and degradative cellular functions, mechanism and mode of action of enzymes, inhibition and regulation of enzyme action, Enzyme Kinetics, In vitro activity of purified enzymes, application of enzymes in industry, food processing and medicine.

## **Cell Biology**

- Cell as basic unit of living systems, The cell theory
- Precellular evolution : Artificial creation of "cells"
- Board classification of cell types : PPLOS, bacteria, eukaryotic microbes, plant and animal cells. A detaled classification of cell types within an organism. Cell, tissue, organ and organism as different levels of organization of otherwise genetically similar cells.
- Ecological amplitude of cell in high altitude, sediments, arctic, hot spring, arid, brackishand fresh water environments.
- Biochemical composition of cells : proteins, lipids, carbohydrate, nucleic acids and themetabolic pool.
- Ultra structure of the cell membrane.
- Structure and function of cell organelles, ultra structure of cell membrane, cytosol bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures, Golgi(actin, microtubules etc.) Mitochondria, chloroplast, lysosomes, peroxysomes, nucleus(nuclear membrane, nucleoplasm, nucleolus, chromatin).
- Cell division and cell cycle. (including cell synchrony and its applications)
- Cell-cell interation.
- Cell locomotion : amoeboid, flagellar and ciliar.
- Muscle and nerve cells
- Cell senescence and death
- Cell differentiation in plants and animals

### Microbiology

- Development of Microscopy (Optical, TEM And SEM)
- Contributions of Eminent Microbiologists.
- Concept and methods of Sterilization.



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**B.Sc. (Bio-Tech)** 



- Different types of bacteria and bacterial cell structure.
- Nature of Microbial Cell Surface.
- Gene transfer in microorganisms.
- Archaebacteria and Rickettsiae.
- PPLOs.
- Reference to phages.
- Prokaryotic and Eukaryotic Microbial Cells.
- Nutritional Classification of bacteria.
- Microbes in extreme environment : Thermophiles and alkalophiles.
- Pathogenic microorganisms.
- Symbiosis and Antagonism among microbial populations.
- N2-Fixing microbes in Agriculture- (Rhizobium).
- Microbial Metabolism (Respiration and photosynthesis).
- Fermentation products of bacteria.
- Significance of bacteria.



#### Genetics (40 Marks)

- Nature of genetic material, Nucleic acids, DNA replication.
- Mendelian laws of inheritance, gene interactions.
- Sex determination in plants and animals, sex linkage, non disjunction as a proof ofchromosomal theory of inheritance.
- Linkage : mapping genes, interference, coincidence in pro and eukaryotes. Chromosomes: chemical composition, structural organization of chromatids, centromeres telomeres, chromatin, nucleosome organization, eukaryote and hetrochromatin, special chromosome (e.g. Polytene and lampbrush chromosome), banding patterns in human chromosomes.
- Structural and numerical aberrations involving chromosomes, evolution of wheat, cotton and rice, Hereditary defects : Kleinefelter, Turner, cri-du-chat and Down's syndromes.
- Mutations : spontaneous and induced, chemical and physical mutagens, induced mutationin plants, animals and microbes for economic benefit of man.
- Basic microbial genetics, conjunction, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathways, one gene-one enzyme hypothesis.
- Extra chromosomal inheritance, mitochondrial and chloroplast genetic systems.
- Population genetics : Hardy-Weinberg equilibrium, gene and genotypic frequencies.

## Maths and Computers (35 marks)

- The set theory : properties of subsets.
- Linear and geometric functions. Limits and derivatives of functions.
- The binomial theorem.
- Logarithm.

- Differentiation & Integration.
- Probability calculation.
- Method of sampling, confidence level.
- Measurement of central tendencies and deviations.







- Computers : general introduction of computers, organization of computers, digital andanalog computers, computer algorithm.
- Computers in online monitoring and automation.
- Application of computers in coordination of solute concentration, pH and of a fermenter in operation.
- Demonstration of the above utilities (along with above lectures).

