SCHOOL OF BIO SCIENCES AND TECHNOLOGY

M.Sc Integrated Biotechnology
(5yr.)

Curriculum
(2019-2020 admitted students)
VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

  World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
  Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.
  Impactful People: Happy, accountable, caring and effective workforce and students.
  Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.
  Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF BIOSCIENCES AND TECHNOLOGY

To nurture high-quality bioengineers and science graduates with the potential to innovate, invent and disseminate knowledge for the benefit of society and environment.

MISSION STATEMENT OF THE SCHOOL OF BIOSCIENCES AND TECHNOLOGY

  • To create opportunities for multi-disciplinary education, training and research in biotechnology and bio-sciences.
  • To instill a spirit of innovation and creativity in young minds from across the globe with sound research aptitude.
  • To foster ethically strong biologists who effectively contribute towards the growth of the nation.
M.Sc Integrated Biotechnology (5yr.)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be practitioners and leaders in their chosen field.
2. Graduates will function in their profession with social awareness and responsibility
3. Graduates will interact with their peers in other disciplines in their work place and society and contribute to the economic growth of the country
4. Graduates will be successful in pursuing higher studies in their chosen field
5. Graduates will pursue career paths in teaching or research.
M.Sc Integrated Biotechnology (5yr.)

PROGRAMME OUTCOMES (POs)

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognise the need for independent and lifelong learning
M.Sc Integrated Biotechnology (5yr.)

ADDITIONAL PROGRAMME OUTCOMES (APOs)

APO_01: Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

APO_02: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified) (University Elective)

APO_03: Having design thinking capability

APO_04: Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning

APO_05: Having Virtual Collaborating ability

APO_06: Having an ability to use the social media effectively for productive use

APO_07: Having critical thinking and innovative skills

APO_08: Having a good digital footprint
M.Sc Integrated Biotechnology (5yr.)

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M.Sc Integrated Biotechnology (5yr.) programme, graduates will be able to

- **PSO1**: Gain and apply knowledge to plan, analyze and find innovative solutions in the field of biological sciences.

- **PSO2**: Explore problems and provide valid solutions through the industry-academia interactions.

- **PSO3**: Acquire interdisciplinary knowledge in the areas of biological, chemical, environmental and technical sciences for the benefit of society.
M.Sc Integrated Biotechnology (5yr.)

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M.Sc Integrated Biotechnology (5yr.)

DETAILED CURRICULUM

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# M.Sc Integrated Biotechnology (5yr.)

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M.Sc Integrated Biotechnology (5yr.)

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M.Sc Integrated Biotechnology (5yr.)

University Elective Baskets

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UNIVERSITY CORES
BIY6099 Masters Thesis

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<th>T</th>
<th>P</th>
<th>J</th>
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<tr>
<td>Pre-requisite</td>
<td>0</td>
<td>0</td>
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<td>As per the academic regulations</td>
<td>Syllabus version</td>
<td>1.0</td>
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</table>

Course Objectives:
To provide sufficient hands-on learning experience related to the area of specialization with a focus on research orientation

Expected Course Outcome:
At the end of the course, the student will be able to

1. Formulate specific problem statements for ill-defined real-life problems with reasonable assumptions and constraints.
2. Perform a literature search and/or patent search in the area of interest.
3. Design and Conduct experiments
4. Perform error analysis/benchmarking/costing
5. Synthesize the results and arrive at scientific conclusions
6. Document the results in the form of technical report/presentation

Student Learning Outcomes (SLO):
9. Having problem-solving ability, solving social issues and engineering problems
20. Having a good digital footprint

Contents
1. It can be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, correlation and analysis of data, software development, applied research, and any other related activities.
2. The project can be for one or two semesters based on the completion of the required number of credits as per the academic regulations.
3. It should be individual work.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer-reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Recommended by Board of Studies | 04.03.2016
Approved by Academic Council | 40th AC | Date | 18.03.2016
Course code | Comprehensive Examination | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
BIY4098 | | 0 | 0 | 0 | 0 | 2

Pre-requisite | Syllabus version
--- | ---
| 1.00

Student Learning Outcomes (SLO): 2

[2] Having a clear understanding of the subject related concepts and of contemporary issues

Module 1:


Module 2:


Module 3:


Module 4:


Module 5:

### Module 6:
Pharmaceutical Biotechnology: General pharmacology, Pharmacology, Formulating Biotech drugs, Biotech drugs, Clinical Trials & Regulations.

### Module 7
Plant Biotechnology: Plant growth and development, Plant genome Organization and Tissue culture, Plant transformation, transgenic plants, Marker technology.

<table>
<thead>
<tr>
<th>Recommended by Board of Studies</th>
<th>04.03.2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved by Academic Council</td>
<td>40th AC</td>
</tr>
</tbody>
</table>
Course code: CHY1003
Course title: Environmental Studies
Pre-requisite: None

Course Objectives: (C Ob) The course is aimed at
- To make students understand and appreciate the unity of life in all its forms and the implications of lifestyle on the environment.
- To broaden the understanding of global climate changes and the importance of renewable sources of energy.
- To give students a basic understanding of the major causes of environmental degradation on the planet, with specific reference to the Indian situation.
- To inspire students to find ways in which they can contribute personally and professionally to prevent and rectify environmental problems.

Course Outcomes: (CO):
At the end of the course, the student should be able to
[1] Know the importance of environment and awareness on natural resources to find the causes, effects, and consequences if not protected.
[2] Acquire knowledge of renewable and non-renewable energy resources to solve future problems on energy demand.
[4] Identify the numerous causes for environmental pollutions, hazards, their management, and control methods.
[5] Find ways to protect the environment on global climatic changes and their mitigation.
[6] Recognise some of the social issues and gaining knowledge on the protection of the environment.
[7] Develop adequate knowledge of population, which enabling them to make better in life decisions as well as enter a career in an environmental profession or higher education.

Student Learning Outcomes (SLO) involved: 2, 10, 11
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
11. Having an interest in lifelong learning

Module: 1  Environment and Natural Resources  7 hours
Definition, scope, importance, the need for public awareness on natural resources Forest resources – use, exploitation, causes, and consequences of deforestation. Water resources – use of surface and subsurface water; dams - effect of drought, water conflicts. Land resources - Land degradation, soil erosion, and desertification. Indian Case studies. Food resources – Definition, world food problems, Traditional and modern agriculture, and its impacts and remedies.

Module: 2  Energy Resources  7 hours
Definition of renewable and non-renewable energy resources. Non-renewable energy resources - oil, Natural gas, Coal, Nuclear energy. Renewable energy - Solar energy, Hydroelectric power, Ocean thermal energy, wind, and geothermal energy. Biomass energy and Bio Gas.
<table>
<thead>
<tr>
<th>Module:3</th>
<th>Ecosystem and Biodiversity</th>
<th>5 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Environmental changes and Remediation</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air, water, soil, Thermal Pollution: Causes, effects and control measures; Nuclear hazard. Solid waste Management - Causes, Effects and control measures. Floods, earthquakes, cyclones, tsunami and landslides, Case studies.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Global Climatic Change and Mitigation</th>
<th>5 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Social Issues and the Environment</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Human Population and the Environment</th>
<th>7 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Expert Lectures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total Lecture hours: | 45 hours |
|----------------------------------|----------|--------|

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

Recommended by Board of Studies 12-8-2017

Approved by Academic Council No.47 Date 05-10-2017
Course code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
CHY1005 | Allied Chemistry | 3 | 0 | 0 | 0 | 3

Pre-requisite | Chemistry at 12th standard or equivalent | Syllabus version | 2.0

Course Objectives

The course is aimed at
- To understand the interdependency of chemistry and biological systems and the relationship between chemical structure and biological activity
- To introduce analytical and separation techniques essential for biologists

Expected Course Outcomes:

At the end of the course, the students will
1. be able to acquire knowledge about the stereochemistry of organic and biomolecules
2. be able to acquire knowledge on various electronic effects in biological systems.
3. be familiar with the fundamental chemistry of the biomolecules
4. be familiar with the fundamental chemistry of chlorophyll and Haemoglobin
5. be able to acquire knowledge on the various functions of several metal ions and the complexes in the biological systems.
6. be able to acquire knowledge about the uses, mechanism of action of essential drugs, and their SAR.
7. Demonstrate basic knowledge of the separation and analytical techniques.

Student Learning Outcomes involved: 2,18

2. Having a clear understanding of the subject related concepts and contemporary issues
18. Having critical thinking and innovative skills

Module:1 | Introduction to Stereochemistry | 6 hours
--- | --- | ---
Isomerism in organic compounds – structural, stereo, geometrical and optical isomerism-Chirality-Racemisation–Specific optical rotation-Enantiomeric Excess-Optical purity-Resolution–R-S notation–E-Z nomenclature

Module:2 | Electronic effects | 6 hours
--- | --- | ---
Intermolecular bonding forces-ionic bonds, hydrogen bonds, Van der Waals interactions, Dipole-dipole and Ion-dipole interactions, Repulsive interactions, water, and hydrophobic interactions –Importance of these effects in biological systems.

Module:3 | Chemistry of Biomolecules | 6 hours
--- | --- | ---
Amino acids, Proteins, and Enzymes - Chemical structure and function.

Module:4 | Molecules of Life | 4 hours
--- | --- | ---
Structure and functions of Haemoglobin and Chlorophyll

Module:5 | Role of metal ions in Biology | 6 hours
### Essential and toxic metals – metal ions deficiency and its treatment – metal ion toxicity – Fe, Cu, Cr, Pb, As, Hg, Cd – Natural detoxification – chelating drugs for detoxification – examples for Chelating drugs – Anti-arthritic gold drugs – psychiatric drug – Lithium – Anticancer drugs –

### Module: 6  
**Antibiotics, Anti-ulcer and Analgesic drugs**  
9 hours

### Module: 7  
**Separation and Analytical Techniques**  
6 hours
- Chromatography – Adsorption, Absorption, Partition- HPLC, GC -Spectroscopy – the interaction of electromagnetic radiation with matter, type of interaction, the origin of IR, UV – Visible, Emission spectroscopy (fluorescence) and applications.

### Module: 8  
**Contemporary issues:**  
2 hours
- Industry Expert Lecture

| Total Lecture hours: | 45 hours |

### Text Book(s)


### Reference Books


### Mode of evaluation: Internal assessment (CAT, Quizzes, Digital Assignment) and FAT

| Recommended by Board of Studies | 12.08.2017 |
| Approved by Academic Council | No.46 Date | 24.08.2017 |
Course code | Introduction to Computers and their Applications | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
CSE1012 | | 2 | 0 | 2 | 0 | 3
Pre-requisite | None | Syllabus version | 1.1

**Course Objectives:**
1. Gaining foundation in the fundamentals of computers concerning computer components and their usage
2. Making students understand different web technologies and computer networks
3. Exploring the application suite of software for the betterment of presentation and management of data

**Expected Course Outcome:**
1. The students will have the knowledge and skills to describe the software and hardware components
2. Explain some of the web technologies and illustrate how these can be used to manage scientific data
3. Obtain and analyze information and data relating to specific word applications for fine document preparation and report writing.
4. Data computation using spreadsheet application and presentation application for scientific findings.
5. Perform practical data management techniques, including DDL and DML and database querying.

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
8. Having a clear understanding of professional and ethical responsibility

**Module: 1  History of Computers**
4 hours
History of Computers, Basic Components of Computer Systems, CPU, Memory, I/O Devices, Operating system, DOS and Unix system commands

**Module: 2  Web Technologies**
4 hours
Introduction to Internet - URL, WWW, HTML, Internet Protocols- HTTP, TCP/IP, E-Mail & FTP.

**Module: 3  Computer Networks**
3 hours

**Module: 4  Word Processing**
4 hours
Word basics, Editing and formatting a document, layout and inserting and managing graphics, formatting tables

**Module: 5  Spreadsheets**
4 hours
Spreadsheet basics, Editing worksheets, Form cells – formatting worksheets, formulas and function, data filtering and sorting, chart, and graphs.
### Module 6: Presentation

**5 hours**

Presentation basics, Creation of Presentation, editing presentation, formatting presentation, working with multimedia.

### Module 7: Database Management

**4 hours**

Database basics, advantages of Database, create a database, updating and manipulating data, DDL and DML command, database querying.

### Module 8: Recent trends

**2 hours**

**Total Lecture hours:** 30 hours

### Text Book(s)


### Reference Books


### Mode of Evaluation:

Assignments, Continuous assessment tests and Final assessment test.

### List of Experiments

<table>
<thead>
<tr>
<th>SLO: 2,8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Unix and DOS commands</td>
</tr>
<tr>
<td><strong>2.</strong> Creating and Formatting Word document</td>
</tr>
<tr>
<td><strong>3.</strong> Creating and Manipulating Tables in a document</td>
</tr>
<tr>
<td><strong>4.</strong> Inserting any Graphics in a document</td>
</tr>
<tr>
<td><strong>5.</strong> Create a Personal Resume</td>
</tr>
<tr>
<td><strong>6.</strong> Using the Excel Formula and Functions</td>
</tr>
<tr>
<td><strong>7.</strong> Representing Data in a Chart</td>
</tr>
<tr>
<td><strong>8.</strong> Excel Using Pivot Table</td>
</tr>
<tr>
<td><strong>9.</strong> Excel Using Functions</td>
</tr>
<tr>
<td><strong>10.</strong> Working with Design Templates and Auto Content wizards by using PowerPoint</td>
</tr>
<tr>
<td><strong>11.</strong> Formatting and editing slides</td>
</tr>
<tr>
<td><strong>12.</strong> PowerPoint Slide design</td>
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<tr>
<td><strong>13.</strong> Slide transition effects</td>
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**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

<table>
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<tr>
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<td>No. 5.</td>
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<td>Date</td>
<td>13-12-2018</td>
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</tbody>
</table>
Course code  | Course Title                  | L | T | P | J | C
--- | --- | --- | --- | --- | ---
CSE2009 | Computer Programming for Biologists | 2 | 0 | 2 | 0 | 3

Pre-requisite  | Introduction to Computers and their Applications | Syllabus version | 1.1

**Course Objectives:**

1. To make students understand and practice beginning and advanced skills in the areas of computer command line mode operations.
2. To broaden the understanding of Bash shell scripting to automate the workflow process, including pattern search.
3. To give a biology-specific programming language to concentrate on the string data structure.
4. To inspire students to find ways in which they can contribute to features prediction from biological sequences.

**Course Outcomes: (CO):**
At the end of the course, the student should be able to

1. Know the importance of the bash environment and awareness on command line operations.
2. Acquire knowledge on automating a list of command-line process.
3. Enriching the understanding of regular expression in string data structure pattern finding.
4. Identify the appropriate and essential functions to debug or troubleshoot programs.
5. Find ways to protect the environment on global climatic changes and their mitigation.
6. Recognise improved computational proficiency.
7. Apply the powerful combination of shell and python programing to get expedite on the big data analysis.

**Student Learning Outcomes (SLO)  2,7**

2. Having a clear understanding of the subject related concepts and contemporary issues
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)

| Module:1 Shell Scripting | 4 hours | CO: 1, 2 |
--- | --- | --- |
Bash and Bash Scripts – Common Shell programs, Executing commands, Developing Good Scripts, Creating and running a script, Scripts basics, and Debugging bash scripts.

| Module:2 The Bash Environment and statements | 4 hours | CO: 2, 3 |
--- | --- | --- |
Shell initialization file, Variables, Quoting characters, Shell expansion, and Aliases, variables, condition statements, and loop statements.

| Module:3 Python Programming | 3 hours | CO: 3, 6 |
--- | --- | --- |
Python environment, printing and manipulating text- comments to annotate your code, error message and debugging, storing strings in variables, and manipulating strings.

| Module:4 List and Loops | 4 hours | CO: 4, 5 |
--- | --- | --- |
Creating a list and retrieving elements, list elements, loop, indentation error, splitting strings, iterating, and looping with ranges.
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Functions and Conditional statements</th>
<th>5 hours</th>
<th>CO: 4, 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function definition, calling and encapsulation, function argument and return value, Decision-making programs, if statements, if...else...elif statements, and while loops.</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Regular expression and Dictionaries</th>
<th>4 hours</th>
<th>CO: 1, 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns in Biology, modules, patterns in a string, searching and extracting patterns and Positions, creating, and iterating dictionaries.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Reading and writing files</th>
<th>4 hours</th>
<th>CO: 1, 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading text from files, file content and file name, dealing with newlines, writing text to files, closing files.</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Recent trends</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Expert Lectures</td>
<td></td>
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</tr>
</tbody>
</table>

Total Lecture hours: 30 hours

Text Book(s)


Reference Books


List of Challenging Experiments

1. Basic Bash Shell commands
2. Creating Bash Script
3. Understanding Shell configuration files
4. Control Statements
5. Conditional Statements
6. Python program to calculate AT content and Complement of a DNA Sequence.
7. Splitting of Genomic DNA
8. Processing DNA in a file
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>9.</td>
<td>Percentage of amino acid residue</td>
</tr>
<tr>
<td>10.</td>
<td>Printing out gene names for all genes between a specific length ranges.</td>
</tr>
<tr>
<td>11.</td>
<td>Printing accession names and double digestion</td>
</tr>
<tr>
<td>12.</td>
<td>DNA translation using python Dictionaries</td>
</tr>
<tr>
<td></td>
<td><strong>Total Lab Hours - 30</strong></td>
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**Mode of Evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

Recommended by Board of Studies | 12-8-2017 |
Approved by Academic Council | No.53 | Date | 13-12-2018 |
<table>
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<th>C</th>
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<td>2</td>
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<tr>
<td>Pre-requisite</td>
<td>Cleared EPT/English for Beginners</td>
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</tbody>
</table>

### Course Objectives:

1. To synthesize information, analyze simple arguments, generate and express their own opinions on a limited range of technical as well as general-interest topics inside as well as outside the classroom.
2. To develop competencies in all the areas of LSRW skills
3. To speak and write in grammatically error-free English with the aid of active vocabulary.

### Expected Course Outcome:

1. Develop communicative competence to express himself/herself in English in all challenging situations
2. Apply knowledge, ideas and concepts in the technicalities of proper pronunciation, Grammatical structure
3. Have better grasp over appropriate use and style of the English Language as well as the application areas of English communication
4. Write all types of official Letters/Emails used in the corporate world
5. Interpret text, diagram etc. which helps them in their academic as well as professional career.

### Student Learning Outcomes (SLO):

16. Having a good working knowledge of communicating in English
18. Having critical thinking and innovative skills

---

**THEORY**

### Module: 1 | Grammar and Vocabulary | 4 Hours

- Grammatical & structural aspects covering - Types of sentences, Active & Passive Voice, Tenses, WH- Question Tags, Gerund, Auxiliaries & Modal Verbs, Preposition
- Vocabulary: Synonyms, Antonyms, Homonyms, Homophones
- Activity: Solving Worksheets of Grammar; Enhancing the knowledge of vocabulary through written interpretation and reading English newspapers/magazines

### Module: 2 | Text-based Analysis | 6 Hours

- Two short-stories-i) *A Tiger in the House* by Ruskin Bond; ii) *Real Time* by Amit Chaudhury
- Activity: Understanding sentence structures and enriching vocabulary by analyzing a text

### Module: 3 | Job-related Communication | 3 Hours

- Writing resumes, Job-application & Thank-you letters.
- Activity: An in-depth discussion on the different types of resumes, Job-application and Thank-you letters.