## Practicals (50 Marks)

## **Biochemical Techniques**

- Quantitative estimation of sugar in given solution and sugar in biological samples.
- Extraction and separation of lipids.
- Estimation of proteins.
- Estimation of DNA/RNA.
- Isolation and purification of proteins.
- Assay of enzyme activity.
- Kinetic study of enzymes.
- Chromatographic methods for separation of macromolecules.

### **Microbiological Techniques**

- Cleaning of glassware.
- Preparation of media, cotton plugging and sterilization.
- Personal hygiene-microbes from hands tooth scum and other body parts.
- Isolation of microorganisms from air, water and soil samples. Dilution and pour plating.Colony purification.
- Enumeration of microorganisms, Total vs. viable counts.
- Identification of isolated bacteria. Gram staining, other staining methods, metabolic characterization (e.g. IMVIC test).
- Growth curve of microorganisms.
- Antibiotic sensitivity of microbes, use of antibiotic discs.
- Testing of water quality.
- Test for antibodies against given bacteria.
- One step growth of bacteriophage.
- Culture from body fluids stool, urine, blood.
- Alcoholic and mixed acid fermentation.





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**B.Sc.** (Bio-Tech)

The students are to undergo month "on-the-job training in a clinic/a fermentation plant/brewery or bakery after completion of classes/exam. they would have to submit its report. A certifcate would be issued by the department with grading from the institution providing the training.



## **Molecular Biology**

- Molecular basis of life.
- Structure of DNA.
- DNA replication in prokaryotes and oukaryotes.
- DNA recombination molecular mechanisms in prokaryotes and eukaryotes.
- Insertion elements and transposons.
- Structure of prokaryotic genes.
- Prokaryotic transcription.
- Prokaryotic translation.
- Prokaryotic gene expression (lac, his, trp, catabolic repression).
- Structure of eukaryotic genes.
- Eukaryotic transcription.
- Eukaryotic translation.
- Eukaryotic gene expression. Transcription factors and translation factors.
- Gene expression in yeast.
- Gene expression in protozoan parasites.
- Gene organization and expression in mitochondria and chloroplasts.
- Post translation regulation of gene expression.
- Developmental and environmental regulation of gene expression.

#### **Recombinant DNA technology**

- What is gene cloning and why do we need to clone a gene?
- Tools and techniques, plasmids and other vehicles, genomic DNA, handling of DNA, RNA and c-DNA, RT enzymes and other reagents techniques, laboratory requirement.
- Safety measures and regulations for recombinant DNA work.
- Choice and selection of the tools and techniques.
- Vehicles : Plasmids and bacteriophages, available phagemids, cosmids, viruses.
- Purification of DNA from bacterial, plant and animal cells.
- Manipulation of purified DNA.
- Introduction of DNA into living cells.
- Cloning vectors for *E.coli*.
- Cloning vectors for organisms such as yeast, fungi, for plants *Agrobacterium* sps, and plant viruses, animal viruses.
- Application of cloning in gene analysis (How to obtain a clone of a specific gene? Studying gene location and structure, studying gene expression).
- Gene cloning and expression of foreign genes in research and biotechnology (Production of protein from cloned genes). Gene cloning in medicine (Pharmaceutical compounds, artificial insulin gene, recombinant vaccine, diagnostic reagents).

# Paper-IV (75 Marks)

## Biophysics

- Energetics of a living body. Sources of heat limits to temperature. Heat dissipation and conservation.
- Lambert-Beer law. Spectrophotometry and colorimetry. Primary events in photosynthesis.
- Strategies of light reception in microbos, plants and animals.
- Correction of vision faults.
- Electrical properties of biological compartments. Electricity as a potential signal.



## **COLLEGE OF COMMERCE, ARTS & SCIENCE, PATNA**



- Generations and reception of sonic vibrations, Hearing aids.
- Intra- and intermolecular interactions in biological systems. Spatial and charge compatibility as determinant
  of such interactions.
- Physical methods applied to find out molecular structure : X-ray crystallography and NMR.
- Physical methods of imaging intact biological structures: Ultrasound, optical filters, X-ray, CAT scan, ECG, EEG, NMR imaging.