### Module: 4 | Reading Skills | 2 Hours

- Skimming, scanning, guessing unfamiliar words from context, understanding text organization, recognizing argument and counter-argument; distinguishing between main information and supporting detail, fact and opinion, hypothesis versus evidence; summarizing and note-taking
### Activity: Reading of Newspapers & Articles in the class

#### PRACTICE SESSIONS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-1</td>
<td><strong>Listening Comprehensions</strong>&lt;br&gt;Listening &amp; Note Making: Short speeches/ news clips from Indian TV channels in English with interpretive questions&lt;br&gt;Session: Summarizing/ note-making and drawing inferences</td>
<td>4 hours</td>
</tr>
<tr>
<td>Activity-2</td>
<td><strong>Introduction to Phonetics</strong>&lt;br&gt;Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker&lt;br&gt;Session: Learning varied types of speech sounds</td>
<td>4 hours</td>
</tr>
<tr>
<td>Activity-3</td>
<td><strong>Public Speaking: Two Models</strong>&lt;br&gt;i) The interactional model of public speaking which includes encoding, decoding and feedback.&lt;br&gt;ii) The transactional model of public speaking takes on a more mutual communication effort between the sender and receiver wherein both seek to find mutual meaning in the message.&lt;br&gt;Session: The learners watch different videos on Public speaking and accordingly engage themselves in planning and preparing speeches that inform, persuade, or fulfill the needs of a special occasion.</td>
<td>6 hours</td>
</tr>
<tr>
<td>Activity-4</td>
<td><strong>Skit on Social issues / Debate</strong>&lt;br&gt;To highlight the use of functional English which helps the students to learn the usage of language in different occasions&lt;br&gt;Session: Under the supervision of the Instructor and the audio-visual materials, the students will enact small skit on social issues and learn different expressions used for various situations like getting to know someone, introducing someone etc.; they will also hone their oratory power and argumentative skills by taking part in debates</td>
<td>6 hours</td>
</tr>
</tbody>
</table>
| Activity-5 | **Reading E-books through Intonation**<br>Intonation refers to the way the reader varies the voice in tone, pitch, and volume to reflect the meaning of the text--sometimes called "expression."
Session: Students learn to read E-books properly with the appropriate use of intonation | 4 hours  |
| Activity-6 | **Information Transfer**<br>Information transfer, or presenting verbal account of facts and processes in pictorial form and, conversely, changing Web-based graphic representations to writing, involves learning how to restate a given body of material in different ways.<br>Session: The learners will be interpreting the information in different forms like tree diagrams, bar charts, pie charts | 6 hours  |
1. Wren & Martin, (Re-Printed 2018), *High School English Grammar & Composition* (Revised by Dr. N.D.V. Prasada Rao); New Delhi, S. Chand & Company Ltd.,

**Reference Books**


**Mode of Evaluation:** Quizzes, Presentations, Discussions, Role Play, Assignments and FAT.

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vocabulary building through reading a newspaper article</td>
<td>5</td>
</tr>
<tr>
<td>2. Reading the prescribed text and writing a summary</td>
<td>10</td>
</tr>
<tr>
<td>3. Writing a resume</td>
<td>5</td>
</tr>
<tr>
<td>4. Listening to speeches/news clips and making inferences</td>
<td>5</td>
</tr>
<tr>
<td>5. Public speaking</td>
<td>10</td>
</tr>
<tr>
<td>6. Debates on current issues</td>
<td>10</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours** 45 Hours

**Mode of Evaluation:** Quizzes, Presentations, Discussions, Role Play, Assignments and FAT.

**Recommended by Board of Studies** 08.06.2019

**Approved by Academic Council**

<table>
<thead>
<tr>
<th>No. 55</th>
<th>Date</th>
<th>13-06-2019</th>
</tr>
</thead>
</table>

M.Sc Intg Biotechnology (5yr.)
Course code: ENG1912  
Course title: General English-II  
Pre-requisite: General English-I  
Pre-requisite: General English-I  
Syllabus version: 1  

Course Objectives:
1. To provide resources for the students to learn pronunciation of the English sounds through the knowledge of syllable-break-up and stress; and to know the advance level English grammar and vocabulary.
2. To learn to appear for personal interview and to participate in Group Discussions.
3. To develop the students' reading skills to enable them to skim an adapted text for main idea, to scan the text for specific information, to interpret and for inferences.

Course Outcome:
1. Communicate effectively in medium level interview and group-discussions;
2. Develop the listening skills so as to understand and apply specific information from the source;
3. Use English appropriately in their professional and academic environment.
4. Improve the Grammar writing skills to enable the students to respond to input provided through training so as to stimulate, to select and to summarize information in Technical Reports and apply acquired information to a specified task like Transcoding, writing letters etc.
5. Develop the overall personality and to hone the leadership qualities of the learners.

Student Learning Outcomes (SLO):
16. Having a good working knowledge of communicating in English
18. Having critical thinking and innovative skills

THEORY

Module:1  Advanced-level Grammar  5 hours
Simple, Compound and Complex Sentences, Phrases-Adjective Phrases, Adverb Phrases, Noun Phrases, Direct and Indirect Speech, Conditionals, Concord, Punctuation
Vocabulary building: Idioms
Activity: Grammar Worksheet

Module:2  Professional Dialogues  2 hours
Formal Conversations – at the office with the CEO/ with the Registrar of a University/ Introducing oneself at an interview panel
Activity: Role play [students practice short formal conversations in pairs/groups of 5-6]

Module:3  Drafting  4 hours
Notice, Circular, Resolution & Minutes, Business letter writing- Offer letter, quotation, status enquiry, Confirmation, Execution, Refusal and cancellation of order, recommendation, credit collection, claim, bank loan
Activity: Worksheets
### Module: Text-based Analysis

**You Can Win** by Shiv Khera

Activity: Skimming, scanning, guessing unfamiliar words from context; summarizing/note making & drawing inferences from the Text

### PRACTICE SESSIONS:

<table>
<thead>
<tr>
<th>Activity-1</th>
<th>Listening Comprehension for General Details</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Listening Comprehension Tests; Testing Exercises</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Session: Students will reflect back what they hear from the videos, which help them to be understood.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-2</th>
<th>Syllable structure; Word stress</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Tone &amp; Rhythm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Session: Practicing basic rules of word accent - Stress shift - Weak forms and Strong forms- Sentence Stress</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-3</th>
<th>Verbal &amp; Non-Verbal Communication</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposure to videos of structured talks delivered by leaders across all domain - Presentation Skills- Non-verbal Communication</td>
<td></td>
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<tr>
<td></td>
<td>Session: Students will make short speeches by watching relevant TED-Talk videos – PPT presentations by students communicating non-verbally in a pair/group</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-4</th>
<th>Features of Good Conversation</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategies for effective Communication and the use of polite language through the aid of audio-visual materials.</td>
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<tr>
<td></td>
<td>Session: Making requests and seeking permissions, Telephone etiquette, Participating in Case-study based Group Discussions</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-5</th>
<th>Report Writing &amp; Transcoding</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Report writing format; Essential qualities of technical writing; Data interpretation &amp; Transcoding; logical and analytical reasoning questions</td>
<td></td>
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<td></td>
<td>Session: Students write a Report; they interpret graphs of medium level difficulty</td>
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</table>

<table>
<thead>
<tr>
<th>Activity-6</th>
<th>Leadership Development</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The focus will be on individual, group and organization factors associated with leadership.</td>
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<tr>
<td></td>
<td>Session: Students will be acquainted with the development of the conception of leadership and in the process would hone their vocabulary and conversational power, by watching videos of leaders delivering Lectures; Seminars conducted by Administrative Heads of various Schools/ Departments within the University.</td>
<td></td>
</tr>
</tbody>
</table>

**Total Practical hours:** 45 hours

Text Book/ Work Book
**Reference Books**


**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role play, Assignments and FAT

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Error detection in paragraph</td>
<td>6 hours</td>
</tr>
<tr>
<td>2 Role plays on professional situations</td>
<td>10 hours</td>
</tr>
<tr>
<td>3 Discussing a Case on communication skills</td>
<td>7 hours</td>
</tr>
<tr>
<td>4 Academic listening and note taking</td>
<td>7 hours</td>
</tr>
<tr>
<td>5 Report Writing</td>
<td>10 hours</td>
</tr>
<tr>
<td>6 Guessing unfamiliar words from the prescribed text</td>
<td>5 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours**

45 hours

**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role Play, Assignments & FAT

**Recommended by Board of Studies** 08-06-2019

**Approved by Academic Council** Number 55 Date 13-06-2019
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tr>
<td>ENG1913</td>
<td>Effective Communication Skills</td>
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<thead>
<tr>
<th>Pre-requisite</th>
<th>Syllabus version</th>
</tr>
</thead>
<tbody>
<tr>
<td>General English-II</td>
<td>v.1</td>
</tr>
</tbody>
</table>

**Course Objectives:**

1. To be an independent/ a competent speaker in all areas of written and spoken communication for successful business/ professional interactions.
2. To organize, compare and contrast, categorize and describe complex content.
3. To speak and write with fluency and confidence, with minor grammatical errors and with a fairly wide active vocabulary.

**Course Outcome:**

- Acquire an effective command over the language, though with minor inaccuracies
- Understand complex theories of varied subjects and understand detailed logic & reasoning
- Perform well in middle to upper-end placement interviews/ competitive exams/ general social situations
- Participate actively and independently in seminars/discussions
- Understand the requisite proficiency for difficult/ varied levels of communications in BBC/UK & CNN/US accents

**Student Learning Outcomes (SLO):**  16, 18

16. Having a good working knowledge of communicating in English
18. Having critical thinking and innovative skills

**THEORY**

**Module:1 | Verbal-Logic & Reasoning**

Verbal reasoning tests assess the learner’s understanding and comprehension skills.

Activity: Interpreting short texts.

**Module:2 | The Art of Paraphrasing**

A restatement of the meaning of a text or passage using other words.

Activity: Paraphrasing different articles & Research papers

**Module:3 | Text-based Analysis**

*The Thousand Faces of Night* by Githa Hariharan

Activity: Summarizing/ note making & drawing inferences from the text

**Module:4 | Research Paper Writing**

Structure of a Research paper; Plagiarism

Activity: Practice on Research Paper writing.

**PRACTICE-SESSIONS**

**Activity-1 | Vocalics**

The learners will undergo training in vocalics which are rate, or speed at which the person speaks, pitch, inflection and variety in the voice, volume, being loud or soft, and articulation and pronunciation, or how correctly and clearly the person speaks.

Session: Type the learners will undergo training in vocalics

**Activity-2 | Travel blogs / E-Travel Diary**

Briefing on the art of writing travel blogs.

Session: The learners will engage in writing relevant blogs
<table>
<thead>
<tr>
<th>Activity-3</th>
<th>Video-conference and Interview</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparing the students for Interviews.</td>
<td></td>
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<tr>
<td>Session: Students will participate in mock-Interviews and real-time video-conference</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-4</th>
<th>Language Sensitivity &amp; Cross Cultural Communication</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Meaning &amp; importance of Cross Cultural Communication; Understanding Inter and Cross-Cultural Communication Nuances through relevant videos &amp; case-studies</td>
<td></td>
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<tr>
<td>Session: Students will attempt a case study on cross-cultural communication</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-5</th>
<th>Mass-Media Communication</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefing on the constituents of mass media such as newspapers, magazines, films/documentaries, radio, television, the mechanism of conveying information to a mass-audience and an academic investigation of the different methods of mass correspondence</td>
<td></td>
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<tr>
<td>Activity: An advanced understanding of news media and their role in the society and relevant media education through the mode of note-making &amp; interpretive exercises</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity-6</th>
<th>Writing Abstract/Summary/Articles</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equip participants with skills in writing and presenting effective and successful Abstract/ Summary. The participants will also acquire skills in writing quality Articles which can engage the audience.</td>
<td></td>
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<tr>
<td>Session: Each individual student will submit an Article under the guidance of the course-Instructor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Text Book/Work Book**


**Reference Books**


**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role play, Assignments & FAT

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiments</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interpreting short texts and writing a paragraph</td>
<td>8 hours</td>
</tr>
<tr>
<td>2. Writing an abstracts</td>
<td>10 hours</td>
</tr>
<tr>
<td>3. Mock Interviews through video conferencing</td>
<td>12 hours</td>
</tr>
<tr>
<td>4. Analysing and discussing a case on cross cultural communication</td>
<td>6 hours</td>
</tr>
<tr>
<td>5. Listening and paraphrasing</td>
<td>4 hours</td>
</tr>
<tr>
<td>6. Reading aloud travel blogs or E-travel diary with focus on vocalics</td>
<td>5 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours:** 45 hours

**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role play, Assignments & FAT

**Recommended by Board of Studies** 08.06.2019

**Approved by Academic Council** No.55 Date 13-06-2019
**Course code** | **Course title** | **L** | **T** | **P** | **J** | **C**
---|---|---|---|---|---|---
HUM1021 / HUM1032 | Ethics and values | 2 | 0 | 0 | 0 | 2

**Pre-requisite** | **None** | **Syllabus version**
---|---|---

**Course Objectives:**
1. To understand and appreciate the ethical issues faced by an individual in profession, society, and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

**Expected Course Outcome:**
Students will be able to:
1. Follow sound morals and ethical values scrupulously to prove as good citizens
2. Understand various social problems and learn to act ethically
3. Understand the concept of addiction and how it will affect the physical and mental health
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use, and citation of sources, the objective presentation of data, and the treatment of human subjects
5. Identify the main typologies, characteristics, activities, actors, and forms of cybercrime

**Student Learning Outcomes (SLO):** 2,10,11,12
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
11. Having an interest in lifelong learning
12. Having adaptive thinking and adaptability

**Module:1 | Being Good and Responsible**
| 5 hours |
Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society’s interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

**Module:2 | Social Issues 1**
| 4 hours |
Harassment – Types - Prevention of harassment, Violence, and Terrorism

**Module:3 | Social Issues 2**
| 4 hours |
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices;
White collar crimes - Tax evasions – Unfair trade practices

**Module:4 | Addiction and Health**
| 5 hours |
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides;
Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

**Module:5 | Drug Abuse**
| 3 hours |
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws, and prevention

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Personal and Professional Ethics</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dishonesty - Stealing - Malpractices in Examinations – Plagiarism</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Abuse of Technologies</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hacking and other cybercrimes, Addiction to mobile phone usage, Video games and Social networking websites</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest lectures by Experts</td>
<td></td>
<td></td>
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</tbody>
</table>

Total Lecture hours: 30 hours

Reference Books


Mode of Evaluation: CAT, Assignment, Quiz, FAT, and Seminar

Recommended by Board of Studies | 26-07-2017
Approved by Academic Council | No. 46 | Date | 24-08-2017
Course Code | Course title | L | T | P | J | C
---|---|---|---|---|---|---
MAT-1001 | Fundamentals of Mathematics | 3 | 2 | 0 | 0 | 4

Pre-requisite | Syllabus Version | None | 1.0

Course Objectives
The course is aimed at providing
[1] necessary and relevant background to understand the other important engineering mathematics courses
[2] basic knowledge for the non-mathematics students to learn further topics and apply it in solving real-world engineering problems

Course Outcomes
At the end of the course, the student should be able to
[1] Solve a system of linear equations by matrix method
[2] Apply the techniques of differentiation to find maxima and minima, and techniques of integration to evaluate areas and volumes of revolution
[3] Understand the concept of ordinary differential equations, and first and second-order linear differential equations
[4] Have a clear understanding of analytic geometry and vector algebra
[5] Apply concepts of mathematical logic and elementary probability to real-life problems

Student Learning Outcomes
2, 7, 9

Module:1 Matrices 5 hours
Matrices - types of matrices - operations on matrices - determinants - adjoint matrix – Inverse of a matrix - solution of a system of linear equations by inversion method – elementary transformations – the rank of a matrix - consistency, and inconsistency of the system of equations

Module:2 Differential Calculus 6 hours
Differentiation of functions of a single variable – differentiation techniques physical interpretations - differentiation of implicit functions – higher-order derivatives – Taylor’s, McClaurin’s series - maxima and minima of functions of a single variable

Module:3 Integral Calculus 6 hours
Partial fractions - Integration- integration techniques- integration by parts- definite integrals – properties- evaluation of area and volume by integration

Module:4 Linear Ordinary Differential Equations 6 hours
Differential equations-definition and examples- formation of the differential equation- solving differential equations of the first order - solving second order homogenous differential equations with constant coefficients

**Module:5 Analytic geometry 5 hours**
Analytic geometry of three dimensions - direction cosines and direction ratios - plane, straight line and sphere, distance between points, distance to a plane

**Module:6 Vector Algebra 7 hours**
Vectors–operations on vectors- angle between two vectors– projection of one vector on another vector – equations of the plane, straight line, and sphere in vector forms-shortest distance between two skew lines - equation of a tangent plane to a sphere

**Module:7 Logic and Probability 8 hours**

**Module:8 Contemporary Issues 2 hours**
Industry Expert Lecture

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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</thead>
<tbody>
<tr>
<td>Tutorial</td>
<td></td>
</tr>
<tr>
<td>• A minimum of 10 problems to be worked out by students in every Tutorial Class</td>
<td></td>
</tr>
<tr>
<td>• Another 5 problems per Tutorial Class to be given as homework</td>
<td></td>
</tr>
<tr>
<td>Mode: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums</td>
<td></td>
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<tr>
<td>30 hours</td>
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</table>

**Text Book(s)**

**Reference Books**

**Mode of Evaluation**
Digital Assignments (Solutions by using a soft skill), Quiz, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies 25-02-2017
Approved by Academic Council No. 47 Date 05-10-2017
<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>MAT-1012</td>
<td>Statistical Applications</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: None

Syllabus Version: 1.0

**Course Objectives:**

1. This course provides the meaning and scope of Statistical Applications.
2. This enables the students to understand and use statistics in real-world problems.
3. This course imparts comprehensive knowledge on data collection, presentation of data, pictorial representation, and measures of central tendency, measures of dispersion, control charts, correlation, regression, time series, probability, estimation, and inference.

**Expected Course Outcome:**

1. Organize, present, and interpret statistical data, both numerically and graphically.
2. Perform regression analysis and compute and interpret the coefficient of correlation.
3. Use various methods to compute the probabilities of events.
4. Analyse and interpret data using appropriate statistical hypothesis and parametric testing techniques.
5. Apply statistical quality control techniques.
6. Implement SPSS code for statistical data.

**Student Learning Outcomes**

2, 7

2. Having a clear understanding of the subject related concepts and contemporary issues.
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning).

**Module: 1 Introduction to Statistics and Data Collection:** 5 hours

Importance of statistics, concepts of statistical population, and a sample - Methods of Random and Non-Random Sampling - quantitative and qualitative data - Measurement scales - nominal, ordinal, interval, and ratio - Primary and secondary data - Classification and tabulation of data. Diagrammatic and graphical representation of data-Histograms and Frequency Polygons.

**Module: 2 Describing Business Data:** 5 hours

Measures of Central tendency- Mean, median, and mode- Measures of Dispersion, Range, Quartile deviation, Mean Deviation, Standard Deviation-The coefficient of Variation.

**Module: 3 Correlation and Regression Analysis:** 4 hours

The Scatter Plot- Correlation-Types-Karl Pearson’s Coefficient of Correlation-Spearman’s Rank Correlation–Regression lines and coefficients- the coefficient of Determination-Residuals-the standard error of Estimate.
<table>
<thead>
<tr>
<th>Module:4</th>
<th>Probability</th>
<th>4 hours</th>
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</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Testing of Hypothesis</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing of Hypothesis – Z-test, Student’s t-test, F-test, Chi-square test.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Statistical Quality Control Charts</th>
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<tr>
<th>Module:7</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
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<tr>
<td>Industry Expert Lecture</td>
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<table>
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<th>Total Lecture hours:</th>
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<table>
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<tr>
<th>Text Book(s)</th>
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<table>
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<tr>
<th>Reference Books</th>
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<table>
<thead>
<tr>
<th>Mode of Evaluation</th>
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<tbody>
<tr>
<td>Digital Assignments, Continuous Assessments, Final Assessment Test</td>
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</table>

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
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<tbody>
<tr>
<td>1</td>
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**Mode of Evaluation**

- Weekly Assessments, Final Assessment Test

**Recommended by Board of Studies**

- 12-06-2016

**Approved by Academic Council**

- No. 37
- Date 16-06-2015
<table>
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<th>J</th>
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<tr>
<td>MGT1022</td>
<td>Lean Start up Management</td>
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<td>v.1.0</td>
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</table>

**Course Objectives:** To develop the ability to
1. Learn methods of company formation and management.
2. Gain practical skills in and experience of stating business using a pre-set collection of business ideas.
3. Learn the basics of entrepreneurial skills.

**Expected Course Outcome:** On the completion of this course, the student will be able to:
1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of the enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
   Foreseeing and quantifying business and financial risks

**Student Learning Outcomes (SLO):** 2, 3, 5
2. Having a clear understanding of the subject related concepts and contemporary issues
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)
5. Having design thinking capability

**Module: 1**
2 Hours
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)

**Module: 2**
3 Hours
Minimum Viable Product (Value Proposition, Customer Segments, Build-measure-learn process)

**Module: 3**
3 Hours
Business Model Development(Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Business model canvas – the lean model templates)

**Module: 4**
3 Hours
Business Plan and Access to Funding(visioning your venture, taking the product/service to market, a Market plan including Digital & Viral Marketing, start-up finance - Costs/Profits & Losses/cash flow, Angel/VC/Bank Loans and Key elements of raising money)

**Module: 5**
3 Hours
Legal, Regulatory, CSR, Standards, Taxes

**Module: 6**
2 Hours
Lectures by Entrepreneurs
### Text Book(s)

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Edition</th>
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<tr>
<td>2</td>
<td>The Four Steps to the Epiphany</td>
<td>Steve Blank</td>
<td>K&amp;S Ranch; 2nd edition</td>
<td>(July 17, 2013)</td>
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<tr>
<td>3</td>
<td>The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses</td>
<td>Eric Ries</td>
<td>Crown Business; (13 September 2011)</td>
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### Reference Books

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Edition</th>
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<tr>
<td>1</td>
<td>Holding a Cat by the Tail</td>
<td>Steve Blank</td>
<td>K&amp;S Ranch Publishing LLC</td>
<td>(August 14, 2014)</td>
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<td>3</td>
<td>Zero to One: Notes on Startups, or How to Build the Future</td>
<td>Peter Thiel</td>
<td>Crown Business</td>
<td>(June 18, 2008)</td>
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<td>4</td>
<td>Lean Analytics: Use Data to Build a Better Startup Faster</td>
<td>Alistair Croll &amp; Benjamin Yoskovitz</td>
<td>O'Reilly Media; 1st Edition</td>
<td>(March 21, 2013)</td>
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</tbody>
</table>

### Website References:

5. https://www.youtube.com/watch?v=fEvKo90qBns
10. chventures.blogspot.in/ platformsandnetworks.blogspot.in/p/saas-model.html

### Mode of Evaluation:

- Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks

### Project

<table>
<thead>
<tr>
<th>No.</th>
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**Total Project** 60 hours
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Pre-requisite: None

Syllabus version: 1.0

Course Objectives:
To enable the student to understand the basic principles of Physics behind (a) those latest areas of biotechnology such as nanobiotechnology and (b) medical applications involving lasers, ultrasound and fiber optics.