#### Immunology

- The immune system and immunity along with historical perspective.
- Antigens and antibodies and their structure.
- The organs and the cells of the immune system and their function.
- Antigen-antibody interaction.
- Humoral and cell mediated immunity (role of MHC and genetic restriction).
- Origin of diversity in the immune system.
- Effector mechanisms.
- Immunity to infectious diseases and vaccines.

## Practicals (50 marks)

## **Immunological methods**

- Purification of antigens.
- Raising polyclonal antibodies.
- Purification of antibodies.
- Conugation and labeling of antibodies.
- Enzyme linked immunoassay.
- Radio Immunoassay.
- Radial immunodiffusion analysis.
- Generation of ascetic fluids.
- Diagnosis of an infectious disease by immunoassay.

### **Cellular biology**

- Cytological preparations:
  - Fixation, dehydration and staining.
  - Squash in stain.
  - Embedding and sectioning.
- Cell counting methods : the hemocytometer and other aids.
- Measurements with the aid of light microscope :
  - Calibration of occular micrometer.
  - Finding out average cell size.
  - Chromosome lengths.
- Separation of cell types from blood.
- Separation of cell organelles :
  - Method for cell lysis : rupture/osmotic/chemical/enzymatic lysis of cells followed by centrifugation. Monitoring cell lysis by release of cellular material and change in ligh scattering etc.
  - Mechanical rupture of cells: Ultrasonic vibrations, French pressure cell followed b centrifugation for cell organelles.

One month (summer) "on-the-job training" in an immunology/veterinary/ virologinstitute. Report by students.





# B.Sc. Part-III (Hons.) Paper-V (100 Marks)

## Animal cell culture

- History of development of cell cultures.
- The natural surroundings of animal cells.
- Metabolic capabilities of animal cells.
- Simulating natural condition for growing animal cells.
- Importance of growth factors of the serum.
- Primary cultures. Anchorage dependence of growth. Non-anchorage dependent cells.
- Secondary cultures. Transformed animal cells : Established/continuous cell lines.
- Commonly used animal cell lines their origin and characteristics.
- Growth kinetics of cells in culture.
- Application of animal cell culture for studies on gene expression.
- Organ culture.
- Transfection of animal cells : Selectable markers, HAT selection, antibiotic resistance etc.
- Cell fusion.
- Transplantation of cultured cells.
- Differentiation of cells.
- **Animal Cell Biotechnology**
- General metabolism.
- Special secondary metabolities/products : Insulin, growth hormones, interferon, t-plasminogen activator, factor VIII etc.
- Expressing cloned proteins in animal cells. Over production and processing of chosen protein.
- The need to express in animal cells.
- Production of monoclonal antibodies.
- Growth factors promoting proliferation of animal cells : EFG, FGF, PDGF, IL-1, IL-2, NGF, erythroprotein etc.
- Bioreactors for large scale culture of cells.
- Transplanting cultured cells.



## **Plant Biotechnology**

- Introduction to *in vitro* methods. Terms and definitions. Use of growth regulators.
- Beginning of *in vitro* cultures in our country : ovary and ovule culture, in vitro pollination and fertilization.
- Embryo culture, embryo rescue after wide hybridization and its application.
- Introduction to processes of embryogenesis and organogenesis and their practical applications.
- Clonal multiplication of elite species (micropropagation), axillary bud, shoot tip and meristem culture.
- Haploids and their applications, Somaclonal variations and applications (Treasure your exceptions).
- Endosperm culture and production of triploids.
- Practical application of tissue and organ culture (summarizing the practical applications of all the above techniques).
- Single cell suspension cultures and their applications in selection of variants/mutants with or without mutagen treatme (of haploid cultures preferably).
- Introduction to protoplast isolation : principles and applications.
- Testing of viability of isolated protoplasts.
- Various steps in regeneration of protoplasts.
- Somatic hybridization an introduction.
- Various methods for fusing protoplasts : chemical, electrical.
- Use of markers for selection of hybrid cells.
- Practical applications of somatic hybridization : hybrids vs. cybrids.
- Use of plant cells, protoplasts and tissue culture for genetic manipulation of plants. Introduction to A. tumefaciens.