Expected Course Outcome: Students will be able to
1. Understand the concept of dual nature of the electromagnetic radiation and its verification
2. Understand the quantum physics concept by studying the behavior of the particle in a box.
3. Study the material properties as a function of particle size, especially at the nano level.
4. Explore the properties and types of LASERs and its application.
5. Understand the properties, production, and detection of Ultrasonic waves.
6. Get insight into the communication system through fiber optics.
7. Learn the applications of LASER, Ultrasonic and Fiber optics in the medical field and to appreciate the contemporary issues.
8. Demonstrate the ideas of quantum nature and ultrasonic waves-LAB
9. Carry out a mini project in the abovementioned topics-J COMPONENT

Student Learning Outcomes (SLO): 2, 9, 14, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
4. Having problem-solving ability- solving social issues and engineering problems
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data
18. Having critical thinking and innovative skills

Module:1 Quantum Physics 7 hours
Dual nature of electromagnetic radiation, Compton effect (Qualitative), experimental verification-deBroglie waves- Davisson-Germer Experiment, Heisenberg uncertainty principle - Schrödinger equation.

Module:2 Applications of Quantum Physics 6 hours
Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative), Scanning Tunneling Microscope, Atomic Force Microscope.

Module:3 Nanotechnology 6 hours
Introduction to Nano-materials, Properties of Nano-materials, Bionanomaterials, membranes, electrical properties of nano membranes, CNT, Applications of nanobiotechnology- longer-lasting medical implants, nanodrugs

Module:4 Lasers 6 hours

M.Sc Intg Biotechnology (5yr.)
Laser characteristics, Einstein’s theory of stimulated emission, pumping mechanisms-population inversion, three-level, four-level lasers, Nd-YAG, He-Ne-laser, CO2 laser.

Module:5  Ultrasonics  6 hours

Module:6  Fiber Optics  6 hours
Light propagation through fiber, Acceptance angle, numerical aperture, types of fiber.

Module:7  Application of Lasers, Ultrasonics and Fiber Optics  6 hours
Laser in surgery, ophthalmology, dentistry, ultrasonogram, POT-sensors- fiber-optic- biosensors, keyhole surgery.

Module:8  Contemporary issues:  2 hours
Current Topics - Industry Experts Talk

Total Lecture hours: 45 hours

Text Book(s)

Reference Books

Mode of Evaluation: Quizzes, Digital Assignments, CAT-I and II and FAT

Recommended by Board of Studies  13.05.2017
Approved by Academic Council No. 45  Date  15.06.2017

List of Challenging Experiments (Indicative)
1. Calculation of interplanar spacing of polycrystalline graphite from electron diffraction pattern (Module 1)  2 hrs
2. Fabry Perot Interferometer: Determination of wavelength of the laser beam and finding spacing of the etalon (Module 4)  2 hrs
<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Duration</th>
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<tbody>
<tr>
<td>3.</td>
<td>Determination of wavelength of the laser source (He-Ne laser and diode lasers of different wavelengths) using diffraction technique (Module 4)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>4.</td>
<td>Integrated optics: Determination of refractive index of the prism (Module 6)</td>
<td>2 hrs</td>
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<tr>
<td>5.</td>
<td>Determination of refractive index of various liquids (Module 6)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>6.</td>
<td>Optical Fiber Characterization: determination of numerical aperture of a given multimode optical fiber (Module 6)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>7.</td>
<td>Determination of the size of the fine particle using laser diffraction (Module 4)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>8.</td>
<td>Determination of the track width (periodicity) in a written CD (Module 4)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>9.</td>
<td>Analysis of crystallite size and strain in a nano-crystalline film using a given X-ray diffraction pattern (Module 3)</td>
<td>2 hrs</td>
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<tr>
<td>10.</td>
<td>Ultrasonic interferometer: Determination of velocity of the ultrasonic wave in different liquids and its adiabatic compressibility (Module 5)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>11.</td>
<td>Numerical solutions of Schrödinger equation (e.g., particle in a box problem) (can be given as an assignment) (Module 1)</td>
<td>2 hrs</td>
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<tr>
<td>12.</td>
<td>Exploring the link between quantum confinement and Heisenberg's uncertainty principle (can be given as assignment). (Module 1+3)</td>
<td>2 hrs</td>
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**Total Laboratory Hours** 24 hrs

Recommended by Board of Studies 13.05.2017
Approved by Academic Council No. 45 Date 15.06.2017
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<td></td>
<td>Syllabus version</td>
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**Course Objectives:**
The course gives students the necessary background to:
- Demonstrate proficiency in reading, writing, and speaking in basic Spanish. Learning vocabulary related to profession, education centers, day-to-day activities, food, culture, sports and hobby, the family set up, workplace, market, and classroom activities is essential.
- Demonstrate the ability to describe things and will be able to translate into English and vice versa.
- Describe in simple terms (both in written and oral form) aspects of their background, immediate environment, and matters in areas of immediate need.

**Expected Course Outcome:**
The students will be able to
- Remember greetings, giving personal details and Identify genders by using correct articles
- Apply the correct use of SER, ESTAR and TENER verb for describing people, place, and things
- Create opinion about time and weather conditions by knowing months, days and seasons in Spanish
- Create opinion about people and places by using regular verbs
- Apply reflexive verbs for writing about the daily routine and create small paragraphs about hometown, best friend and family

**Student Learning Outcomes (SLO):**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Abecedario, Saludos y Datos personales: Origen, Nacionalidad, Profesión</td>
<td>3</td>
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</tbody>
</table>

Competencia Gramática: Vocales y Consonantes. Artículos definidos e indefinidos (Numero y Genero).
Competencia Escrita: Saludos y Datos personales

<table>
<thead>
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<th>Module</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Edad y posesión. Números (1-20)</td>
<td>3</td>
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Competencia Gramática: Pronombres personales. Adjetivos. Los verbos SER y TENER.
Competencia Escrita: Escribe sobre mismo/a y los compañeros de la clase

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Vocabulario de Mi habitación. Colores. Descripción de lugares y cosas.</td>
<td>5</td>
</tr>
</tbody>
</table>

Competencia Gramática: Adjetivos posesivos. El uso del verbo ESTAR. Diferencia entre SER y ESTAR.
Competencia Escrita: Mi habitación

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>Mi familia. Números (21-100). Direcciones. Expresar la hora. Los meses del año.</td>
<td>4</td>
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</tbody>
</table>

Competencia Gramática: Frases preposicionales. Uso del HAY. La diferencia entre MUY y MUCHO. Uso del verbo GUSTAR
<table>
<thead>
<tr>
<th>Competencia Escrita: Mi familia. Dar opiniones sobre tiempo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module:5</strong></td>
</tr>
</tbody>
</table>

Competencia Gramática: Los verbos regulares (-AR, -ER, -IR) en el presente. Adjetivos demostrativos.

Competencia Escrita: Mi mejor amigo/a. Expresar fechas. Traducción inglés a español y Español a Ingles.

| **Module:6** | Describir el diario. Las actividades cotidianas. | **3 hours** |

Competencia Gramática: Los Verbos y pronombres reflexivos. Los verbos pronominales con e/ie, o/ue, e/i, u/ue.

Competencia Escrita: El horario. Traducción inglés a español y Español a Ingles.

| **Module:7** | Dar opiniones sobre comidas y bebidas. Decir lo que está haciendo. Describir mi ciudad y Ubicar los sitios en la ciudad. | **5 hours** |


| **Module:8** | Guest Lectures/ Native Speakers | **2 hours** |

**Total Lecture hours:** 30 hours

**Text Book(s):**

**Reference Books**

**Recommended by Board of Studies:** DD-MM-YYYY

**Approved by Academic Council:** No. xx Date DD-MM-YYYY
### Course Objectives:

The course gives students the necessary background to:

1. Understand isolated sentences and frequently used expressions in relation to immediate priority areas (personal or family information, shopping, close environment, work).
2. Communicate in simple and routine tasks requiring only a simple and direct exchange of information on familiar and habitual topics.
3. Enable students to describe with simply means his training, his immediate environment and evoke familiar and habitual subjects, evoke subjects that correspond to immediate needs.

### Expected Course Outcome:

The students will be able to:

1. Understand expressions in French.
2. Create sentences by using frequent lexicon related to himself, his family, his close environment (family, shopping, work, school, etc).
4. Analyze predictable information in common documents, such as advertisements, flyers, menus, schedules, simple personal letters.
5. Create simple and routine tasks.
6. Create a simple and direct exchange of information on familiar activities and topics.

### Student Learning Outcomes (SLO): 2,11

1. Having a clear understanding of the subject related concepts and contemporary issues
2. Having an interest in lifelong learning

### Module: 1 Expressions simples 8 hours

La vie quotidiennes - Le verbe pronominal - Le passé composé avec l’auxiliaire - avoir et être- le passé récent : venir de + infinitif - Le comparatif - Le superlatif - Les mots interrogatifs (les trois formes)

**Savoir-faire pour**: Faire des achats, faire des commandes dans un restaurant, poser des questions.

### Module: 2 Les activités quotidiennes 6 hours

**Savoir-faire pour :** Réserver les billets pour le voyage, réserver les chambres dans un hôtel, S’informer sur les lieux de la ville, indiquer la direction à un étranger.

<table>
<thead>
<tr>
<th>Module</th>
<th>Thème</th>
<th>Durée</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>Les activités de loisirs</td>
<td>7 heures</td>
</tr>
<tr>
<td>4</td>
<td>La Francophonie</td>
<td>7 heures</td>
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<tr>
<td></td>
<td>L’espace francophone - Première approche de la société française – La consommation alimentaire – caractériser un objet – décrire une tenue - Le pronom relatif (qui/que/dont/où)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>La culture française</td>
<td>5 heures</td>
</tr>
<tr>
<td></td>
<td>Parler de ses activités quotidiennes - les fêtes en France – Parler de sa famille – réserver un billet à l’agence - la gastronomie française</td>
<td></td>
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<tr>
<td>6</td>
<td>La description</td>
<td>5 heures</td>
</tr>
<tr>
<td></td>
<td>Décrire physiquement une personne – les vacances – les achats – réserver une chambre dans un hôtel – les plus grands français - raconter des événements passés</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>S’exprimer</td>
<td>5 heures</td>
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<tr>
<td></td>
<td>Parler du climat - parcours francophone – placer une commande au restaurant — la mode - parler de son projet d’avenir.</td>
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<tr>
<td>8</td>
<td>Guest lectures</td>
<td>2 heures</td>
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<tr>
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<td>Guest lectures/ Natives speakers</td>
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**Total Lecture hours:** 45 hours
1. Alter Ego 1, Méthode de français, Annie Berthet, Hachette, Paris 2010.

**Reference Books**

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<tr>
<td>1.</td>
<td>CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010.</td>
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<td>CONNEXIONS 1, Le cahier d’exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010</td>
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**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

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<td>No. xx</td>
<td>Date</td>
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### Course Code: Grundstufe Deutsch

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<th>Syllabus version</th>
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<tbody>
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<td>v.1</td>
</tr>
</tbody>
</table>

#### Pre-requisite
None

#### Course Objectives:
The course gives students the necessary background to:

1. Demonstrate proficiency in reading, writing, and speaking in basic German. Learning vocabulary related to profession, education centers, day-to-day activities, food, culture, sports and hobby, the family set up, workplace, market, and classroom activities are essential.
2. Make the student's industry-oriented and make them adapt to the German culture.

#### Expected Course Outcome:
The students will be able to:

1. Remember greeting people, introducing oneself, and understanding basic expressions in German.
2. Understand necessary grammar skills to use these in a meaningful way.
3. Remember beginner's level vocabulary
4. Create sentences in German on a variety of topics with significant precision and detail.
5. Apply good comprehension of written discourse in areas of special interests.

#### Student Learning Outcomes (SLO):

- **2.** Having a clear understanding of the subject related concepts and contemporary issues
- **11.** Having an interest in lifelong learning

#### Module: 1

**3 hours**

- Begrüssung, Landeskunde, Alphabet, Personalpronomen, Verben- heissen, kommen, wohnen, lernen, Zahlen (1-100), W-Fragen, Aussagesätze, Nomen- Singular und Plural, der Artikel - Bestimmter- Unbestimmter Artikel

**Lernziel:**
Sich vorstellen, Grundlegendes Verständnis von Deutsch, Deutschland in Europa

#### Module: 2

**3 hours**

- Konjugation der Verben (regelmässig/unregelmässig), das Jahr- Monate, Jahreszeiten und die Woche, Hobbys, Berufe, Artikel, Zahlen (Hundert bis eine Million), Ja/-Nein- Frage, Imperativ mit „Sie”

**Lernziel:**
Sätze schreiben, über Hobbys, Berufe erzählen, usw

#### Module: 3

**6 hours**

- Possessivpronomen, Negation, Kasus (Bestimmter- Unbestimmter Artikel) Trennbareverben, Modalverben, Uhrzeit, Präpositionen, Lebensmittel, Getränkeund Essen, Farben, Tiere

**Lernziel:**
Sätze mit Modalverben, Verwendung von Artikel, Adjektiv beim Verb
### Module: 4
- **4 hours**
- Übersetzung: (Deutsch – Englisch / Englisch – Deutsch)

**Lernziel:**
- Die Übung von Grammatik und Wortschatz

### Module: 5
- **5 hours**
- Leserverständnis. Mindmap machen, Korrespondenz- Briefe und Email

**Lernziel:**
- Übung der Sprache, Wortschatzbildung

### Module: 6
- **5 hours**
- **Aufsätze:** Die Familie, Bundesländer in Deutschland, Ein Fest in Deutschland,

**Lernziel:**
- Aktiver, selbständiger Gebrauch der Sprache

### Module: 7
- **4 hours**
- **Dialoge:**
  a) Gespräche mit einem/einer Freund /Freundin.
  b) Gespräche beim Einkaufen; in einem Supermarkt; in einer Buchhandlung;
  c) in einem Hotel - an der Rezeption; ein Termin beim Arzt.
  d) Ein Telefongespräch; Einladung–Abendessen

### Module: 8
- **2 hours**
- Guest Lectures/ Native Speakers (Einleitung in die deutsche Kultur und Politik)

**Total Lecture hours:** **30 hours**

### Text Book(s)

### Reference Books
2. Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2013
3. Studio d A1, Hermann Funk, Christina Kuhn, Cornelsen Verlag, Berlin :2010
4. Tangram Aktuell-I, Maria-Rosa, SchoenherrTil, Max Hueber Verlag, Muenchen :2012

- [www.goethe.de](http://www.goethe.de)
- [wirtschaftsdeutsch.de](http://wirtschaftsdeutsch.de)
- [hueber.de](http://hueber.de)
- [klett-sprachen.de](http://klett-sprachen.de)
- [www.deutschtraining.org](http://www.deutschtraining.org)

### Mode of Evaluation:
- CAT / Assignment / Quiz / FAT

**Recommended by Board of Studies**  DD-MM-YYYY
**Approved by Academic Council**  No. xx  Date  DD-MM-YYYY
### Course Objectives:
The course gives students the necessary background to:
- Enable students to read, listen and communicate in Spanish in their day to day life.
- Enable students to describe situations by using present, past, and future tenses in Spanish.
- Enable to develop comprehension skill in Spanish language.

### Expected Course Outcome:
The students will be able to
- Create sentences in near future and future tenses and correctly using the prepositions like POR and PARA
- Create sentences in preterito perfecto and correctly use the direct and indirect object pronouns
- Create sentences related to likes and dislikes and also give commands in a formal and informal way
- Create sentences in past tense by using imperfecto and idefinido forms and describe past events
- Create conversations in Spanish at places like restaurants, hotels, Shops and Railway stations
- Understand different Spanish speaking countries and its culture and traditions.

### Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and of contemporary issues
11. Having interest in lifelong learning

### Module: 1
**Números (101 – 1 millón). Expresar los planes futuros. Los números ordinales.**
- Competencia Gramática: Futuros cercanos (Ir+a+Infinitivo). Futuros (Verbos regulares e irregulares). Uso del POR y PARA.
- Competencia Escrita: Traducción inglés a español y español a Inglés.
- Comprensión - Los textos y Videos

### Module: 2
**Las ropas, colores y tamaños. Costar, valer, descuentos y rebajas**
- Competencia Escrita: Traducción inglés a español y español a Inglés. Comprensión - Los textos y Videos

### Module: 3
**Escribir un Correo electrónico formal e informal.**
- Competencia Gramática: Imperativos formales e informales. Pretérito perfecto.
- Competencia Escrita: Traducción inglés a español y español a Inglés.
- Comprensión - Los textos y Videos
<table>
<thead>
<tr>
<th>Module:4</th>
<th>Curriculo Vitae. Presentarse en una entrevista informal.</th>
<th>6 hours</th>
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<tbody>
<tr>
<td>Competencia Escrita: Traducción ingles a español y español a Ingles.</td>
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<tr>
<td>Comprension - Los textos y Videos</td>
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</tr>
<tr>
<td>Module:5</td>
<td>Introduccion personal, Expresar los planes futuros.</td>
<td>5 hours</td>
</tr>
<tr>
<td>Comprension oral: Introduccion personal, Expresar los planes futuros. ¿Que vas a hacer en las proximas vacaciones?</td>
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<tr>
<td>Comprension auditiva: Las preguntas sobre un cuento auditivo. Relacionar el audio con las imagenes. Las preguntas basadas en canciones.</td>
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<tr>
<td>Medio de transporte: Comprar y Reservar billetes</td>
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</tr>
<tr>
<td>Module:6</td>
<td>Dialogos entre dos</td>
<td>5 hours</td>
</tr>
<tr>
<td>Comprension oral: Dialogos entre dos (cliente y tendero de ropas, pasajero y empleado, en un restaurante, Reservacion de habitacion en un hotel). Presentacion en una entrevista.</td>
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<td></td>
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<tr>
<td>Comprension auditiva: Las preguntas basadas en canciones. Las preguntas basadas en dialogos.</td>
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<tr>
<td>Module:7</td>
<td>Presentacion de los paises hispánicos.</td>
<td>5 hours</td>
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<td>Comprension oral: Dialogo entre un medico y paciente. Presentacion de los paises hispánicos. Describir su infancia. Describir vacaciones ultimas o las actividades de ultimo fin de semana.</td>
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<td>Comprension auditiva: Rellenar los blancos del cuento en pasado. Las preguntas basadas en el cuento. Las preguntas basadas en un anuncio</td>
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<tr>
<td>Module:8</td>
<td>Guest Lectures/ Native Speakers</td>
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**Text Book(s)**


**Reference Books**


Authors, book title, year of publication, edition number, press, place

**Recommended by Board of Studies**

DD-MM-YYYY

**Approved by Academic Council**

No. xx Date DD-MM-YYYY
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<td>STS 1021</td>
<td>Introduction to Softskills</td>
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**Pre-requisite**: None

**Syllabus version**: Syllabus version

**Course Objectives:**
- To enhance critical thinking and innovative skills
- To have a working knowledge of communicating in English
- To have critical thinking and innovative skills

**Expected Course Outcome:**
- Students will be able to exhibit appropriate presentation skills
- Students will be able to exhibit appropriate analytical skills
- The students will be able to deliver impactful presentations

**Student Learning Outcomes (SLO):** 10, 11, 12, 13

10. Having a clear understanding of professional and ethical responsibility
11. Having an interest in lifelong learning
12. Having adaptive thinking and adaptability
13. Having cross-cultural competency exhibited by working in teams

**Module:1 Lessons on excellence 10 hours**

**Ethics and integrity**
Importance of ethics in life, Intuitionism vs. Consequentialism, Non-consequentialism, Virtue ethics vs. situation ethics, Integrity - listen to conscience, Stand up for what is right

**Change management**
Who moved my cheese?, Tolerance of change and uncertainty, Joining the bandwagon, Adapting change for growth - overcoming inhibition

**How to pick up skills faster?**
Knowledge vs. skill, Skill introspection, Skill acquisition, "10,000 hours rule" and the converse

**Habit formation**

**Analytic and research skills.**
Focused and targeted information seeking, How to make Google work for you, Data assimilation

---

**Module:2 Team skills 11 hours**

**Goal setting**
SMART goals, Action plans, Obstacles -Failure management

**Motivation**
Rewards and other motivational factors, Maslow's hierarchy of needs, Internal and external motivation
Facilitation
Planning and sequencing, Challenge by choice, Full Value Contract (FVC), Experiential learning cycle, Facilitating the Debrief

Introspection
Identify your USP, Recognize your strengths and weakness, Nurture strengths, Fixing weakness, Overcoming your complex, Confidence building

Trust and collaboration
Virtual Team building, Flexibility, Delegating, Shouldering responsibilities

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Emotional Intelligence</th>
<th>12 hours</th>
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<tbody>
<tr>
<td><strong>Transactional Analysis</strong></td>
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<td>Introduction, Contracting, Ego states, Life positions</td>
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<td><strong>Brain storming</strong></td>
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<td>Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming</td>
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<td><strong>Psychometric Analysis</strong></td>
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<td>Skill Test, Personality Test</td>
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<tr>
<td><strong>Rebus Puzzles/Problem Solving</strong></td>
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<td>More than one answer, Unique ways</td>
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<th>Module:4</th>
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<tr>
<td><strong>Theatrix</strong></td>
<td></td>
<td></td>
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<tr>
<td>Motion Picture, Drama, Role Play, Different kinds of expressions</td>
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<tr>
<td><strong>Creative expression</strong></td>
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<tr>
<td>Writing, Graphic Arts, Music, Art and Dance</td>
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<tr>
<td><strong>Flexibility of thought</strong></td>
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<tr>
<td>The 5 ’P’ framework (Profiling, prioritizing, problem analysis, problem-solving, planning)</td>
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<tr>
<td><strong>Adapt to changes (tolerance of change and uncertainty)</strong></td>
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<td>Adaptability Curve, Survivor syndrome</td>
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<th>Text Book(s)</th>
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</table>

Reference Books

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M.Sc Intg Biotechnology (5yr.)