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- Tumor formation in plants using *A. tumefaciens*. (monocots vs. dicots).
- Root formation using *A. rizogenes*.
- Practical application of genetic transformation.



## **Environmental Biotechnology**

- Renewable and non-renewable resources.
- What is renewable should be bioassimilable/biodegradable.
- Major consumer items : food, fuel and fibers.
- Conventional fuels and their environmental impact : firewood, plant/animal wastes, coal, gas and animal oils.
- Modern fuels and their environmental impact : methanogenic bacteria and biogas, microbial hydrogen proudction conversion of sugar to ethanol – the gasohol experiment, solar energy converters – hopes from the photosynthetic pigments, plant based petroleum industry, cellulose degradation for combustible fuel.
- Biotechnological inputs in producing good quality natural fibers : transgenic sheep and trasgenic plants.
- Microbiological quality of food and water.
- Treatment of municipal waste and industrial effluents.
- Degradation of pesticides and other toxic chemicals by microorganisms.
- Thuringiensis toxin as natural pesticide.
- Biological control of other insects swarming the agricultural fields.
- Enrichment of ores by microorganisms.
- Biofertilizers. Nitrogen fixing microorganisms enrich the soil with assimilable nitrogen.

## PAPER-VIII Practical (100 Marks)

### **Molecular & Cellular Biology**

- Separation of cell types from blood.
- Separation of cell organelles : Mathod for cell lysis: osmotic/chemical/enzymatic lysis of cells followed by centrifugation Monitoring cell lysis by release of cellular material and change in light scattering etc.
- Mechanical rupture of cells : Ulrasonic vibrations, French pressure cell followed by centrifugation for cell organelles.
- Separation of constituent molecules of the extract in aqueous buffer : Get filtration, lon exchange chromatography.
- Thin layer chromatography of extracted material.
- Isolation of chromosomal and plasmid DNA from bacteria.
- Restriction digestion of DNA and assigning restriction sites (may be done as a demonstration).
- Making competent *E. coli*.
- Transfection of plasmid DNA and selection for transformants.

#### **Culture methods**

- Initiating plant tissue culture : dedifferentiation of explants.
- Growth of plant cell into undifferentiated mass.
- Large cultivation of plant cells in suspension.
- Induction of differentiation by modulating the hormonal balance.
- Culture of lymphocytes from blood samples : Preparation of media, filter sterilization, monitoring microbial contamination (bacteria, fungi and mycoplasma), cloning of animal cells by cell and colony purification.
- Fusion of cultured cells with myeloma cells.
- Production of monoclonal antibodies at a large scale.
- Demonstration/operation of large scale fermentors.

#### **Project work**

The students of 2nd year (Biotechnology) would be assigned to generate data on certain research projects and/ or compile available information from literature on a given topic of biotechnological relevance under a chosen faculty member towards their end. They would have to submit their draft at their practical exams.





### Entrepreneurship

The students will be delivered lectures on how to select for a product line, design and develop processes, economics on material and energy requirement, stock the product and release the same for marketing etc. They should also be apprised of basic regulation of excise.

### Practice in a project draft

Students will also be asked to survey the demand for a given product, feasibility of its production under the given constraints of raw materials, energy input, financial situation, export potential etc. Procedural details on how to select process, how to move for loans, how to operate and how to repay the loans in a phasic manner should also be highlighted. The year would end with submission of a draft project by the students.

## **Curriculum : Subsidiary Papers**

The subsidiary course will be common with that of other Honours courses and the syllabus to be followed would be the one provided by Patliputra University, Patna. An outline of the syllabus is provided below.

## **B.Sc. Part-I Hons.**

## Botany-I Theory (75 marks)

Students are required to answer five questions out of total ten.