2. Phil Lapworth, An Introduction to Transactional Analysis, 2011, Sage Publications (CA)

**Mode of Evaluation**: FAT, Assignments, Projects, Case studies, Roleplays, 3 Assessments with Term End FAT (Computer Based Test)
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**Course Objectives:**
- To enhance critical thinking and innovative skills
- To have a working knowledge of communicating in English
- To have critical thinking and innovative skills

**Expected Course Outcome:**
- Students will be able to exhibit appropriate presentation skills
- Students will be able to exhibit appropriate analytical skills
- The students will be able to deliver impactful presentations

**Student Learning Outcomes (SLO):** 16, 18

- 16. Having a good working knowledge of communicating in English
- 18. Having critical thinking and innovative skills

**Module: 1**
**Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions**

- 10 Tips to prepare PowerPoint presentation
- Outlining the content
- Passing the Elevator Test
- Blue sky thinking
- Introduction, body and conclusion
- Use of Font
- Use of Color
- Strategic presentation
- Importance and types of visual aids
- Animation to captivate your audience
- Design of posters
- Setting out the ground rules
- Dealing with interruptions
- Staying in control of the questions
- Handling difficult questions

**Module: 2**
**Analytical Writing – Articulate and support complex ideas**

- 30 minute - Analyse an Issue
- 30 minute - Analyse an Argument
- Construct and Evaluate arguments
- Focused and Coherent discussion

**Module: 3**
**Business Etiquette**

- Social and Cultural Etiquette
  - Value, Manners, Customs, Language, Tradition
- **Writing Company Blogs**
  - Building a blog, Developing brand message, FAQs', Assessing Competition
- **Internal Communications**
Open and objective Communication, Two-way dialogue, Understanding the audience

**Planning**
Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning

**Writing a press release and meeting notes**
Write a short, catchy headline, Get to the Point – summarize your subject in the first paragraph, Body – Make it relevant to your audience

<table>
<thead>
<tr>
<th>Module: 4</th>
<th>Listening and speaking skills</th>
<th>10 hours</th>
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<table>
<thead>
<tr>
<th>Module: 5</th>
<th>PEST Analysis &amp; Lean Concepts</th>
<th>7 hours</th>
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<tbody>
<tr>
<td></td>
<td>SLEPT, STEEPLE, 360 Feedback, Product life cycle, Waste reduction, Technology change, Product support</td>
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<th>Module: 6</th>
<th>Non Verbal Communication</th>
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<td></td>
<td>Proximecs : Types of proximecs, Rapport building</td>
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<td></td>
<td>Reports and Data Transcoding: Types of reports</td>
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<td></td>
<td>Negotiation Skill : Effective negotiation strategies</td>
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<tr>
<td></td>
<td>Conflict Resolution : Types of conflicts</td>
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</table>

**Total Lecture hours**: 45 hours

**Reference Books**

**Websites:**
1. www.chalkstreet.com
2. www.skillsyouneed.com
3. www.mindtools.com
4. www.thebalance.com
5. www.eguru.ooo

<p>| Mode of Evaluation: FAT, Assignments, Projects, Case studies, Roleplays, 3 Assessments with Term End FAT (Computer Based Test) |</p>
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<td>Fundamentals of Aptitude</td>
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**Course Objectives:**
- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students

**Expected Course Outcome:**
- Students will be introduced to basic concepts of Quantitative Aptitude, Logical reasoning, and verbal ability
- Students will be able to read and demonstrate good comprehension of text in areas of the student’s interest
- Students will be able to demonstrate the ability to resolve problems that occur in their fields.

**Student Learning Outcomes(SLO):**
5. Having design thinking capability
9. Having problem-solving ability- solving social issues and engineering problems
10. Having a clear understanding of professional and ethical responsibility
11. Having interest in lifelong learning
12. Having adaptive thinking and adaptability
16. Having a good working knowledge of communicating in English

**Module:1**
Lessons on excellence
2 hours
- Skill introspection, Skill acquisition, consistent practice

**Module:2**
Logical Reasoning
16 hours

**Thinking Skill**
- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

**Coding & decoding, Series, Analogy, Odd man out and Visual reasoning**
- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

**Sudoku puzzles**
Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

**Attention to detail**
Picture and word driven Qs to develop attention to detail as a skill

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Quantitative Aptitude</th>
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<tr>
<td><strong>Speed Maths</strong></td>
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<tr>
<td>• Addition and Subtraction of bigger numbers</td>
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<tr>
<td>• Square and square roots</td>
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<tr>
<td>• Cubes and cube roots</td>
<td></td>
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<tr>
<td>• Vedic maths techniques</td>
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<tr>
<td>• Multiplication Shortcuts</td>
<td></td>
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<tr>
<td>• Multiplication of 3 and higher digit numbers</td>
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<tr>
<td>• Simplifications</td>
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<td>• Comparing fractions</td>
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<tr>
<td>• Shortcuts to find HCF and LCM</td>
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<tr>
<td>• Divisibility tests shortcuts</td>
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Algebra and functions

<table>
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<tr>
<th>Module:4</th>
<th>Recruitment Essentials</th>
<th>5 hours</th>
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Looking at an engineering career through the prism of an effective resume

• Importance of a resume - the footprint of a person's career achievements
• How a resume looks like?
• An effective resume vs. a poor resume: what skills you must build starting today and how?

**Impression Management**
Getting it right for the interview:

• Grooming, dressing
• Body Language and other non-verbal signs
• Displaying the right behaviour

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Verbal Ability</th>
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</table>

**Essential grammar for placements:**

• Nouns and Pronouns
• Verbs
• Subject-Verb Agreement
• Pronoun-Antecedent Agreement
• Punctuations

**Verbal Reasoning**

<table>
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<th>Total Lecture hours:</th>
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**Mode of Evaluation:** FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

**Text Book(s):**

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Pre-requisite: None

Syllabus version: 1

**Course Objectives:**
- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students for academic purpose

**Expected course outcome:**
- Students will be able to show more confidence in solving problems of Quantitative Aptitude
- Students will be able to show more confidence in solving problems of Logical Reasoning
- Students will be able to show more confidence in understanding the questions of Verbal Ability

**Student Learning Outcomes (SLO):**
- 5. Having design thinking capability
- 9. Having problem-solving ability - solving social issues and engineering problems
- 16. Having a good working knowledge of communicating in English

**Module: 1 Logical Reasoning**
- **11 hours**
  - Word group categorization questions
    - Puzzle type class involving students grouping words into right group orders of logical sense
  - Cryptarithmetic
  - Data arrangements and Blood relations
    - Linear Arrangement
    - Circular Arrangement
    - Multi-dimensional Arrangement
    - Blood Relations

**Module: 2 Quantitative Aptitude**
- **18 hours**
  - Ratio and Proportion
    - Ratio
    - Proportion
    - Variation
    - Simple equations
    - Problems on Ages
    - Mixtures and alligations
  - Percentages, Simple and Compound Interest
    - Percentages as Fractions and Decimals
    - Percentage Increase / Decrease
    - Simple Interest
    - Compound Interest
    - Relation Between Simple and Compound Interest
### Number System
- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

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<td>- Prepositions</td>
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<td>- Adjectives and Adverbs</td>
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<td>- Forms and Speech and Voice</td>
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<td>- Idioms and Phrasal Verbs</td>
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<td>- Collocations, Gerund, and Infinitives</td>
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<td><strong>Reading Comprehension for placements</strong></td>
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<td>- Types of questions</td>
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<td>- Comprehension strategies</td>
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<td>- Practice exercises</td>
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<tr>
<td><strong>Articles, Prepositions, and Interrogatives</strong></td>
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<td>- Definite and Indefinite Articles</td>
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<td>- Omission of Articles</td>
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<td>- Prepositions</td>
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<td>- Compound Prepositions and Prepositional Phrases</td>
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<td>- Interrogatives</td>
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<td>- Exposure to solving questions of</td>
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**Mode of Evaluation:** FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

**Text Book(s):**

**Reference Book(s):**
**Course code** | **Course title** | **L** | **T** | **P** | **J** | **C**
--- | --- | --- | --- | --- | --- | ---
STS 3021 | Getting started to skill enhancement | 3 | 0 | 0 | 0 | 1

**Pre-requisite:** None

**Syllabus version:** 1

### Course Objectives:
- To develop the students’ logical thinking skills and apply them in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students

### Expected Course Outcome:
- Students will be able to demonstrate critical thinking skills, such as problem-solving related to their subject matters
- Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
- Students will be able to perform good written communication skills

### Student Learning Outcomes (SLO):
- 5. Having design thinking capability
- 9. Having problem-solving ability - solving social issues and engineering problems
- 16. Having a good working knowledge of communicating in English

### Module: 1 Logical Reasoning 11 hours

#### Clocks, calendars, Direction sense and Cubes
- Clocks
- Calendars
- Direction Sense
- Cubes

#### Data interpretation and Data sufficiency
- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

### Module: 2 Quantitative Aptitude 18 hours

#### Time and work
- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

#### Time, Speed and Distance
- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

#### Profit and loss, Partnerships and averages
- Basic terminologies in profit and loss
- Partnership
- Averages
- Weighted average

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<td><strong>Sentence Correction</strong></td>
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<td>- Subject-Verb Agreement</td>
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<td>- Modifiers</td>
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<td>- Parallelism</td>
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<td>- Pronoun-Antecedent Agreement</td>
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<td>- Verb Time Sequences</td>
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<td>- Comparisons</td>
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<td>- Prepositions</td>
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<td>- Determiners</td>
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<tr>
<td><strong>Sentence Completion and Para-jumbles</strong></td>
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<td>- Pro-active thinking</td>
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<td>- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)</td>
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<td>- Fixed jumbles</td>
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<td>- Anchored jumbles</td>
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<tr>
<td><strong>Essay writing</strong></td>
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<tr>
<td>- Idea generation for topics</td>
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<td>- Best practices</td>
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<td>- Practice and feedback</td>
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Pre-requisite None

Syllabus version 1

**Course Objectives:**
- To develop the students’ logical thinking skills and apply them in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students
- To strengthen the basic programming skills for placements

**Expected Course Outcome:**
- The students will be able to interact confidently and use decision-making models effectively
- The students will be able to deliver impactful presentations
- The students will be able to be proficient in solving quantitative aptitude and verbal ability questions effortlessly

**Student Learning Outcomes (SLO):**
5. Having design thinking capability
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)
9. Having problem-solving ability- solving social issues and engineering problems
12. Having adaptive thinking and adaptability
16. Having a good working knowledge of communicating in English

**Module:1  Logical Reasoning** 5 hours

Logical connectives, Syllogism and Venn diagrams
- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation
- Venn Diagrams - Solving

**Module:2  Quantitative Aptitude** 11 hours

Logarithms, Progressions, Geometry and Quadratic equations
- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability
- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
<table>
<thead>
<tr>
<th>Module:3</th>
<th>Verbal Ability</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Critical Reasoning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Argument – Identifying the Different Parts (Premise, assumption, conclusion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Strengthening statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weakening statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mimic the pattern</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Recruitment Essentials</th>
<th>7 hours</th>
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<tbody>
<tr>
<td><strong>Cracking interviews - demonstration through a few mocks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample mock interviews to demonstrate how to crack the:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• HR interview</td>
<td></td>
<td></td>
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<tr>
<td>• MR interview</td>
<td></td>
<td></td>
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<tr>
<td>• Technical interview</td>
<td></td>
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<tr>
<td><strong>Cracking other kinds of interviews</strong></td>
<td></td>
<td></td>
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<tr>
<td>• Skype/ Telephonic interviews</td>
<td></td>
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<tr>
<td>• Panel interviews</td>
<td></td>
<td></td>
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<tr>
<td>• Stress interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resume building – workshop</strong></td>
<td></td>
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<tr>
<td>A workshop to make students write an accurate resume</td>
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</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Problem-solving and Algorithmic skills</th>
<th>18 hours</th>
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</thead>
<tbody>
<tr>
<td>• Logical methods to solve problem statements in Programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Basic algorithms introduced</td>
<td></td>
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<tr>
<td><strong>Total Lecture hours:</strong></td>
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<td>45 hours</td>
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**Mode of Evaluation**: FAT, Assignments, Mock interviews, 3 Assessments with Term End FAT (Computer Based Test)

**Text Book(s):**

**Reference Book(s):**
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
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<th>C</th>
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<tr>
<td>STS 4022</td>
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Pre-requisite: None

Course Objectives:
- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject-related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:
- Clear Knowledge about problem-solving skills in JAVA concepts
- Students will be able to write codes in Java

Student Learning Outcomes(SLO):
- 7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)
- 18. Having critical thinking and innovative skills

Module: 1  **Collections**  12 hours

- ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set
- Programming questions based on collections
- Real-world problems based on data structure

Module: 2  **Threads, Exceptions, LinkedList, Arrays**  6 hours

- Need of threads
- Creating threads
- Wait
- Sleep
- Thread execution

- Need for exception handling
- try, catch, throw, throws
- Creating own exception (Java, Python)
- Handling own exceptions

- Solving programming questions based on linked list and arrays

Module: 3  **Stack and Queue, Trees**  7 hours

- Solving programming questions based on stacks and queues
- How to implement a stack using queue?
- How to implement a queue using stack?
- Solving programming questions based on trees, binary trees, binary search trees

Module: 4  **JDBC Connectivity, JDBC Data**  10 hours

- JDBC Overview
Database Setup
Install the MySQL Database
Create New Database User in MySQL Workbench
Selecting data from tables
Inserting Data into the Database
Updating Data in the Database
Deleting Data from the Database
Creating Prepared Statements

Module: 5 | Networking with Java | 10 hours
---|---|---
Working with URLs
Sending HTTP Requests
Processing JSON data using Java
Processing XML data using Java

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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Reference Books
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)
<table>
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<tr>
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<th>Syllabus version</th>
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**Course Objectives:**
- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject-related concepts
- To develop computational ability in Java programming language

**Expected Course Outcome:**
- Clear Knowledge about problem-solving skills in JAVA concepts
- Students will be able to write codes in Java

**Student Learning Outcomes (SLO):**
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)
18. Having critical thinking and innovative skills

**Module: 1**
**Object and Class, Data types**

8 hours

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object-based questions

Data types
Data
Why data type
Variables
Available data types
Numeric – int, float, double
Character – char, string
Solving MCQs based on typecasting, data types
Solving debugging based MCQs

**Module: 2**
**Basic I / O, Decision Making, Loop Control**

8 hours

Printing
Getting input from the user during run time
Command-line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making

Types of looping statements
Entry Controlled
For
While
Exit Controlled
do-while
break and continue
Demo on looping
Common mistakes with looping statements (like using; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

<table>
<thead>
<tr>
<th>Module:3</th>
<th>String, Date, Array</th>
<th>10 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>String handling, data handling</td>
<td>Solving problems based on arrays like searching, sorting, rearranging, iteration)</td>
<td>Multi-dimensional arrays</td>
</tr>
<tr>
<td>Solving pattern problems using 2D arrays</td>
<td>Real-time application based on 2D arrays</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Inheritance, Aggregation &amp; Associations</th>
<th>12 hours</th>
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</thead>
<tbody>
<tr>
<td>Need</td>
<td>Is A – Inheritance</td>
<td>Types of inheritance supported</td>
</tr>
<tr>
<td>Diagrammatic representation</td>
<td>Demo on inheritance</td>
<td>Has A – Aggregation</td>
</tr>
<tr>
<td>Diagrammatic representation</td>
<td>Demo on aggregation</td>
<td>Uses A - Association</td>
</tr>
<tr>
<td>Diagrammatic representation</td>
<td>Demo on association</td>
<td>Assignment on relationships</td>
</tr>
<tr>
<td>Solving MCQs based on relationships between classes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Modifiers, Interface &amp; Abstract classes (Java specific), Packages</th>
<th>7 hours</th>
</tr>
</thead>
</table>
Types of access specifiers  
Demo on access specifiers  
Assignment on access modifiers  
Instance Members  
Solving MCQs based on modifiers  

Abstract Classes  
Need  
Abstract Classes  
Abstract Methods  
Interfaces  
Assignment on abstract classes and interface  

Need for packages  
Access specifiers & packages  
Import classes from other packages  

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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</thead>
</table>

**Reference Books**

2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean  

**Mode of Evaluation:** FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)
PROGRAMME CORES
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
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<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>BIY1001</td>
<td>Biochemistry</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>v. 1.1</td>
</tr>
</tbody>
</table>

**Pre-requisite**: None

**Course Objectives:**
1. Demonstrate the structure and function of biomolecules
2. Outline different pathways involved in cellular metabolism
3. Relate inhibitors and activators of key metabolic reactions

**Expected Course Outcome:**
1. Compare and contrast the structural basis of biological macromolecules.
2. Analyze the chemical bonds of importance in carbohydrates, lipids, proteins, and nucleic acids.
3. Illustrate the catabolism and anabolism of carbohydrates
4. Summarize the energetics and regulation of metabolic pathways
5. Interpret experiments and techniques based on the significance of biomolecules.

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having interest in lifelong learning
18. Having critical thinking and innovative skills

**Module:1 Chemistry of Life**
5 hours
Elements of life, chemical bonding, covalent, ionic, and weak chemical bonds. Water and buffers. Properties of water-solubility, ionization, and water as a reactant.

**Module:2 Carbon the backbone of life**
5 hours
Organic molecules and the origin of life. Properties of living system-review on cellular, chemical, physical, the genetic, and evolutionary background to Biochemistry.

**Module:3 Fuel and building material**
7 hours
Proteins, Carbohydrates, and lipids. Classification, structure, and function. Energy by oxidizing organic molecules: Catabolic pathway-glycolysis, TCA cycle

**Module:4 Nucleotides structure and Biosynthesis of ATP**
7 hours
Different nucleotide structures. ATP as cellular currency. Substrate level, oxidative, and photophosphorylation. Amino acids from glycolysis, TCA intermediates by transamination. Gluconeogenesis, Pentose phosphate pathway. Anaerobic respiration. ATP as important currency in cells.

**Module:5 Amino Acids and their polymer proteins**
6 hours
Classification, structure, and biological importance of amino acids. Zwitter ion nature. Peptide bond formation-polypeptide chain

**Module:6 Proteins**
6 hours
Structure, Classification and biological function, protein structure and function relationships concerning fibrous proteins such as keratin, collagen, silk fibroin and globular proteins such as hemoglobin and myoglobin, insulin, Protein denaturation
### Module: 7  Lipids a diverse group of hydrophobic molecules. Fatty acids.