- 1. **Microbiology :** A general account of bacteria, viruses and their economic importance.Role of microbes in fermentation and nitrogen fixation.
- Thallophyta : Structure, function and diagnostic features. Algae : Nostoc, Oedogonium, Chara, Vaucheria, Fucus and Batrachospermum. Fungi : Albugo, Peziza and Puccinia. Lichens : General account and economic importance.
- 3. Bryophyta : Structure and life history of Marchantia, Anthoceros and Sphagnum.
- 4. **Pteridophyta :** Structure and life history of *Selaginella, Equisetum* and *Marsilea*.
- 5. **Gymnosperm :** Structure and life history of pinus.
- 6. Cytology, Genetics and plant breeding :
  - (a) Structure of cell as seen under an electron microscope
  - (b) Mitosis and meiosis
  - (c) Structure of chromosome, crossing over and mutation
  - (d) Nature, structure and replication of genetic material (DNA).
- 7. Economic Botany :
  - (a) Cereal : wheat, maize, rice.
  - (b) Oils: mustard, groundnut, linseed.
  - (c) Sugar: sugarcane.
  - (d) Spices : coriander, chilli, turmeric.
  - (e) Beverages:tea
  - (f) Drugs: Rauwolfia
  - (g) Fibres : cotton, jute.

### **Botany Practical (25 marks)**

- 1. Morphology and structural details of algae, fungi and bryophytes included in the syllabus and their temporary stained microscopic slides (6 marks).
- 2. Morphological and anatomical study of pteridophytes / gymnosperms included in the syllabus and their microscopic preparation (temporary) (8 marks).
- 3. To identify and comment upon spots (6 marks).
- 4. Class records (5 marks).

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## **Group-A (Physical Chemistry)**

#### 1. The States :

(a) Gaseous state : Kinetic theory of gases, derivation of kinetic gas equation, deduction of gas laws, calculation of gas constants and kinetic energy.

(b) Types of soilid, crystal forces law of constancy of angles, seven crystal systems, law of rational indices, Bragg's law, Lattice energy, Born Haber cycle.

#### 2. Thermochemistry:

Heat in chemical reactions, reaction enthalpy, standard enthalpy changes, Hess law, Kirchoff law, bond energies and determination.

#### 3. lonic equilibrium :

lonic product of water, pH, pka and pkw, buffer solution, idea of buffer solution in day to day life. Solubility product and its applications in salt analysis, common ion effect, conductancespecific, equivalent and molar.

#### 4. (a) Chemical kinetics :

Rate of reaction, order and molecularity, expression for specific rate constant of first order reaction, half life period, unit.

#### (b) Colligative properties :

Colligative properties, osmosis, osmotic pressure and its determination, vapour pressure, Roult's law of lowering of vapour pressure, relation between osmotic pressure and lowering of vapour pressure.

#### Group-B (Inorganic Chemistry)

#### 1. Atomic structure and bonding :

Features of H-spectra and Bohr's theory, shapes of orbitals and their labellings, idea of quantum number, Pauli's exclusion principle, Hund's rules, Aufban principle, electronic configuration of elements.

Idea of ionic and covalent bonds, I.P.E.N. and E.A., Fajan's rule.

#### 2. Chemistry of the following elements :

Li, Sn, Fluorine, Chlorine, lodine.

- 3. Principles involved in the volumetric and gravimetric estimation of Cu-and iron.
- 4. Isotopes: Brief idea of detection and separation, tracer techniques, radiocarbon dating.

#### Group-C (Organic Chemistry)

#### 1. Structure and mechanism :

Hybridization, bond angle, bond length, idea of bonds, inductive effect, electromeric effect, monomeric effect, bond fission and fission products, elementary idea of reagents and types of reactions.

#### 2. Nomenclature :

Acquaintance with IUPAC nomenclature of aliphatic and aromatic compounds.

- 3. (a) Alcohols: monohydric.
  - (b) Grignard's reagent.
- 4. Idea of purification of compounds : Criteria of purity, Chromatography.