**Lipids**
- Classification, structure, properties, function, and metabolism of fatty acids.
- Classification, structure, properties, and biological function of Simple lipids – triacylglycerol and waxes.
- Compound lipids- phospholipids and glycolipids.
- Cholesterol- structure, properties, and importance.
- Eicosanoids

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues: Lectures by experts</th>
<th>2 hours</th>
</tr>
</thead>
</table>

**Total Lecture hours:** 45 hours

### Text Book(s)


### Reference Books


### Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory practices in biochemistry and reagent preparation -% solution, molar solution, and saturated solution.</td>
<td>2 hours</td>
</tr>
<tr>
<td>Preparation of buffers and pH change</td>
<td>2 hours</td>
</tr>
<tr>
<td>Carbohydrates from biological sources fruits, sugarcane, corn, and milk.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Quantitative analysis of reducing sugars.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Use of Formal titration method to estimate glycine amino acid.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Colorimetric analysis of amino acids arginine, cysteine, histidine, tryptophan, and tyrosine.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Acid-Base titration of amino acids</td>
<td>2 hours</td>
</tr>
<tr>
<td>Spectroscopic estimation of nucleic acids</td>
<td>2 hours</td>
</tr>
<tr>
<td>Fatty acids- chromatographic separation</td>
<td>4 hours</td>
</tr>
<tr>
<td>Revisions</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours** 30 hours

### Mode of evaluation:

- Recommended by Board of Studies: 03-08-2017
- Approved by Academic Council: No. 46 Date 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>BIY1002</td>
<td>Cell Biology</td>
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<td>0</td>
<td>2</td>
<td>0</td>
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</tbody>
</table>

**Pre-requisite**: None

**Syllabus version**: v. 1.1

**Course Objectives:**
1. Develop a basic understanding of the unit of life that is cell
2. Relate the organization and function of different cell organelles
3. Extend the knowledge earned from the course

**Expected Course Outcome:**
1. Recall critical concepts, facts, and theories relevant to biological sciences
2. Correlate the functions of different organelles of the cell
3. Examine contemporary issues in related fields
4. Interpret data presented in pictorial or numerical form
5. Perceive recent developments in the field
6. Able to apply scientific knowledge to address the nature problems.

**Student Learning Outcomes (SLO):**

2. Having a clear understanding of the subject related concepts and contemporary issues
9. Having an interest in lifelong learning
18. Having critical thinking and innovative skills

**Module: 1**  The fundamental unit of life - Cell  5 hours

- Cell theory, diversity, and commonality of cells and evolutionary relations between organisms.
- Structure of prokaryotic and eukaryotic cells; plant and animal cells.

**Module: 2**  Cell structure and functions  9 hours

- Biomembrane: lipid and protein constituents, cytoskeleton, cell wall, nucleus, mitochondria, chloroplast, endoplasmic reticulum, Golgi apparatus, peroxisome, vacuole, lysosome, ribosome, centrosome, and glyoxisome.

**Module: 3**  The life cycle of cells  6 hours

- Cell division in prokaryotes and eukaryotes, mitosis and meiosis, and regulation of cell cycle by mitogens, cyclins, and Cdns. Apoptosis in multicellular organisms.

**Module: 4**  Transport across cell membranes  7 hours

- Osmosis, endocytosis, exocytosis, passive diffusion, uniporters, symporters, antiporters, gated and non-gated ion channels, and ATP pumps.

**Module: 5**  Cell signaling  5 hours

- Primary and secondary signaling molecules. Autocrine, paracrine, and endocrine signal. Signal amplification, each with one example.
### Module: 6 | Signal transduction pathways | 6 hours

Introduction to major signaling pathways. G-protein coupled signal transduction pathway involving cAMP, cGMP, IP₃, DAG, and Ca²⁺ as second messengers.

### Module: 7 | Cell motility and integration | 5 hours

Module content


### Module: 8 | Contemporary issues: Lectures by experts | 2 hours

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


**Authors, book title, year of publication, edition number, press, place**

**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

1. Principles and handling of microscopes. | 2 hours
2. Studying the diversity of cells using permanent slides. | 2 hours
3. Differentiating plant cells from animal cells using a basic, acidic, and a combination stain. | 4 hours
4. Subjecting cells to different pH, concentrations, and analyzing the structural changes occurring due to osmosis. | 4 hours
5. Imaging and visualization of sub-cellular organelles using a fluorescent microscope. | 4 hours
6. Fractionation of nucleus and mitochondria from cauliflower cells and visualization using methyl green pyronin under a bright-field microscope of 400x magnification. | 4 hours
7. Enumerating and finding out whether RBCs/WBCs are in the optimal range | 2 hours
8. Growing root tips of different plants and comparing the chromosome number by fixing at the metaphase stage.

9. Comparison of various stages of Meiosis I and Meiosis II during microsporogenesis of *Rheodiscolor*.

10. Revisions

<table>
<thead>
<tr>
<th>Description</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Growing root tips of different plants</td>
<td>2</td>
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<tr>
<td>Comparison of various stages of Meiosis I and Meiosis II</td>
<td>4</td>
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<tr>
<td>Revisions</td>
<td>2</td>
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<td>Total Laboratory Hours</td>
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Mode of evaluation: Continuous assessment and Final assessment test.

Recommended by Board of Studies: 03-08-2017

Approved by Academic Council: No. 46 Date: 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
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<th>P</th>
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<td>BIY1003</td>
<td>Biodiversity and Conservation Biology</td>
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<td>4</td>
<td>3</td>
<td>v. 1</td>
</tr>
</tbody>
</table>

**Pre-requisite:** None

**Course Objectives:**
1. Demonstrate the concepts and values of biodiversity
2. Analyze the ways to protect the habitat
3. Formulate scientific intervention tools for conservation

**Expected Course Outcome:**
1. Illustrate the values of biodiversity
2. Summarize the genetic diversity and factors causing loss of genetic diversity
3. Demonstrate methods involved in species inventory and its richness.
4. Classify ecosystem types of the world and how to manage biodiversity.
5. Examine the process of evolution and various factors that govern a population.
6. Build possible measures to overcome species extension and loss of ecosystem.

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having interest in lifelong learning

**Module: 1 Introduction to Biodiversity**
- 4 hours
- Biodiversity Scope and its constraints, causes for diversity, quantifying biodiversity, Maintenance of ecological biodiversity, Uses and Values of Biodiversity.

**Module: 2 Genetic diversity**
- 4 hours

**Module: 3 Species diversity**
- 4 hours
- Species inventory, problems in inventorying species, monitoring, the total number of species of microbes, plants, and animals. Origin in species diversity, species richness, species abundance, toxic diversity, future of species diversity studies

**Module: 4 Ecosystem diversity**
- 4 hours
- Classification of the ecosystem, measuring ecosystem diversity, major ecosystem types of the world, agro ecosystem-, diversity of domesticated species-land races, advanced cultivars, wild relatives of cultivated plants, wild plants, urban and peri-urban diversity, loss of ecosystem diversity

**Module: 5 Evolutionary Genetics in a natural population**
- 4 hours
- Factors controlling the evolution of population, selection, and adaptation, Migration and gene flow, low genetic diversity in threatened species, mutation and selection balance

**Module: 6 Loss of Biodiversity**
- 4 hours
- Factors causing loss of biodiversity (Habitat degradation & loss, Overexploitation, Biological invasions, Climate change) Loss of agro, ecosystem, and species. The fate of endangered species
<table>
<thead>
<tr>
<th>Module:7</th>
<th><strong>Conservation Biodiversity</strong></th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Why conserve biodiversity? Ecological economics &amp; nature conservation, Conservation of genetic and methodologies, species and ecosystem</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th><strong>Contemporary issues:</strong> Lectures by industrial experts</th>
<th>2 hours</th>
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</thead>
</table>

| **Total Lecture hours:** | 30 hours |

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
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</table>

Pre-requisite: None

Syllabus version: v. 1

**Course Objectives:**
- 1. Recall basic concepts in molecular genetics
- 2. Dissect classical experiments to understand gene transfer
- 3. Choose the correct experimental model organism

**Expected Course Outcome:**
- 1. Explain genetic inheritance through historical experiments
- 2. Discuss chromosome organization and sex determination
- 3. Relate genetic makeup of different organisms
- 4. Distinguish factors that alter allele frequencies under exemptions
- 5. Relationship between mutation and evolution
- 6. Demonstrate the metabolic pathway and to utilize it for improvement of the human race.

**Student Learning Outcomes (SLO):**
- 2. Having a clear understanding of the subject related concepts and contemporary issues
- 10. Having a clear understanding of professional and ethical responsibility
- 11. Having an interest in lifelong learning

<table>
<thead>
<tr>
<th>Module:</th>
<th>Course title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Principles of Inheritance</strong></td>
<td>4</td>
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<tr>
<td></td>
<td>Mendelian laws, Post Mendelian inheritance –</td>
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<tr>
<td></td>
<td>Codominance; Incomplete dominance; Epistasis;</td>
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<tr>
<td></td>
<td>Lethal Genes; Multiple alleles, Linkage,</td>
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<tr>
<td></td>
<td>Crossing over and chromosomal mapping.</td>
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</tr>
<tr>
<td>2</td>
<td><strong>Chromosomes structure and sex determination</strong></td>
<td>4</td>
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<td></td>
<td>Prokaryotic and eukaryotic chromosome</td>
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<td>structure, variations in structure and</td>
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<td>number. Giant chromosomes - sex determination</td>
<td>in</td>
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<td>plants and animals, dosage compensation.</td>
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<td></td>
<td>Sex chromosomes and sex-linked inheritance,</td>
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<td>Extrachromosomal inheritance.</td>
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<td>3</td>
<td><strong>Model systems to study genetics</strong></td>
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<tr>
<td></td>
<td>Bacteriophage, E. coli, Neurospora crassa,</td>
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<td></td>
<td>yeast, Arabidopsis, maize, Drosophila, C.</td>
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<tr>
<td></td>
<td>elegans, Zebra fish, Homo sapiens</td>
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<td>4</td>
<td><strong>Forces that change allele Frequencies</strong></td>
<td>4</td>
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<tr>
<td></td>
<td>Hardy – Weinberg law and its applications,</td>
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<td></td>
<td>Factors affecting allele frequencies,</td>
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<tr>
<td></td>
<td>selection, mutation, migration and genetic</td>
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<td>drift, inbreeding and outbreeding,</td>
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<td>Quantitative Genetics, C-value.</td>
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<td><strong>Mutation</strong></td>
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<td>Spontaneous and Induced mutations, and its</td>
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<td>role in evolution, Radiation injury and DNA</td>
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<td>repair mechanisms, Relationship between</td>
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<td>Mutations and Phenotypes, genetic toxicity</td>
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<td>6</td>
<td><strong>Biochemical Genetics</strong></td>
<td>4</td>
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<tr>
<td></td>
<td>Biochemical Genetics</td>
<td></td>
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</tbody>
</table>
Altered pathway of phenylalanine and tyrosine metabolism in humans, Eye pigmentation pathways of Drosophila melanogaster

**Module: 7** | **Eugenics and euthenics** | 4 hours
---|---|---

Studies of twins, genetic disorders, Prenatal diagnosis with special emphasize on amniocentesis and chorionic villus sampling, artificial insemination, genetic counseling

**Module: 8** | **Contemporary issues:** Lectures by experts | 2 hours
---|---|---

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<tr>
<td><strong>Total Lecture hours:</strong></td>
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**Text Book(s)**


**Reference Books**


**‘J’ component:** Experiments

**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**Recommended by Board of Studies** | 03-08-2017
---|---
**Approved by Academic Council** | No. 46 | Date | 24-08-2017
<table>
<thead>
<tr>
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<th>Course title</th>
<th>L</th>
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<th>P</th>
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<thead>
<tr>
<th>Pre-requisite</th>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>None</td>
<td>v. 1.1</td>
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</table>

### Course Objectives:
1. Recall necessary information related to all microorganisms in general
2. Elaborate on laboratory safety and specialized microbiological laboratory skills
3. Apply the knowledge gained towards research, diagnostic, and therapeutic purposes

### Expected Course Outcome:
1. Demonstrates the structure, diversity, classification, and application of microorganisms
2. Compare the ubiquitous nature of microorganisms and their ecological niches
3. Outline the theoretical basis of the tools, technologies, and methods common to microbiology
4. Illustrate problem-solving skills and other concepts in microbiology
5. Relate the role of microbes in the fields of medicine and biotechnology
6. Utilize various research or internship activities in the field of microbiology

### Student Learning Outcomes (SLO):
- 2. Having a clear understanding of the subject related concepts and of contemporary issues
- 10. Having a clear understanding of professional and ethical responsibility
- 11. Having an interest in lifelong learning

### Module: 1 Introduction
4 hours
Scope and branches of Microbiology, The Historical Foundations of Microbiology, General Characteristics of Microorganisms, Taxonomy: Naming, Classifying, and Identifying Microorganisms. Importance of Bergey’s classification

### Module: 2 Methods of studying Microorganism
4 hours
Microscopes (light microscope, phase contrast microscope, dark ground microscope, fluorescent microscope, and electron microscope). Staining methods and identification of Bacteria. Different culture methods, techniques of pure culture and preservation of cultures

### Module: 3 Microbial Nutrition, transport and Growth
4 hours
Classification based on the nutritional requirements. Microbial growth, techniques of Measurement of growth, and enumeration. Factors affecting growth, growth curve

### Module: 4 Microbial Metabolism
4 hours

### Module: 5 Antimicrobial therapy
4 hours
Principles of antimicrobial therapy, Antimicrobial agents, tests for antimicrobial agents. Antimicrobial drug resistance and acquisitions

### Module: 6 Control of Microbial Growth
4 hours

Controlling microorganism growth by Physical and Chemical agents.

**Module:7  |  Microbes in infectious disease | 4 hours**

Normal Flora, Infection, and Methods of Transmission, Microbial Pathogenicity. Lab diagnosis (Sample collection, processing, and reporting)

**Module:8  |  Contemporary issues: Industrial expert lecture | 2 hours**

**Total Lecture hours:** 30 hours

**Text Book(s)**


**Reference Books**


**Project: ‘J’ component**

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

1. Different methods to sterilization 2 hours
2. Staining: Simple staining, differential staining, Capsule staining, Spore staining, acid-fast staining, and Lacto phenol cotton blue (LPCB). 4 hours
3. Microbial specific media preparation: Solid and liquid media 2 hours
4. Techniques to culture microbes on solid media: Pour plate, Spread plate, Streak plate, and Dilution techniques. 6 hours
5. Biochemical test for identification of bacteria: Catalase test, Oxidase test, Urease test, IMViC test, LAO test, Gelatin liquefaction test, Starch degradation test, Carbohydrate fermentation. 6 hours
6. Isolation of antibiotics producing microorganisms from soil 4 hours
7. Kirby-Bauer method of antibiotic susceptibility test 4 hours
8. Growth curve 2 hours

**Total Laboratory Hours** 30 hours

Mode of evaluation: CAT / Assignments / FAT / Quiz

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24-08-2017
## Course Objectives:
1. Define all the anatomical and medical terminologies in the field
2. Relate the functions of different organ systems in the human body
3. Examine the physiological basis for human diseases and identify treatment

## Expected Course Outcome:
1. Infer the various medical terminologies and discuss with health professionals
2. Outline the functions of different blood cell types
3. Evaluate the functions of the digestive and excretory systems
4. Compare the functions of the male and female reproductive systems
5. Discuss the mechanics of respiratory and cardiovascular systems
6. Explain the basics of the brain and the nervous system

## Student Learning Outcomes (SLO):
1. Having a clear understanding of the subject related concepts and contemporary issues
2. Having interest in lifelong learning

## Module: 1 Introduction
5 hours

Introduction to human anatomy and physiology. Anatomical and medical terminology. Osteology, joints, and muscle cells. Body fluids and homeostasis

## Module: 2 Blood and its components
6 hours


## Module: 3 Digestive and excretory system
7 hours

Organs of the digestive system. Salivary secretion, gastric secretion, and pancreatic secretion. Bile secretion and functions of bile. Absorption of food substances. Movements of the digestive tract. Structure and function of excretory organs such as kidney, skin, and liver.

## Module: 4 Endocrine and reproductive systems
7 hours


## Module: 5 Respiratory system
6 hours


## Module: 6 Cardiovascular system
6 hours

Structure of heart and blood vessels. Conducting system of the heart and electrocardiogram. Factors are maintaining arterial blood pressure. Regulation of arterial blood pressure.

<table>
<thead>
<tr>
<th>Module</th>
<th>Nervous system</th>
<th>6 hours</th>
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<table>
<thead>
<tr>
<th>Module</th>
<th>Contemporary issues: Lectures form industry/Hospital</th>
<th>2 hours</th>
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**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
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<td>2</td>
<td>0</td>
<td>4</td>
<td>v. 1</td>
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</tbody>
</table>

**Course Objectives:**
1. Illustrate the molecular concepts of life.
2. Explain the organization and functions of DNA, RNA, and proteins
3. Demonstrate the regulation of various biological processes

**Expected Course Outcome:**
1. Recall key concepts, facts, and theories relevant to biological macromolecules
2. Outline the contemporary issues in related fields
3. Correlate the different steps in the translation of genetic information.
4. Apply the knowledge gained to address various problems
5. Perceive recent developments in the field
6. Interpret biological data presented in pictorial or numerical forms

**Student Learning Outcomes (SLO):**  2, 11, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having interest in lifelong learning
18. Having critical thinking and innovative skills

**Module:1**  Genome organization  6 hours

Molecular Biology – An Overview – Structure of DNA - denaturation, and renaturation of DNA - Genome organization in prokaryotes and eukaryotes - DNA packaging in nucleosome - chromatin and chromosome.

**Module:2**  Genetic Material / Replication enzymes  6 hours


**Module:3**  DNA Replication  6 hours


**Module:4**  RNA and Transcription  6 hours

RNA structure, types of RNA, RNA polymerases, transcription in prokaryotes-initiation and elongation, promoters, termination of transcription. Eukaryotic promoters.

**Module:5**  Post Transcriptional process  6 hours

Distinction between pro and eukaryotic transcription. Post-transcriptional processing and modifications of RNA -mRNA, t-RNA, and r-RNA, reverse transcription.

**Module:6**  Translation  6 hours

Module: 7  Post Translational Modification  7 hours

Module: 8  Contemporary issues: Lecture by industrial experts  2 hours

Total Lecture hours: 45 hours

Text Book(s)

Reference Books

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)
1. Learning Molarity, normality, and molality by preparing various buffers used in the molecular biology lab  4 hrs
2. Understanding differences in the absorption of light by DNA, RNA, and protein by using a spectrophotometer  6 hrs
3. Measuring absorption of DNA at different temperatures and understanding the theory behind the melting curve  2 hrs
4. Learning how to separate DNA and RNA molecules by using agarose gel electrophoresis  4 hrs
5. Understanding the role played by different reagents in isolating genomic DNA from plants  2 hrs
6. Isolation and classification of RNA by separating on agarose gel electrophoresis  4 hrs
7. Learning Beer Lambert’s law by performing protein estimation by Lowry’s method | 2 hrs
8. Separation of given proteins based on molecular weight by SDS-PAGE | 4 hrs
9. Western blotting (Demonstration) | 2 hrs

| Total Laboratory Hours | 30 hours |

Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.
Recommended by Board of Studies | 03-08-2017
Approved by Academic Council | No. 46 | Date | 24-08-2017
Course code: BIY1008
Course title: Research Methodology
Pre-requisite: None
Syllabus version: v. 1

Course Objectives:
1. Identify the essential components of research
2. Design the various strategies involved in experimental research
3. Recommend the importance of statistical analysis in research

Expected Course Outcome:
1. List the various modalities that are to be followed while conducting research
2. Compare the various methodologies that are available in higher education
3. Develop an understanding of ethical as well as safety aspects for good quality research
4. Analyze systematic methods for data collection, data processing, and data analysis
5. Evaluate statistical methods to assess the outcome of the research
6. Build various steps involved in the conduct of proper research

Student Learning Outcomes (SLO): 2, 3
2. Having a clear understanding of the subject related concepts and contemporary issues
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

Module: 1  What is Research Methodology  6 hours
Module content:

Module: 2  Research Methods Vs. Methodology  5 hours
Module content:
Library research, Field research, and laboratory research

Module: 3  Testing of Hypothesis and Lab design  6 hours
Module content:
Formulation of hypothesis, the concept of Null hypothesis. Testing the significance of the Null hypothesis. Lab design- Basic, containment.

Module: 4  Biosafety Guidelines  6 hours
Module content:
Microbiological risk assessment, Biosafety levels, laboratory animal facilities, guidelines for lab facility commissioning, certification, biosecurity, safety cabinets, Good microbial practices, biosafety and recombinant DNA technology, chemical, fire, and electrical safety, safety organization and training, safety for support staff, safety checklist

Module: 5  Data Collection  6 hours
Module content:
Sources of Data – Primary Data – Secondary Data - Procedure Questionnaire – Sampling Methods – Merits and Demerits – Experiments – Observation Method – Sampling Errors - Type-I Error & Type-II Error.

Module: 6  Statistical Analysis  6 hours
Module content


<table>
<thead>
<tr>
<th>Module:7</th>
<th>Research Reports</th>
<th>6 hours</th>
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Module content


Introduction To SPSS.