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## **Chemistry practical (25 marks)**

#### **Group-A**

- 1. Volumetric analysis :
  - (a) Acidimetry and alkalimetry.
  - (b) Use of potassium permagnate and potassium dichromate, lodometry. (12 marks)

#### **Group-B**

- Organic detection : Detection of nitrogen, sulphur and halogens organic compounds, detection of the following functional groups of organic compounds : (1) OH (phenolic). (i) CHO, (iii) C=O, (iv) COOH, (v) NH, and (vi) NO. : (8 marks)
- 3. Records of class work and viva-voce. (5 marks)

**B.Sc. Part-II Hons.** 

## Botany-II Theory (75 marks)

Students are required to answer two questions from group A and group B each and one from group C out of total ten (four from group A and Group B each and two from group C).

## Group-A (Angiosperms)

- (A) Morphology and taxonomy : Importance of classification of angiosperms with referenceto Bentham and Hooker and Hutchinson systems. Naming of genus and species. Diagnostic features, affinities and economic importance of *Ranunculaceae, Cucurbitaceae, Euphorbiaceae, Amranthaceae, Acanthaceae, Lamiaceae, Apocynaceae, Poaceae* and *Cyperaceae*.
- (B) Anatomy : Cell structure and tissue systems. Meristems. Root stem transition. Initiation roots and and activity of cambium including abnormal behaviour, primary and secondary growth in roots and stems.
- (C) **Embryology :** Life cycle of a typical flowering plant based on the major events in the development of anther, microspore, ovule, embryo sac, fertilization, endosperm, embryo and seed.

## Group-B (Plant Physiology)

- Water relation, absorption of water and salts.
- Transpiration.
- Mineral nutrition-role of major and minor elements.
- Enzymes nature proportion and classification.
- Photosynthesis photophosphorylation, Calvin cycle and factors affecting photosynthesis.
- Translocation of organic substances.
- Respiration glycolysis, Krebs' cycle and factors affecting respiration.
- Nitrogen metabolism nitrogen fixation and protein synthesis.

### Group-C (Environmental Biology)

- Pollution
- Soil types, water holding capacity, reclamation.
- Plant communities and ecosystem.
- Succession (Hydrosere and xerosere).

### **Botany Practical (25 marks)**

- 1. To comment upon a plant physiology experiment set up from the following experiments (5marks).
  - (a) T/A ratio
  - (b) Ganong's potometer : rate of transpiration.

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- Farmer's potometer : rate of transpiration. (c)
- (d) Unequal transpiration by CaCl, method.
- (e) Oxygen evolution during photosynthesis.
- (f) Rate of photosynthesis by Wilmott's bubbler.
- Moll's experiment. (g)
- (h) Anaerobic respiration.
- 2. Description and identification of plants of families studied (5 marks)
- 3. Microscopic preparation of anatomical specimens (5 marks)
- 4. To identify and comment upon spots covering the courses (5 marks)
- 5. Practical record based on class work and field studies (5 marks)

## Chemistry-II Theory (75 Marks)

## **Group-A (Physical Chemistry)**

#### States of Matter : 1.

- (a) Gaseous state : Vander Wall equation (no derivation), critical constants, collision number, collision frequency, mean free path.
- Solid State : Bravais lattices and lattice planes, elementary idea of types of lattices, (b) stoichiometric and non-stoichiometric defects in simple ionic solids.

#### 2. **Thermodynamics:**

Definitions of terms : system, extensive, intensive properties, first and second law of thermodynamics, Carnot theorum and Carnot cycle.

- 3. (a) lonic equilibrium : Ostwald's dilution law, conductance measurement of dissociation constant of acetic acid, salt hydrolysis, idea of theory of acid-base indicators.
  - Phase rule : Terms, equation (no derivation required), HO system, S-system. (b)

#### 4. **Chemical Kinetics:**

Second order reaction, expression for specific rate constant of second order reaction, half life period and its unit, effect of temperature on reaction rate, Arrhenius equation, idea of catalytic activity at surfaces and catalytic processes such as hydrogenation, oxidation, cracking and reforming.