<table>
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<tr>
<th>Module:8</th>
<th>Research Methodology of the present and future: problems and perspectives</th>
<th>4 hours</th>
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<table>
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Text Book(s)


Reference Books

2. Statistical Methods by SP Gupta (2012)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Using and calibration of instruments generally used in the laboratory</td>
<td>2 hours</td>
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<tr>
<td>2.</td>
<td>Understanding the purpose of using different biosafety cabinets</td>
<td>2 hours</td>
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<tr>
<td>3.</td>
<td>Methods to dispose of microbial plates</td>
<td>2 hours</td>
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<tr>
<td>4.</td>
<td>Methods and place to store different chemicals</td>
<td>2 hours</td>
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<tr>
<td>5.</td>
<td>Understanding the differences between qualitative and quantitative research</td>
<td>2 hours</td>
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<td>6.</td>
<td>Purpose of using animals on research and ethics involved</td>
<td>2 hours</td>
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<tr>
<td>7.</td>
<td>Disposal methods for laboratory waste disposal</td>
<td>2 hours</td>
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<td>8.</td>
<td>Disposal methods for cell culture waste / sharp materials</td>
<td>2 hours</td>
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<tr>
<td>9.</td>
<td>Methods to dispose of the sharp waste</td>
<td>2 hours</td>
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<tr>
<td>10.</td>
<td>Different sterilization technique</td>
<td>2 hours</td>
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<tr>
<td>11.</td>
<td>Laboratory safety from chemical, fire, and electricity</td>
<td>2 hours</td>
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<tr>
<td>12.</td>
<td>Animal house rules and regulations</td>
<td>2 hours</td>
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<tr>
<td>13.</td>
<td>Importance of labeling and methods of labeling laboratory animals</td>
<td>2 hours</td>
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<tr>
<td>14.</td>
<td>Different chemicals used as disinfectants in Microbial spill and containment</td>
<td>2 hours</td>
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<tr>
<td>15.</td>
<td>Designing a laboratory ( Microbiology lab / Cell culture / Animal dissection / Plant culture lab / Biosafety lab III and IV )</td>
<td>2 hours</td>
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<tr>
<td>Total Laboratory Hours</td>
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<tr>
<td>BIY1009</td>
<td>Analytical Techniques</td>
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Pre-requisite: None
Syllabus version: v. 1

**Course Objectives:**
1. Demonstrate the principle and applications of various techniques in biotechnology
2. Analyze various samples using appropriate techniques
3. Utilize analytical instruments for biomolecular estimation

**Expected Course Outcome:**
1. List the various Good Laboratory Practices (GLPS)
2. Recall concepts related to solution preparation
3. Outline the principles of various analytical instruments
4. Summarize the role of instrumentation
5. Infer the applications of various analytical instruments
6. Demonstrate advanced analytical instruments to carry out an estimation of various biomolecules

**Student Learning Outcomes (SLO):** 2, 11, 13
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
13. Having cross-cultural competency exhibited by working in teams

**Module:1  GoodLab Practices**  

**Module:2  Biological Solutions**  
Types of the solution- molarity, percent solutions, buffers- Henderson hasselbach equation, types of buffers. Preparation of buffers, pH meter.

**Module:3  Advanced microscopy**  
Principle, construction, and working of Bright-field, SEM, and TEM – image formation, resolving power and magnification.

**Module:4  Chromatography**  
The principle, column, and planar chromatography. Classification based on separation mechanism. Applications.

**Module:5  Electrophoretic Techniques**  
Principle and working of Gel Electrophoresis, Pulse field, Zone, Isoelectric focussing, Capillary, Gel filtration, and Affinity.

**Module:6  Spectrophotometry**  
6 hours
Fluorometry, colorimetry, polarimetry, nephelometry, and turbidimetry - principle and applications. The absorption laws of spectrophotometry. Methods used in single-beam and double - beam spectrophotometry.

**Module:7   Radioisotope Techniques**  
Basics, GM and Scintillation counter, Medical, Agricultural and Industrial application  
| Module:8 | Contemporary issues: Lecture by industry experts | 2 hours |

**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Maintenance of Lab Notes and Records</td>
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<tr>
<td>Collection, storing and transport of different types of samples</td>
<td>2 hour</td>
</tr>
<tr>
<td>Buffer preparation</td>
<td>3 hour</td>
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<tr>
<td>pH measurement</td>
<td>1 hour</td>
</tr>
<tr>
<td>Calorimetry</td>
<td>3 hour</td>
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<tr>
<td>Estimation of BSA sodium using UV Spectrophotometer</td>
<td>2 hour</td>
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<tr>
<td>Estimation of BSA sodium using VIS Spectrophotometer</td>
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<tr>
<td>Conductivity Meter</td>
<td>3 hour</td>
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<tr>
<td>Estimation of sodium by Flame photometer</td>
<td>3 hour</td>
</tr>
<tr>
<td>Analysis of samples by HPLC</td>
<td>3 hour</td>
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<tr>
<td>Demonstration of IR Spectrophotometer</td>
<td>2 hour</td>
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<tr>
<td>Demonstration of SEM</td>
<td>2 hour</td>
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<td>Demonstration of TEM</td>
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**Pre-requisite**: BIY 1002

**Course Objectives:**
1. Recall the basics of immunology and facilitate the understanding of core immunology
2. Develop skills necessary for the critical analysis of contemporary literature on topics related to health and diseases.
3. Outline the molecular and cellular basis of the development and function of the immune system in states of health and disease.

**Expected Course Outcome:**
1. Describe the role of the immune cells in both maintaining health and contributing to disease.
2. Identifying the cellular and molecular basis of antigen processing and immune responses.
3. Distinguish and define the molecular basis of complex cellular processes involved in immune disorders.
4. Translate theoretical immunology into clinical decision-making and cancer diagnosis.
5. Effectively interpret underlying mechanisms of disease and therapeutic implications of vaccines.
6. Build a strong foundation for more advanced courses in immunology.

**Student Learning Outcomes (SLO):** 2, 11, 18

**Module:1** Introduction

Overview of the immune system, innate immunity, acquired immunity, cells, and organs of the immune system, antigens, structure of antigen, and its different types.

**Module:2** Immune cells

Biology of T and B lymphocytes, functions of T cells, and B cells. Antibodies, structure, types, and their functions. TCR structure. Antibody structure and types. Molecular basis of TCR and antibody diversity.

**Module:3** Defense strategies in immune system

Complement Pathways, biological consequences and deficiencies. Immune response: humoral immune response and cell mediated immune response.

**Module:4** MHC and immune system

Major Histocompatibility Complex, Class-I, II, and III, Antigen processing and presentation. Transplantation immunology

**Module:5** Immune related disorders

Immune tolerance, auto-immunity, autoimmune disorders, immunotherapy for autoimmune disorders, hypersensitivity reactions, types and treatment. AIDS.

**Module:6** Cancer and Immunology

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M.Sc Intg Biotechnology (5yr.)  
Page 102
Tumor immunology, Immunotherapy to tumors. Role of immune cells in preventing cancer and metastasis.

Module: 7  **Molecular basis of vaccination and techniques used in immunology**  8 hours


Module: 8  **Contemporary issues in Immunology**  2 hours

Lecture by Industrial experts

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


Authors, book title, year of publication, edition number, press, place

**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

| 1. Detection of antibody against pathogen from patient’s serum by slide agglutination | 3 hours |
| 2. Detection of blood group by Rh typing | 2 hours |
| 3. Antigen quantitation by Single Radial Immuno Diffusion (SRID) method | 4 hours |
| 4. Antibody Titration by Ouchterlony Double Diffusion | 4 hours |
| 5. Determination of IgM, IgG, and IgA in the given serum by Immunoelectrophoresis | 4 hours |
| 6. Detection of interaction between antigen and antibody by ELISA | 4 hours |
| 7. Visual differentiation of Blood cells with Wright’s stain | 2 hours |
| 8. Lymphatic system and organs of the immune system (demo only) | 3 hours |
| 9. Methods to raise antibodies in animals (Demo only) | 4 hours |

**Total Laboratory Hours 30 hours**

**Mode of evaluation:** Assignments, Continuous assessment tests and Final assessment test.
Recommended by Board of Studies | 03-08-2017
Approved by Academic Council | No. 46 | Date | 24-08-2017
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Pre-requisite: None

Syllabus version: v. 1

**Course Objectives:**
1. Relate basic laws of chemical engineering about the calculation for processes
2. Demonstrate knowledge on solving heat transfer, material and energy balances for chemical process systems
3. Interpret fluid mechanics to analyze the complexities involved in solving fluid flow problems and ideal reactors

**Expected Course Outcome:**
1. Choose problems related to units and conversions and fit given data using methodologies
2. Solve problems related to material and energy balance concepts and design reactors for biochemical processes
3. Illustrate the types and design of a heat exchanger
4. Utilize the knowledge gained on different types of flow and losses of flow in pipes
5. Select the right choice of pipes, valves, and pumps
6. Design ideal batch, mixed flow, and plug flow reactors

**Student Learning Outcomes (SLO):** | 2, 9, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
9. Having problem-solving ability - solving social issues and engineering problems
18. Having critical thinking and innovative skills

**Module 1: Dimensions and system of units** | 7 hours
Module content
Fundamental quantities, derived quantities and conversions - Basic chemical engineering calculations, Atomic, molecular and equivalent weights, molar concepts, concentration units for pure components, vapour pressures, moles, mixtures and solution, Molarity, normality and partial pressures, composition of mixtures and solutions, weight fraction, mole fraction, volumetric composition, partial pressures, density and specific gravity.

**Module 2: Gases** | 6 hours
Module content

**Module 3: Material Balance** | 6 hours
Module content
Law of conservation of mass, meaning of material balance and its applications, process flow sheet, drawing material balance on non reacting steady system, recycling, bypassing, material balance on steady-state reacting systems with recycling and bypassing.

**Module 4: Energy Balance** | 6 hours
Module content
Law conservation of Energy, the meaning of Energy balance and its importance inputs of energy balance, specific heat and sensible heat, Latent heat and heats of transition, sublimation, enthalpy of solutions, chemical reactions, conversion, yield, standard heats of reaction, Hess Law, Kirchoff’s Law
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Heat transfer</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, classification, performance, and application of types of the heat exchanger, Different methods of heat exchange, Design of Heat Exchanger, Estimation of heat exchange area</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Fluid Mechanics</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Module content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept of fluid, the behavior of Newtonian and non-Newtonian fluids, types of fluid flow, nature of the flow, Fluid head and manometry, the basic equation of fluid flow, continuity and Bernoulli’s equation, application Bernoulli’s equation, the concept of friction factor piping system and its components</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Pipes, Valves and Pumps and Ideal reactors</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factors and selection of pipe size, good piping system, types of valves, and fitting. Transportation devices, pumps, and their working. Design for homogeneous systems, Design equation for the Batch reactor, Stirred tank reactor, and tubular flow reactor.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Lecture by Industrial expert</th>
<th>2 hours</th>
</tr>
</thead>
</table>

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
<table>
<thead>
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<th>P</th>
<th>J</th>
<th>C</th>
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<tr>
<td>BIY1012</td>
<td>Bioinformatics</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
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</table>

Pre-requisite: None

Syllabus version: v. 1.1

**Course Objectives:**
1. Recall the basic practical techniques of bioinformatics
2. Extend the knowledge of bioinformatics and biological databases to solving real research problems
3. Formulate the use of a wide variety of tools, servers, biological databases and apply them in appropriate fields

**Expected Course Outcome:**
1. Choose knowledge of the basic principles of biology, computer science, and mathematics
2. Evaluate biological databases using bioinformatics algorithms
3. Build existing software effectively to extract information from large databases and apply the information in computer modeling
4. Assess problem-solving skills, including the ability to develop new algorithms and analysis methods
5. **Perceive knowledge about analyzing big datasets statistically and bioinformatically**
6. Improve skills in a professional environment via an industrial or academic internship in bioinformatics

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having interest in lifelong learning

**Module: 1 Important contributions**

Aims and tasks of Bioinformatics - applications of Bioinformatics - challenges, and opportunities

**Module: 2 Knowledge of various databases**

5 hours

Literature databases: PubMed, Nucleic acid sequence databases: GenBank, EMBL. Protein sequence databases: UniProt, PDB. Sequence submission databases – BankIt

**Module: 3 Sequence analysis**

4 hours

Various file formats for bio-molecular sequences: genbank, FASTA, GCG, nbrf-piret-Basic concepts of sequence similarity, identity and homology- Sequence-based Database Searches-BLAST and FASTA algorithms

**Module: 4 Sequence Alignment**

4 hours

Dot plot and Dynamic Programming - Local alignment smith waterman algorithm - and Global alignment - Needleman-Wunsch - (algorithm and example) –sequence formats

**Module: 5 Multiple sequence alignment**

3 hours

Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results– Clustal W algorithm - Feng Doolittle algorithm. Definition and description of phylogenetic trees and various types of trees
**Module: 6**  **Structural Bioinformatics**  **4 hours**

3D structure prediction – Homology modeling – folds recognition & Ab-initio methods.
Visualization of structures using SPDBViewer or PyMol.

**Module: 7**  **Pharma-informatics**  **4 hours**


**Module: 8**  **Contemporary issues:** Lecture by industrial experts  **2 hours**

---

**Total Lecture hours:**  **30 hours**

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nucleotide sequence from primary nucleotide database</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>2. Protein sequence from protein database</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>3. Protein structure from a structure database</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>4. Access of secondary biological data from various Biological database</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>5. Pairwise alignment using a dot plot</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>6. Pairwise alignment using dynamic programming</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>7. Heuristic Sequence Alignment using BLAST/ FASTA</td>
<td>4 Hrs</td>
</tr>
<tr>
<td>8. Multiple sequence alignment</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>9. Construction of Phylogenetic tree</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>10. Gene prediction analysis</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>11. Prediction of the secondary structure of the protein.</td>
<td>4 Hrs</td>
</tr>
<tr>
<td>12. Visualization of Protein Structure</td>
<td>4 Hrs</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours**  **30 hours**
Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.

<table>
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<th>03-08-2017</th>
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<tr>
<td>Approved by Academic Council</td>
<td>No. 46</td>
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<tr>
<td>Course code</td>
<td>Course title</td>
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<tr>
<td>-------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>BIY1013</td>
<td>Bio Resource Management</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>None</td>
</tr>
</tbody>
</table>

**Course Objectives:**
1. Explain the significance of biological wealth in day-to-day life
2. Illustrate the various approaches used for the management of biological resources
3. Justify the socio-economic issues involved with bio-resource management

**Expected Course Outcome:**
1. Recall knowledge on bio-resource management of various ecosystems
2. Develop theoretical expertise in socio-economy of biodiversity and biotechnology
3. Integrate the knowledge of various disciplines of sciences
4. Assess the economic values of flora and fauna in the environment
5. Create knowledge on the loss and cause of biodiversity
6. Formulate the management of various socio-economic dimensions in the environment

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
11. Having interest in lifelong learning
18. Having critical thinking and innovative skills

**Module:1 Natural resources and human population**
4 hours
- Bioresource – Plant and Animal: Aquatic and terrestrial, Natural resources and human populations
- Genetics resources, human resources – biosystematics, productivity, and working practices.

**Module:2 Ecological Values, Economic value**
4 hours
- Species, habitats, and ecosystem, poverty, cultural values, ethics, and equity. Living plant (produce) collections, botanical gardens, zoo and aquaria, marine stations.

**Module:3 Biodiversity loss, causes of Biodiversity loss**
4 hours
- Biological Resources – rules, property rights, and intellectual resource rights; Fair and Equitable benefits sharing. Legal measures – traditional, national, and international laws.

**Module:4 Sustainable use of biodiversity**
4 hours
- Biodiversity information management -data collection, tools and techniques, Protected Area Network (PAN), Measures for conservation and sustainable use of biodiversity in natural resource management; Biodiversity and Biotechnology – sustainable use of bioresources.

**Module:5 Socio-economic Dimensions of Environmental Management**
4 hours
- Population explosion and social factors are affecting development. Impact of development on the environment - changing patterns of land use, land reclamation, deforestation, resource depletion, pollution, and environmental degradation.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Socio-economic Dimensions of Environmental Management</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Managing biodiversity, protecting and restoring ecosystems, ecofeminism, socio-economic strategies – ecotourism, community management, Eco-technology –industry, reuse, and recycle.</td>
<td></td>
</tr>
<tr>
<td>Module:7</td>
<td>Biotechnological approaches in bio-resource Management</td>
<td>5 hours</td>
</tr>
<tr>
<td></td>
<td>Afforestation, Biotechnological methods of bioresource management building capacity for management.</td>
<td></td>
</tr>
<tr>
<td>Module:8</td>
<td>Contemporary issues: lecture by industrial expert</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>Project: ‘J’ Component</td>
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<tr>
<td></td>
<td>Total Lecture hours: 30 hours</td>
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</table>

Text Book(s)

Reference Books

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24-08-2017
Course code | BIY1014 | Course title | Bio Business & IPR | L | T | P | J | C |
---|---|---|---|---|---|---|---|---|
Pre-requisite | None | Syllabus version | v..1 |

Course Objectives:
1. Interpret the various terminologies involved in bio business
2. Develop cGMP, cGLP skills and become aware of the importance of business models
3. Estimate the possibilities of IP rights and the various ways of securing national and international protection

Expected Course Outcome:
1. Identify the origin of bio business and the current scenario
2. Evaluate the various sectors of bio business
3. Determine different types of business models viz. product, subscription and integrated
4. Adopt international standards and certifications for cGMP and cGLP
5. Perceive the role of IPR in bio business
6. Utilize IP rights in business effectively
7. Decide on patenting procedures, types and filing

Student Learning Outcomes (SLO): 2, 10, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
18. Having critical thinking and innovative skills

Module: 1 Fundamentals of Bio business: Hours 6

Module 2 Overview of Bio business in various sectors Hours 5
Healthcare, Industrial life-Sciences, Agriculture and Agri-biotechnology, Environment and Environmental Biotechnology.

Module:3 Business Models in Bio business- Hours 6
Product Based-Service Based-Subscription Based-Integrated Models.

Module:4 BestPractices Hours 6
Current Good Manufacturing Practices (cGMP), Current Good Laboratory Practices (cGLP).

Module:5 IPR Hours 8
### Module: 6 | IPR Rights

Rights conferred by different types of intellectual property; interpreting the rights conferred by a patent; the patent-granting system, Patent trends.

**Hours 6**

### Module: 7 | Applications forms and procedures

Patent costs and values; and the post-grant processes for enforcing, Safeguarding IPR.

**Hours 6**

### Module: 8 | Recent updates

Group Project Presentation: Case studies of different business models and IPR, eg. Biocon is protecting cancer medicine.

**Hours 2**

### Total Lecture hours

**Hours 45**

### Text Book(s)


### Reference Books

- Project : ‘J’ component
  
  **Mode: Use of technology in teaching, lecture by industry**

  **Mode of Evaluation: Written Examination, Projects, and assignments**

  Recommended by Board of Studies | 03-08-2017

  Approved by Academic Council | No. 46 Date 24-08-2017
<table>
<thead>
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<th>C</th>
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<tr>
<td>BIY2001</td>
<td>Microbial Genetics</td>
<td>3</td>
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</table>

**Pre-requisite:** None

<table>
<thead>
<tr>
<th>Syllabus version</th>
<th>v. 1</th>
</tr>
</thead>
</table>

**Course Objectives:**
1. Outline the regulation of gene expression
2. Explain the importance of mutations
3. Illustrate chromosome inheritance pattern

**Expected Course Outcome:**
1. Recall key concepts about the organization of genes and the process of replication
2. Compare different methods of gene transfer and their related mechanisms
3. Discuss the basis of mutations and gene arrangements
4. Summarize DNA repair mechanisms
5. Elaborate on gene recombination processes

**Student Learning Outcomes (SLO):**
- 2, 11
- 11. Having interest in lifelong learning

<table>
<thead>
<tr>
<th>Module</th>
<th>Organization of Genes and Replication</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>Introduction to genetics. Eukaryotic, Prokaryotic, and Viral Genome and their replication. Pathogenicity island</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Gene Transfer and Mechanism</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>Lateral and Horizontal gene transfer. Conjugation, Transformation, and Transduction (Generalized transduction and specialized transduction) Transformation and &amp; its mechanism. Griffith experiment.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Mutation and Gene arrangement</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>Classes of mutations, spontaneous and induced mutation, mutagens, Reversion and suppression mutations, Ames test. Genetic characterization of mutants.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>DNA repair</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>DNA damage and causative agents. The mechanism that reverse, excise, or tolerate DNA repair.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Genetic Recombination</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>Homologous Recombination, enzymes, and models (Double-stranded invasion model and Meselson and Radding model). Site-specific recombination (Bacteriophage lambda). Short sequence recombination</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Transposition</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td>Transposons, structure, types and mechanism</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Bacteriophage and Natural Plasmids</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module content</td>
<td></td>
<td></td>
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</tbody>
</table>
Bacteriophage structure, lifecycle (lytic and non-lytic cycle), superinfection, Restriction, and modification of DNA. Plasmid types, replication, copy number, incompatibility, and amplification. Genes carried by plasmids.

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues:</th>
<th>6 hours</th>
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<tbody>
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<table>
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<td></td>
<td></td>
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</table>

**Text Book(s)**

1. Chaudhuri K (2012) Microbial Genetics The Energy and Resources Institute, TERI

**Reference Books**


**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**Recommended by Board of Studies**

03-08-2017

**Approved by Academic Council**

No. 46  Date  24-08-2017
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<td>BIY2002</td>
<td>Genetic Engineering</td>
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<td>BIY1007</td>
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</table>

**Course Objectives:**
1. Recall different DNA modifying enzymes used in recombinant DNA technology
2. Compare different vectors and their applications in recombinant DNA technology
3. Illustrate different techniques used in genetic engineering

**Expected Course Outcome:**
1. Choose from different DNA modifying enzymes to modify given DNA as per requirement
2. Design different vectors for cloning and expression of genes in various expression systems
3. Apply appropriate techniques to research in various fields of biotechnology
4. Evaluate different strategies for cloning of gene from various cDNA libraries
5. List the risks associated with genetic engineering experiments
6. Modify genes for higher yield of biotechnology-derived products

**Student Learning Outcomes (SLO):** 2, 11, 18

2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having interest in lifelong learning
18. Having critical thinking and innovative skills

**Module: 1  Enzymes used in genetic engineering**  
6 hours
- Polymerases, ligases, E. coli, alkaline phosphatase, polynucleotide kinases, terminal transferases.
- Endonucleases with special reference to restriction enzymes; properties, creation of sticky and blunt ends, restriction digestion, double digestion, restriction mapping, star activity, Isoschizomers, neoschizomers. Linkers and adapters.

**Module: 2  Vectors for gene cloning**  
6 hours
- Plasmids, Bacteriophage; λ phage and M13 phage, hybrid vectors; cosmids and phagemids.
- Vectors for eukaryotic cell; yeast vector, chromosomal vector; BAC, YAC, Ti and Ri vectors, Baculovirus vectors. Advantages and disadvantages of these vectors one over the other, with examples.

**Module: 3  Methods to locate gene in the genome and modifying cloned genes**  
7 hours
- Transposon tagging, chromosome walking, and chromosome jumping. Site-directed mutagenesis, deletion mutants, and fusion proteins.

**Module: 4  Nucleic acid hybridization**  
5 hours
- Southern and Northern blotting; procedure and application.

**Module: 5  Methods for gene cloning from the genome of prokaryotes and eukaryotes**  
6 hours
- Genomic DNA library screening, cDNA library screening. PCR and RT-PCR.

**Module: 6  Introduction of a foreign gene into**  
6 hours
<table>
<thead>
<tr>
<th>Organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods for gene transfer in bacteria, yeast, plant, and animal cells — selection markers used for the selection of recombinants from non-recombinants.</td>
</tr>
</tbody>
</table>

**Module: 7 | Gene expression and regulation | 6 hours**

Features of expression vectors, constitutive, inducible, and tissue-specific promoters. Regulation of gene expression with the example of lac and trp promoters.

**Module: 8 | Contemporary issues: Lecture by industrial experts | 3 hours**

**Total Lecture hours: 45 hours**

**Text Book(s)**


**Reference Books**

1. Somnath De (2016) Basic Concept of Recombinant DNA Technology Createspace Independent Publications India

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preparation of competent cells (BL-21).</td>
<td>4 hours</td>
</tr>
<tr>
<td>2.</td>
<td>Transformation of BL-21 competent cells with pGEX 4T-1 vector.</td>
<td>4 hours</td>
</tr>
<tr>
<td>3.</td>
<td>IPTG induction of BL-21 cells containing pGEX 4T – 1 and isolation of proteins from control and induced cells.</td>
<td>4 hours</td>
</tr>
<tr>
<td>4.</td>
<td>Analysis of the protein profile of 3rd experiment on SDS-PAGE</td>
<td>4 hours</td>
</tr>
<tr>
<td>5.</td>
<td>Purification of GST protein from whole cell lysate obtained from 3rd experiment</td>
<td>4 hours</td>
</tr>
<tr>
<td>6.</td>
<td>Cloning of the PCR product in TA cloning vector – transformation in DH5 α bacteria.</td>
<td>4 hours</td>
</tr>
<tr>
<td>7.</td>
<td>Screening for recombinant plasmid for experiment 6 by i) colony PCR ii) Restriction digestion.</td>
<td>4 hours</td>
</tr>
</tbody>
</table>

Total Laboratory Hours 30 hours

Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.

Recommended by Board of Studies 03-08-2017

Approved by Academic Council No. 46 Date 24-08-2017
<table>
<thead>
<tr>
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<td>BIY2003</td>
<td>Bioprocess Principles</td>
<td>3</td>
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<td>0</td>
<td>0</td>
<td>3</td>
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</table>

Pre-requisite: None

Syllabus version: v. 1.1

Course Objectives:
1. Summarize the basics of different types of fermentors
2. Recall the basics of sterilization procedures and metabolic stoichiometry
3. Demonstrate the growth kinetics, production kinetics, and inhibition models.

Expected Course Outcome:
1. Design appropriate bioreactor configurations and operation modes based upon the nature of bioproducts
2. Evaluate model required for the microbial growth and can design own batch thermal sterilization
3. Formulate medium using various kinetics for maximum production of metabolites and biocatalyst for commercial applications
4. Model the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes
5. Choose better yield using gene manipulation of microorganisms and integrate research lab and industry
6. Identify problems and seek practical solutions for large scale implementation of biotechnology

Student Learning Outcomes (SLO): 2, 9

2. Having a clear understanding of the subject related concepts and contemporary issues
9. Having problem-solving ability solving social issues and engineering problems

Module: 1 Overview of Fermentation Processes
6 hours
The fermentation process and its development, general requirements of fermentation processes. Factors affecting fermentation

Module: 2 Fermentor and its types
6 hours
The basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Different types of fermentor with example

Module: 3 Medium and Sterilization
5 hours
Thermal death kinetics of microorganisms, batch and continuous heat, sterilization of liquid media, filter sterilization of liquid media, Air, Design of sterilization equipment

Module: 4 Metabolic Stoichiometry
6 hours
Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation

Module: 5 Energetics
7 hours
Maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption, and heat evolution in aerobic cultures, the thermodynamic efficiency of growth.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Kinetics of microbial growth and product formation</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phases of cell growth in batch cultures, Monod model, Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudeking-Piret models</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>title</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Substrate and product inhibition on cell growth and product formation. Gene manipulation of microorganisms for better yield with examples.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Inhibition Models</th>
<th>2 hours</th>
</tr>
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</table>

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


Recommended by Board of Studies | 03-08-2017
Approved by Academic Council | No.46 | Date | 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>BIY 2009</td>
<td>Genomics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>v. 1.1</td>
</tr>
</tbody>
</table>

**Pre-requisite:** BIY1012

**Course Objectives:**
1. Build a foundation in the fundamental principles of genomics
2. Compare different methods available to study DNA and RNA sequence analyses
3. Apply genomic data to provide new insights in the fields of biology and medicines

**Expected Course Outcome:**
1. Improve the knowledge and skills to differentiate recent advances in genome complexities between eukaryotic and prokaryotic genomes and their database.
2. Summarize current updates on genome sequencing technologies to appreciate the differences between these technologies and illustrate the pros and cons of each method.
3. Analyze information relating to Human Genome Project towards ELSI, with GWAS, SNP and miRNA techniques using specific databases and bioinformatics tools.
4. Design and evaluate expression profiling using different methods such as microarray acquisition and analysis and tag-based profile analysis.
5. Extend the concept of pharmacogenomics and toxicogenomics towards personalized medicine.
6. Formulate the concept, methods, and application of metagenomics in phylogeny and novel gene identification.

**Student Learning Outcomes (SLO):**

2. Having a clear understanding of the subject related concepts and contemporary issues
8. Having Virtual Collaborating ability
10. Having a clear understanding of professional and ethical responsibility

**Module: 1 | Genome structure and organization | 6 hours**
Genomes-Prokaryotes, Eukaryotes, Organelles (Mitochondria, Chloroplast), Overview of Genome organization. Various genome databases and their uses.

**Module: 2 | NGS Sequencing platforms and principles | 7 hours**
SOLiD™ Applied Biosystems, GS-FLX-Roche, Ion-Torrent-Thermo Fisher, and Illumina Solexa

**Module: 3 | The story of the Human Genome | 7 hours**
Genome Mapping, Goals and Benefits of HGP, Drawback and ELSI issues, HapMap, GWAS, Micro RNA sequences

**Module: 4 | Techniques in Comparative Genomics | 7 hours**
Traditional and global analysis of RNA expression: spotted DNA arrays, printed oligonucleotide chips – data acquisition and analysis – SAGE, MPSS, DDrTPCR, expression profiling in human diseases

**Module: 5 | Pharmacogenomics | 6 hours**
Concepts and Tools in Pharmacogenomics, Pharmacogenetics Vs. Pharmacogenomics; Understanding drug responses, Gene-disease association; the concept of Personalized Medicine.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Metagenomics</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept, Methods, and Techniques, Metagenome projects and applications</td>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Ethical issues in the classification of the human genome</th>
<th>4 hours</th>
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<tbody>
<tr>
<td>Ethical issues and Genetic Discrimination: Genetic Information Non discrimination Act 2007</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Lecture by industrial experts</th>
<th>2 hours</th>
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<table>
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<tr>
<th>Total Lecture hours:</th>
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**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
Course code: BIY2011  Course title: Proteomics  
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<tbody>
<tr>
<td>3</td>
<td>0</td>
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<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: None

Syllabus version: v. 2.1

Course Objectives:
1. Describe the basics in the field of proteomics
2. Classify various techniques that are used in the study of proteomics
3. Illustrate the biological importance of protein-protein interaction, modeling and protein database, and their clinical relevance

Expected Course Outcome:
1. Recall the basics of proteomics
2. Utilize various techniques in protein separations
3. Choose different methods to identify proteins
4. Explain the importance of protein-protein interactions

Student Learning Outcomes (SLO): 2, 20
2. Having a clear understanding of the subject related concepts and contemporary issues
20. Having a good digital footprint

Module: 1  Overview of Proteomics  4 hours
Proteomics – Introduction, Applications in scientific research, Proteomics in post-genomic era, Human proteome draft

Module: 2  Protein Separation Techniques  8 hours
Proteomics experimental workflow, Basics of protein separation-Centrifugation, Ultrafiltration, Chromatography - GC-MS, LCMS, Electrophoresis – 1-D, 2-D, and DIGE

Module: 3  Protein Identification Techniques  8 hours
Introduction to Mass spectrometry, Experimental design, Sample preparation, Quantitative and qualitative proteomics by mass spectrometry - Basics, ionization techniques and mass analyzers, electrospray ionization (ESI) and matrix adsorption laser dissociation ionization (MALDI) and triple quadrupole (QQQ), SELDI, Peptide mass fingerprinting, Protein Microarray, protein sequencing, FRET analysis, NMR, X-ray crystallography. Analysis of post-translational modifications - Phosphorylation, ubiquitination, acetylation nitration, glycosylation, Sumoylation etc.

Module: 4  Protein-protein/Protein-DNA Interaction Studies  6 hours
Mapping of protein interactions using mass spectrometry-based approaches (ICAT, ITRAQ, SILAC approaches) Yeast Two-Hybrid, Phase Display. Protein-DNA interactions- Identification of ligand-receptor pairing and transcriptional regulators.

Module: 5  Protein Modeling  6 hours
Steps in homology modeling, tools, databases, side-chain modeling, loop modeling. Predicting Protein Structures by Threading using related soft wares
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Clinical Proteomics</th>
<th>5 hours</th>
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</thead>
<tbody>
<tr>
<td>Proteomics in the study of diseases, Storage transportation and processing of clinical samples, Proteomic analysis of body fluids, IHC, Western Blotting</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>title</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Uniprot-KB: SWISS-PROT, TrEMBL, UniParc; Structure Databases: PDB, NDB, PubChem, ChemBank</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Lecture by industrial experts</th>
<th>2 hours</th>
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</thead>
</table>

**Total Lecture hours: 45 hours**

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies** 03-08-2017
**Approved by Academic Council** No.46 Date 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>BIY3001</th>
<th>Course title</th>
<th>Downstream Processing</th>
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<tbody>
<tr>
<td>Pre-requisite</td>
<td>Bioprocess Principles</td>
<td></td>
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<tr>
<td>Syllabus version</td>
<td>v. 1</td>
<td></td>
<td></td>
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<tr>
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</tbody>
</table>

**Course Objectives:**
1. Utilize the unique properties of proteins to separate them from each other
2. Demonstrate the importance of protein purification techniques
3. Assess different stages and techniques involved in protein purification and polishing

**Expected Course Outcome:**
1. Summarize the basic concepts of protein structure
2. Examine the methods to track a protein of interest during different stages of purification
3. Decide upon the type of technique to break the cell and purify the required analyte
4. Apply different enrichment techniques for protein concentration
5. Compare different chromatography technique used for protein purification
6. Develop methods for product polishing and assess different types of vectors available for expression and purification of recombinant proteins

**Student Learning Outcomes (SLO): 2,18**
18. Having critical thinking and innovative skills

**Module: 1**
**Role of Downstream Processing in Biotechnology**
- 5 hours
- Role and importance of downstream processing in biotechnological processes. Economics of downstream processing in Biotechnology. Importance of obtaining pure biological products. Advantages of obtaining biologically relevant compounds through biological method over chemical method.

**Module: 2**
**Overview of purification of Bio-molecules**
- 6 hours
- Basics related to protein structure and purification strategies. Characteristics of biological mixtures. Qualitative and Quantitative assays for protein detection and quantification through different stages of protein purification.

**Module: 3**
**Terminologies used in biological samples purification**
- 6 hours
- Enzyme activity, specific activity, enzyme unit, chiral carbon, plane-polarized light, Absorption, Absorption maximum, enantiomers, optical activity, and viscosity.

**Module: 4**
**Cell lysis methods, separation of solids and liquids**
- 6 hours

**Module: 5**
**Enrichment operations**
- 7 hours
- Precipitation methods (with salts, organic solvents and polymers). Extractive separations: Solvent extraction, Aqueous two phase extraction, Reverse micelle extraction, supercritical...
extraction. Membrane-based separations: Porous and dense membrane separations, Dialysis, Reverse osmosis, Ultrafiltration, Electrodialysis, Pervaporation, Gas permeation, Liquid membranes.

**Module:6  Product Resolution**  
7 hours

Chromatographic principles: distribution coefficients, retention parameters, qualitative and quantitative aspects of chromatography, column efficiency, selectivity and resolution, Gel permeation chromatography, Ion exchange chromatography, Reverse Phase Chromatography, Affinity chromatography. Adsorption chromatography, HPLC

**Module:7  Product polishing and advanced methods for protein purification**  
6 hours

Crystallization, Drying, and product formulation, Lyophilization. Vectors designed for protein purification.

**Module:8  Contemporary issues:** Lecture by industrial experts  
2 hours

**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


Mode of Evaluation: Written examinations, assignments, and quizzes.

**List of Challenging Experiments (Indicative)**

1. Protein estimation  
2. Cell lysis followed by protein estimation  
3. Precipitation of proteins (ammonium sulfate)  
4. Precipitation of proteins (Acetone)  
5. Aqueous two-phase extraction  
6. Reverse micelle extraction  
7. Size Exclusion Chromatography  
8. Affinity chromatography  
9. Dialysis  
10. Crystallization  
11. HPLC (Demonstration)  
12. Fraction collector used in chromatography (Demonstration)  
13. Lyophilization (Demonstration)  

**Total Laboratory Hours** 30 hours
Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.

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PROGRAMME ELECTIVES
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<tbody>
<tr>
<td>BIY1015</td>
<td>Environmental Health</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>v. 1</td>
</tr>
</tbody>
</table>

**Pre-requisite** None

**Course Objectives:**
1. Describe genetic, physiologic and psychosocial factors that affect susceptibility to adverse health outcomes following exposure to environmental hazards
2. Identify current environmental health issues and environmental contaminants
3. Evaluate methods of collection, treatment, disposal, and recycling of solid waste and describe the health hazards associated with improper management of these wastes

**Expected Course Outcome:**
1. Outline the physical, chemical, and biological hazards associated with water pollution, as well as the importance of water quality related to contamination, protection, and monitoring of water supplies
2. Distinguish between health risks associated with indoor and outdoor air pollutions and methods of hazard control
3. Explain the significant sources and types of environmental agents
4. List the transport and fate of these agents in the environment
5. Classify the carriers or vectors that promote the transfer of these agents from the environment to the human
6. Analyze the interaction of agents with biological systems and the mechanisms by which they exert adverse health effects.

**Student Learning Outcomes (SLO):** 2,9,10,18

2. Having a clear understanding of the subject related concepts and contemporary issues
9. Having problem-solving ability - solving social issues and engineering problems
10. Having a clear understanding of professional and ethical responsibility
18. Having critical thinking and innovative skills

**Module:1  Emerging global environmental health Issues** 4 hours
Municipal waste - Industrial waste - Hazardous waste - Air and water pollution.

**Module:2  Environmental issues in Human** 4 hours
Biomarkers and risk analysis - Mutagenesis and carcinogenesis - Chromosomal analysis - Congenital anomalies - Congenital disabilities and infertility.

**Module:3  Environmental Toxicology** 4 hours
Classification of toxicants in the environment - Factors affecting toxicity – Mutagenesis – Teratogenesis - Carcinogens – Hallucinogens - Phytoxins and animal toxins.

**Module:4  Toxicity transformation** 4 hours
Absorption and distribution of toxicants in animal body; Biotransformation of toxicants; Antidotes treatment and detoxification of toxicants; Bio-accumulation.

**Module:5  Environmental Quality Assessment and Monitoring** 4 hours
Definition for environmental quality – Deterioration and assessment of environmental quality - Matrix method and system diagram technique.

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Environmental Impact Assessment</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Environmental Impact Assessment techniques - Adhoc method - Checklist method - Overlay mapping method - Network method - Simulation and modeling technique - Merits and Demerits of EIA studies.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Survey studies</th>
<th>4 hours</th>
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<tbody>
<tr>
<td></td>
<td>Short term studies/surveys - Rapid assessment - Continuous short and long term monitoring.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues- Lecture by industry experts</th>
<th>2 hours</th>
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<table>
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<tr>
<th>Total Lecture hours:</th>
<th>30 hours</th>
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Text Book(s)

Reference Books

Project: ‘J’ component

Mode of Evaluation: CAT / Assignments / FAT

Recommended by Board of Studies 03-08-2017
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<table>
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<tr>
<th>Course code</th>
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<tbody>
<tr>
<td>BIY1016</td>
<td>Behavioral Science</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
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</tr>
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</table>

**Pre-requisite**
None

**Course Objectives:**
1. Interpret the behavior of individuals with society
2. Deduce how communication changes behavioral patterns
3. Relate interrelationship with society

**Expected Course Outcome:**
1. Choose from different methods available to study human behavior
2. Explain how modern communication network is changing human behavior
3. Summarize various body activities controlled by the human brain such as processing, integrating, and coordinating the information it receives from the sense organs and making decisions as to the instructions sent to the rest of the body
4. Demonstrate that the outcome of repeated conscious effort becomes a habit and how it needs enough practice to become a habit
5. Infer behavioral activities explored by various applied disciplines that are practiced in the context of everyday life for counseling
6. Perceive communication as a fundamental life process that is necessary as individuals and to our relationships, groups, organizations, cultures, and societies

**Student Learning Outcomes (SLO):**
1. 2
2. 10
3. 18

**Module: 1 Behavior Sciences study methods and societal role**

Introduction, Methods of studying Behavior Science, Scope, Experimental and non-experimental approaches of research

**Module: 2 Evolution of Human Behavior**

Chronobiological, Comparison of traditional lifestyle and modern lifestyle. Electronic Gadgets, Social networks affecting behaviors, Netoholic, Whatsapp…..etc

**Module: 3 Brain, Sensory organs and Intelligence**

Brain- parts of the brain, the role of each part. The conscious and subconscious mind. Role of the nervous system and endocrine system in behavior. Sensory process (Vision, auditory, touch, taste, vestibular and kinesthesia); Perception; Cognition (Concepts, language and thought, problem-solving and decision – making); Intelligence ( Characteristics, assessment, the role of creativity)

**Module: 4 Habit-forming & Personality Development**

Learning and memory (Principles, types and effective methods); Individual development across the life span; Psychological disorders (Types – moods, anxiety, depression, suicide); Overview of therapies
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Application of Behavioral Sciences</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counseling, Conflict Resolution, Crisis Intervention, Eugenics, Dealing with Special Kids</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Communication and Human Behavior</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Behavioural Emotional and Social Difficulties (BESD), SLCN, Language, Culture, and Cognition, Linguistic Relativity of Thought, A Post-Whorfiian Approach, Body movement, and interpersonal communication, Gesture and posture</td>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Social concepts</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social perceptions; social influences; social relationships; the dynamic interplay of culture and society.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>4 hours</th>
</tr>
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<tbody>
<tr>
<td>Lecture by industrial expert</td>
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**Total Lecture hours:** 30 hours

**Text Book(s)**


**Reference Books**


**Project: ‘J’ Component**

**Mode of Evaluation:** CAT / Assignments / FAT

**Recommended by Board of Studies:** 03-08-2017

**Approved by Academic Council:** No. 46 Date 24-08-2017
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<td>BIY1017</td>
<td>Pharmaceutical Biotechnology</td>
<td>3</td>
<td>0</td>
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</tbody>
</table>

Pre-requisite: None

Course Objectives:
1. Outline the importance of fundamental and conceptual aspects of pharmacological sciences
2. Illustrate the mechanistic aspects of specific categories of drugs including manufacturing and quality control issues
3. Elaborate upon the mechanistic aspects of other drug categories and extend knowledge in Biopharmaceuticals

Expected Course Outcome:
1. Recall the essential aspects of pharmacokinetics/pharmacodynamics and solve pharmacokinetics and pharmacodynamics-related problems
2. Classify different drugs based on the mechanism of action and improve fundamental comprehension
3. Discuss manufacturing and quality control issues and develop competencies relevant to the Pharmaceutical Industry
4. Outline the importance of developing biopharmaceuticals in the future
5. Build on the necessary knowledge and be able to demonstrate the ability to recall the salient aspects of clinical trials and regulatory issues

Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning

Module:1 Overview
Development of drugs, Pharmacodynamics - Antagonists, and Agonists

Module:2 Pharmacokinetics
Pharmacokinetics – Absorption, Distribution, Metabolism, and Excretion. Routes of drug administration, Prodrugs

Module:3 General Pharmacology
Antacids, Antiseptics, NSAIDs, Local Anesthetics, Pharmacotherapy of cough, and peptic ulcer.