### **Group-B** (Inorganic Chemistry)

- 1. Atomic structure and bonding : Idea of duality and matter waves, de Broglie relation, (a) Schrodinger equation (no derivation) and idea of its applications, idea of orbital overlap, hybridization of orbitals, Vander Wall forces, metallic bonding.
  - (b) Idea of complex formation : double salts and complexes. Werner's postulates.

#### 2. Introductory transition metal chemistry :

General features including variable oxidation states, idea of complexes, magnetism oftransition metals.

- 3. Chemistry of group 14 elements : C, Si, basic introduction to fullerences and zeolites, idea of major chemical pollutants in environment.
- 4. Chemistry of the following elements and their important compounds: (b)

(a) Fe, Co, Ni. Cr (c) Mn





## Group-C (Organic Chemistry)

#### 1. Structure and mechanism :

Different types of isomerism, idea of E-Z notations, electrophilic substitution in benzene nucleus and mechanism of nucleophilic substitution at saturated carbon (general idea).

#### 2. Natural products :

- (a) Carbohydrates : nomenclature, classification, non-detailed structure of glucose and fructose, elementary idea of glycosides.
- (b) Elementary idea of alkaloids and terpenes (no structural elucidation needed).
- 3. (a) Structure of benzene, preparation and uses of benzene diazonium chloride.
  - (b) Lactic acid, citric acid.
- 4. (a) Test of common functional groups.
  - (b) Brief idea of polymers, resins, proteins and sulfa drugs.

## Chemistry Practical (25 marks)

### Group-A: 12 marks

Qualitative inorganic analysis of mixture containing four radicals.
 Basic radicals : Ag<sup>+</sup>, Hg<sub>2</sub><sup>+2</sup>, Ph<sup>+2</sup>, Cu<sup>+2</sup>, Hg<sup>+2</sup>, Bi<sup>+3</sup>, Cd<sup>+2</sup>, Sb<sup>+3</sup>, Sn<sup>+2</sup>, Sn<sup>+4</sup>, Fe<sup>+2</sup>, Fe<sup>+3</sup>, Al<sup>+3</sup>, Cr<sup>+3</sup>, Ni<sup>+2</sup>, Co<sup>+2</sup>, Zn<sup>+2</sup>, Mn<sup>+2</sup>, Ca<sup>+2</sup>, Ba<sup>+2</sup>, Sr<sup>+2</sup>, Mg<sup>+2</sup>, Na<sup>+</sup>, K<sup>+</sup>, NH<sub>4</sub><sup>+</sup>.

Acid Radicals :  $CO_2^{-2}$ ,  $SO_3^{-2}$ ,  $S^{-2}$ ,  $SO_4^{-2}$ ,  $NO_2^{-1}$ ,  $NO_3^{-1}$  and halides.

### Group-B (8 marks)

- 2. **Organic preparation :** Preparation of organic compounds by using the following reactions:
  - (a) acetylation of aniline and p-toluidine.
  - (b) nitration of nitrobenzene.
  - (c) oxidation of benzaldehyde.
  - (d) hydrolysis of esters like ethyl benzoate and methyl salicylate.
- 3. Record of Class Work and Viva-Voce. (5 marks)

## Curriculum: Compulsory Paper B.Sc. Part-I Hons.

## हिन्दी रचना (100 marks)

<mark>पद्य एवं गद्य – 80 अंक, हिन्दी व्याकरण – 15 अ</mark>ंक, वाक्य संशोधन, मुहावरे, लोकोक्तियां – 5 अं<mark>क</mark>

### पाठ्य ग्रंथ-

- (क) काव्य के सोपान (डॉ॰ लक्ष्मण प्रसाद सिन्हा) अथवा हिन्दी काव्य संकलन (डॉ॰ नेपाल नाथ मिश्र)
- (ख) कथांजली (डॉ० सत्यदेव नारायण शर्मा ) अथवा कथा पथ (डॉ० राम विनोद सिन्हा )
- (ग) सप्त तरंगिनी (डॉ॰ दिवाकर) अथवा गद्य के रूप (डॉ॰ वंशीधर लाल)
- (घ) व्याकरण संज्ञा, सर्वनाम, विशेषण, अव्यव, लिंग, वचन, कारक, संधि, समास, पद्धति



## B.Sc. Part-II Hons.

## हिन्दी रचना (100 marks)

पद्य एवं गद्य – 50 अंक, निबंध लेखन – 30 अंक,

पत्र लेखन, संक्षेपन, पल्लवन, प्रारूपण, अवबोध – 20 अंक

#### पाठ्य ग्रंथ-

- (क) खंड काव्य यशोधरा अथवा कुरुक्षेत्र
- (ख) एकांकी संकलन नौ पर्दे (डॉ० राम विनोद सिन्हा) अथवा एकांकी कुंज ( उमेश मिश्र )
- (ग) कहानी कथा सरित (डॉ॰ लक्ष्मण प्रसाद सिन्हा) अथवा कथा कुंज (हरिहर नाथ)

## **Personality Development**

In addition to the curriculum for study and training of students admitted to the course, the department will lay special stress on proper development of personality of the disciples, as in today's world, it is outmost significance. One can get coveted assignment and post in high tech. establishments if he or she has a desirably amiable persona. We shall like our students to be highly conscious of it and help us develop a suitable and congenial environment in the department to achieve this goal.

### **Opportunities & Avenues**

Vocational course is basically meant to train students and arm them with required techniques so that they can get proper employment in biotechnology firms/chemical industries, pharmaceutical companies or research laboratories after passing out or they may be able to work as an entrepreneur successfully. Expertise in only one technique would normally be enough for absorption in such establishments. Employment opportunities are expected to increase manifold in future as biotechnology is understandably the fastest developing applied science. Trained and properly skilled individuals may also work in association with other suitably skilled persons or biotech. engineers to develop independent biotechnological clinics or establishments etc. They can also plan to work as biotechnology consultants or researchers at suitable places. But, if one wishes, he can also opt for further studies (M.Sc.) and pure research in India or abroad.

### **Discipline and Regularity**

The foremost quality we stress upon and expect from students is discipline. Good manners and standard behaviour are expected from the students all the time as they carry on their learning activities at the centre. If a student is found lacking in standardized norms, he or she may be dropped from the course. Punctuality and regularity are other features which we stress upon. Absence from classes without any genuine reason is not allowed. Students are required to drop options like preparing for medical entrance tests etc.

### **Entrance Test**

An entrance aptitude test is held for admission in 3-year degree vocational Biotechnology (Hons.) course at the department of Bio-technology on a fixed date as mentioned in the communique of the College of Commerce, Patna published in newspaper and/or as notified on the notice board of the department. The test is of 90 minutes and comprises 50 objective, multiple answer type questions of two marks each. These will be as follows :

:

:

Basic maths. (Matriculation level)
Chemistry (+2 level)

10 questions 15 questions

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Physics (+2 lev <mark>el)</mark>	:	10 questions
Biology (+2 level)	:	10 questions
Common general knowledge	:	05 questions
(Current affairs)		

**Eligibility :** 1.Sc.(+2) with PCB and 45% marks. Candidates who have taken their I.Sc.(+2) exams, in the current year can also apply but they would be required to produce their 1.Sc. (+2) marksheet at the time of admission if selected.

Test questions would be on multiple choice type objective pattern. Candidates appearing at the entrance test must bring their admit card issued by the department at the time of submission of the application form, a Hb pencil, and eraser and a pen. Calculator, mobile phone, carry bags etc. will not be allowed during the test.

Results of the written test and interview are displayed in order of roll numbers and ranks of the successful applicants respectively on the notice board of the department on pre-notifieddates.

NB : Application forms filled in properly and accompanied with a pair of candidate's passport size photograph, an attested photocopy of the marksheet of the qualifying examination, an attested photocopy of the Matriculation certificate as proof of age and caste-cum-income certificate (in case of applicants claiming consideration for seats reserved for SC/ST and OBCs) should be submitted in person before the last date as notified.





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