Module:4 Oral Dosage Forms
Manufacturing, quality control and packaging requirements of tablets, capsules, and solutions

Module:5 Parenteral and Topical Dosage Forms
Manufacturing, quality control and packaging requirements of parenteral, ointments, aerosols, and modified dosage forms

Module:6 Biologics
Monoclonal antibodies, rDNA drugs, Therapeutic proteins, Hormones, Immunobiologicals,
## Course Content

### Module: 7  Clinical Trials and Regulatory Affairs  
6 hours

Phases, Design, ICH GCP, FDA Regulations, Indian Drug Regulations. Regulatory aspects of pharmaceutical and bulk drug manufacturers.

### Module: 8  Contemporary topics  
2 hours

Lecture by industrial experts.

| Total Lecture hours: | 45 hours |

### Text Book(s)


### Reference Books


### Mode of Evaluation:
CAT / Assignment / FAT

### Recommended by Board of Studies  
03-08-2017

### Approved by Academic Council  
No. 46  
Date 24-08-2017
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</table>

**Pre-requisite**: None

**Course Objectives:**
1. Recall knowledge on medium formulation and strain improvement for enhanced production of bioproducts
2. Develop fundamental knowledge to explore microbes for the production of industrially relevant primary and secondary metabolites
3. Extend knowledge on the industrial method of fermentation processes for the production of bioproducts

**Expected Course Outcome:**
1. Outline process-flow sheeting for the industrial fermentation processes
2. Demonstrate the methods of cell culture under various conditions, formulate and optimize media and apply strain improvement to enhance the production
3. Apply the knowledge of kinetics for microbial growth and product formation
4. Choose from the production processes for primary and secondary metabolite
5. Explain the production of commercially critical recombinant proteins

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data
18. Having critical thinking and innovative skills

**Module: 1 Introduction to industrial bioprocess**

A historical overview of industrial fermentation processes and products. Outline of the various unit operation involved in an integrated bioprocesses; process flow-sheeting; a brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology

**Module: 2 Fermentation process**

Isolation, preservation, and improvement of industrial micro-organisms for overproduction of primary and secondary metabolites: medium requirements for fermentation process-carbon, nitrogen, minerals, vitamins, and other nutrients-examples of complex media.

**Module: 3 Kinetics of Microbial growth and Product formation**


**Module: 4 Production of primary metabolites**

Commercially essential organic acids (e.g. Citric acid, itanicoic acid, acetic acid, glucanoic acid, etc). Aminoacids (glutamic acid, lysine, aspartic acid, phenylalnineetc). Alcohols (ethanol, 2, 3, butanediol
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Production of secondary metabolites</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The concept of biocatalysis- Importance of microbial products over chemically synthesized products – ill effects of chemicals - Bacterial pigments – prodigiosin – violacein and deoxyviolacein - fungal monascin - bacterial and algal carotenoids – astaxanthin – production and application</td>
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<table>
<thead>
<tr>
<th>Module:6</th>
<th>Production of commercially important enzymes</th>
<th>4 hours</th>
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<tbody>
<tr>
<td></td>
<td>Proteases, amylases, lipases, cellulases, pectinases, isomerases, and other commercially essential enzymes for the food and pharmaceutical industries.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Production of commercially important recombinant proteins</th>
<th>4 hours</th>
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<tr>
<th>Module:8</th>
<th>Contemporary topics</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lecture by Industrial experts</td>
<td></td>
</tr>
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</table>

| Total Lecture hours: | 30 hours |

**Text Book(s)**


**Reference Books**


**Mode of Evaluation: CAT / Assignments / FAT**

**Project: ‘J’ component**

<p>| Recommended by Board of Studies | 03-08-2017 |
| Approved by Academic Council | No. 46 | Date | 24-08-2017 |</p>
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
<th>Syllabus version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIY1019</td>
<td>Nanobiotechnology</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>v. 1</td>
</tr>
</tbody>
</table>

**Pre-requisite**: None

**Course Objectives:**
1. Recall the basics of nanotechnology
2. Explain potential applications of nanobiotechnology
3. Compare existing and new concepts, methodologies and research results and apply them in an academic or industrial research environment

**Expected Course Outcome:**
1. Appraise students about basic concepts and theories of the subject
2. Demonstrate the applications of analytical techniques in examining nanostructures/particles
3. Illustrate the scope of biomacromolecules in nanotechnology
4. Explain the potential of nanobiotechnology in consumer applications and diagnostics
5. Create a necessary foundation for training in research
6. Infer the importance of risk assessment in the usage of nanostructures/particles in various applications

**Student Learning Outcomes (SLO):**
- 2, 10, 14

- 2. Having a clear understanding of the subject related concepts and contemporary issues
- 10. Having a clear understanding of professional and ethical responsibility
- 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module: 1**  
**The science of nano-bio interface**  
3 hours

History and development of nanobiotechnology; Structure-property relationships.

**Module 2**  
**Types of biologically relevant nanomaterials**  
4 hours

Self-assembly as in proteins, lipids, and nucleic acids; Polymeric nanoparticles; Inorganic nanoparticles- quantum dots, silica-based nanostructures; metallic nanoparticles like silver and gold; nanotubes, nanowires, and nanofibers.

**Module: 3**  
**Synthesis and production**  
4 hours

Physical, Chemical, and Biological means of synthesis; Biomimetic approaches of production: case studies- ferritins, silica in diatoms, FeNPs in magnetosomes; Merits and demerits of bio-based approaches.

**Module: 4**  
**Characterization of nanomaterial**  
4 hours

Optical techniques like UV-Vis and fluorescence spectroscopy; FTIR spectroscopy; electron microscopy (TEM and SEM); Atomic Force Microscopy, dynamic light scattering, zeta potential measurement, XRD (with emphasis on how these techniques to aid in characterizing nanoparticles).

**Module: 5**  
**Functional nanomaterials for biological applications**  
5 hours
Strategies for chemical and biological functionalization; Applications in tissue engineering & regenerative medicine.

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Nanoparticles in biological labelling and cellular imaging</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanoparticles as a reporter: metallic nanoparticles and quantum dots in rapid diagnostics tools; FRET and Molecular Beacons; SPR and SERS-based imaging.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Biosafety and Potential risks of nanomaterials</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routes of exposure; Fate of nanoparticles- short and long term; Cellular interaction; environmental safety; Risk assessment and regulatory mechanisms.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary topics discussion: Lecture by industrial experts</th>
<th>2 hours</th>
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<tbody>
<tr>
<td>Project: “J” COMPONENT</td>
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<tr>
<td>Total Lecture hours:</td>
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</table>

Text Book(s)

Reference Books
2. Eddy G and Poinern J (2014) A Laboratory Course in Nanoscience and Nanotechnology by CRC Press

Authors, book title, year of publication, edition number, press, place

Mode of Evaluation: CAT / Assignments / FAT

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24-08-2017
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<th>J</th>
<th>C</th>
<th>Pre-requisite</th>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>BIY1020</td>
<td>Vaccinology</td>
<td>3</td>
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</table>

Course Objectives:
1. Demonstrate the concepts of vaccines and their mechanisms
2. Outline the up-to-date knowledge, skills and expertise on new and current vaccines and immunization programs
3. Examine the current and emerging challenges to immunization

Expected Course Outcome:
1. Recall the historical background of the most critical vaccines
2. Illustrate the immunological and epidemiological mechanisms of vaccine action
3. Summarize the infectious diseases and their vaccines
4. Distinguish the advantages and disadvantages of current vaccines
5. Examine the challenges in the development of new vaccines
6. Justify the use of current vaccines and reflect upon the challenges and opportunities of new vaccine strategies

Student Learning Outcomes (SLO): 2,5,11
2. Having a clear understanding of the subject related concepts and contemporary issues
5. Having design thinking capability
11. Having an interest in lifelong learning

Module: 1 Overview of Vaccination 5 hours
Concept of vaccines, vaccination against infectious disease, Immunization and eradicating infectious diseases; Effectiveness of vaccines: efficacy and safety

Module: 2 Vaccines and their types 6 hours
Classification of vaccines: conventional vaccines-inactivated or killed vaccines and live attenuated vaccines, recombinant vaccines against viral diseases; Viral and recombinant vaccine production, adjuvant in vaccine and their development

Module: 3 DNA Vaccines 6 hours
DNA Vaccines and induction of immunity, factors influencing the immune response after genetic vaccination-method of plasmid delivery, a dose of injected DNA

Module: 4 Chimeric DNA Vaccines 6 hours
Antigenic form of the expressed protein, cocktail DNA vaccines and co-stimulatory molecules, immuno-stimulating sequences

Module: 5 Novel Genetic vaccines 6 hours
Multigene vaccines, Suicidal DNA Vaccine, DISC virus vaccines, Expression library immunization

Module: 6 Marker vaccines and edible vaccines 6 hours
Pseudorabies virus DIVA vaccines, classical swine fever virus DIVA vaccines, bovine viral...
diarrhea virus (BVDV) DIIA vaccines, DIVA vaccines in disease eradication and prospects for human DIVA vaccines. Edible vaccines vis-à-vis mucosal and systematic immunity, working principles of edible vaccines, current status of edible vaccines for infectious diseases, issues of concern in developing a feasible edible vaccine.

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>IAP – Immunization</th>
<th>5 hours</th>
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<tbody>
<tr>
<td></td>
<td>Immunization, Indian Academy of Pediatrics – Recommendations, Guidelines, Immunization schedule</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues:</th>
<th>5 hours</th>
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<tbody>
<tr>
<td></td>
<td>Hospital/Industry expert lectures</td>
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**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Assignments / FAT

**Recommended by Board of Studies** 03-08-2017
**Approved by Academic Council** No.46 24-08-2017
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<td>BIY1021</td>
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<td>v. 1</td>
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</table>

**Pre-requisite**: None

**Course Objectives:**
1. Relate epidemiology and biostatistics in disease control and the improvement of human health
2. Demonstrate a basic understanding of epidemiologic methods and study design
3. Combine appropriate epidemiological concepts and statistical methods

**Expected Course Outcome:**
1. Summarize the use of epidemiology in the evaluation of screening process
2. Analyze the impact of epidemiology on national and local policies
3. Describe the influence of epidemiology on ethical and professional issues
4. Outline the epidemiology of infectious and non-infectious diseases, problem-solving skills and other concepts
5. Evaluate study design, bias, errors and causal inference in epidemiologic studies
6. Choose disciplines in research or internship activities in the field of epidemiology

**Student Learning Outcomes (SLO):** 2, 10, 18
- 2. Having a clear understanding of the subject related concepts and contemporary issues
- 10. Having a clear understanding of professional and ethical responsibility
- 18. Having critical thinking and innovative skills

**Module: 1 | What is epidemiology? | 5 hours**
Pioneers in epidemiology. The nature and scope of biological, social, and ecological science and of epidemiological variables and outcomes. Epidemiology is a science and practice. Concepts of Disease and health problem: interdependence of clinical medicine and epidemiology

**Module: 2 | Study Design | 5 hours**
Incidence studies (Incidence studies / Incidence case-control studies) Prevalence studies (Prevalence studies / Prevalence case-control studies) complex study designs (Other axes of classification/ Continuous outcome measures / Ecologic and multilevel studies)

**Module: 3 | Study Design Issues | 5 hours**
Precision (Basic statistics / Sample size calculation and power) Validity (Confounding/ Selection bias /information bias) Effect modification (Concepts of interaction/ Additive and multiplicative models/ Joint effects)

**Module: 4 | Conducting a Study | 5 hours**
Measurement of exposure and health status (Exposure/Health status) Cohort studies (Defining the source / population and risk period/Measuring exposure/Follow-up) Case-control studies (Defining the source population and risk period/Selection of cases/Selection of controls/Measuring exposure) Prevalence studies (Defining the source / population/ Measuring health status/ Measuring exposure)
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Analysis and interpretation of studies</th>
<th>5 hours</th>
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<tbody>
<tr>
<td></td>
<td>Data analysis (Basic principles/Basic analyses/Controlling for Confounding) Interpretation (Appraisal of a single study/ Appraisal of all of the available evidence) Meta-analysis.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Epidemiology of communicable disease and prevention</th>
<th>2 hours</th>
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<tbody>
<tr>
<td></td>
<td>Influenza, Tuberculosis, Ebola. Vaccines and therapeutics.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Epidemiology of non-communicable disease and prevention</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coronary heart disease, diabetes and lung cancer. Vaccines and therapeutics.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary topics</th>
<th>1 hours</th>
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</thead>
</table>

| Total Lecture hours: | 30 hours |

**Text Book(s)**


**Reference Books**


Authors, book title, year of publication, edition number, press, place

**Project : “J” component**

Mode of Evaluation: CAT / Assignments / FAT

Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.

Recommended by Board of Studies | 24-08-2017
Approved by Academic Council | No. 46 Date 24-08-2017
Course code | Course title
---|---
BIY1022 | Nutraceuticals

Pre-requisite | None

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</table>

Course Objectives:
1. Explain the nutraceutical constituents in different foods and their role in human health
2. Demonstrate the health benefits of functional foods
3. Illustrate the technologies and processing procedures used to extract functional ingredients from a natural source

Expected Course Outcome:
1. Outline the basis of various phytochemical compounds in maintaining normal physiological function
2. Build awareness about the latest investigations on nutraceutical and functional food components
3. Identify the different sources of nutraceuticals, their extraction methods, and their metabolism
4. Discover various food products that are used as nutraceuticals in making functional foods
5. Relate the role of various nutraceuticals in combating major health problems such as diabetes, obesity, cardiovascular diseases, cancer, and osteoporosis
6. Extend the safety and efficacy of functional foods and regulatory issues

Student Learning Outcomes (SLO): 2, 11, 14
11. Having an interest in lifelong learning
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

Module: 1 Introduction to nutraceuticals and functional foods
Definition, the concept of nutraceuticals, classification of nutraceuticals, dietary supplements, fortified foods, functional foods, scope involved in the industry- Indian and global scenario.

Module: 2 Importance of nutraceuticals
The food pyramid, nutritional assessment, recommended dietary intake, glycemic index, basal metabolic rate, nutraceuticals in fruits, vegetables and grains with health benefits, nutraceuticals about sports and exercise.

Module: 3 Extraction, analysis, physiology, processing of nutraceuticals
Nutraceutical extraction and isolation; nutraceutical analysis; absorption, disposition, metabolism, and elimination of nutraceuticals.

Module: 4 Nutraceuticals of plant and animal origin
Phytochemicals as nutraceuticals- sources and applications in preventive medicine; animal metabolites- sources and applications in preventive medicine; protein and peptide-based nutraceuticals, lipid-based nutraceuticals.

VIT
Vellore Institute of Technology
(Deduced to be University under section 3 of UGC Act, 1956)
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Microbial and marine nutraceuticals</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept, applications of prebiotics and probiotics as nutraceutical agents, microbial nutraceuticals and their applications, marine nutraceuticals and their applications.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Nutraceuticals in disease prevention</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutraceuticals for- cardiovascular health, HIV and cancer risk reduction, bone and joint health, diabetes, hypertension, hypercholesterolemia, immune system, oxidative stress, cognitive function, anti-aging, maternal and infant health, gut health, reproductive health.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Marketing, regulation, health claims, clinical trials</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of safety and efficacy of functional foods and ingredients, regulatory issues and health claims, use of animal models, and pre-clinical and clinical trials involved.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary topics: Lecture by experts</th>
<th>3 hours</th>
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</table>

<table>
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<th>Total Lecture hours:</th>
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**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Assignments / FAT

**Recommended by Board of Studies**

03-08-2017

**Approved by Academic Council**

No. 46 | Date | 24-08-2017
Course code | BIY1023 | Course title | Nutrition and Health | L | T | P | J | C
--- | --- | --- | --- | --- | --- | --- | --- | ---
Pre-requisite | None | Syllabus version | v. 1

Course Objectives:
1. Outline an overview on general aspects of nutrition, health, and food intake
2. Identify different types of foods, nutritive values, and nutritional disorders
3. Relate the assessment of nutrition status based on different criteria/indices

Expected Course Outcome:
1. Recall the influence of food on human health
2. Identify different types of functional foods
3. Summarize the metabolism of various food types
4. Formulate healthy diets to prevent lifestyle diseases
5. Construct a balanced diet based on the knowledge gained from the course

Student Learning Outcomes (SLO): 2,11,12
11. Having an interest in lifelong learning
12. Having adaptive thinking and adaptability

Module: 1 | Introduction to health | 4 hours
Importance and value of health; Dimensions involved- physical, cognitive, cultural, and environmental.

Module: 2 | Food Choices | 4 hours
Food sources- cereals, pulses, vegetables, fruits, confectionery, meat, egg, seafood, dairy, and beverages. Case Study- Evaluating information from various sources- media, supermarkets, internet

Module: 3 | Nutrients Vs. Health | 4 hours
Categories of nutrients- carbohydrates, proteins, lipids, vitamins, minerals, and bioactive components; Process of digestion and absorption; factors influencing the process. Case Study- Effect of processing on the nutrients

Module: 4 | Food to fuel | 4 hours
Extraction of energy from nutrients; biosynthesis, and storage of nutrients. Case Study- energy turn over during fasting and feasting

Module: 5 | Fluids and health | 4 hours
Importance of electrolyte balance; sources of electrolytes. Case study- Delicate balance between water and electrolytes.

Module: 6 | Complementary nutrition | 4 hours
Dietary supplements; functional foods; alternative medicines and health. Case study- Symbiotic role in health.

<table>
<thead>
<tr>
<th>Module:7</th>
<th><strong>Assessment of nutritional status</strong></th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anthropometric measurements, biochemical tests, molecular markers, clinical observations, dietary assessment, others- personal family history, socio-economic, occupational conditions. Case study-facts and fallacies involved in obesity assessment</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th><strong>Contemporary issues:</strong></th>
<th>2 hours</th>
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<tbody>
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<td>Lecture by industrial experts</td>
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| Total Lecture hours: | 30 hours |

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<th><strong>Text Book(s)</strong></th>
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<table>
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<th><strong>Reference Books</strong></th>
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Mode of Evaluation: CAT / AssignmentS / FAT /

Recommended by Board of Studies 03-08-2017

Approved by Academic Council No. 46 Date 24-08-2017
**Course code**: BIY1024  
**Course title**: Computational Biochemistry and Biomedicine  
**Pre-requisite**: None  
**L T P J C**: 3 0 0 0 3  
**Module: 1**  
**The computing of Physical principles**: 6 hours  
Significant biotransformation reactions in a biological system, Energy contribution and distance of non-covalent interactions in biomolecules, computation of intra-molecular and inter-molecular interactions  
**Module 2**  
**Biomolecular Interaction I**: 6 hours  
Binding of Oxygen to heme, Mechanism of Allosteric change, Protein-Carbohydrate Interaction-Mechanism of Lysozyme action, Mechanism, and Regulation of Multienzyme complex.  
**Module: 3**  
**Biomolecular Interaction II**: 6 hours  
Protein-Protein and Protein- Nucleic Acid Interaction: Mechanism of chymotrypsin action, DNA Ligase action, Intron-Splicing mechanism.  
**Module: 4**  
**Discovering Biomolecular Mechanisms**: 6 hours  
Deriving Biological Function of Genome Information with sequence and structure Analysis-Reliable and Specific Protein Function Prediction by Combining Homology with Genomic(s) context - Clues from Three-Dimensional Structure Analysis and Molecular Modeling - Prediction of Protein Function, Obtaining, viewing and analyzing structural data.  
**Module: 5**  
**Biochemistry and Medicine**: 6 hours  
The major cause of the diseases, Metabolic basis of disease –An aberration of lipid metabolism -

**Course Objectives:**
1. Outline the modern computational methods for handling bio-molecules  
2. Demonstrate the principle of Biomolecular interactions and their respective mechanism  
3. Solve some biochemical problems using computer-assisted methods

**Expected Course Outcome:**
1. Outline significant biotransformation reactions and the applications of computer technology in biochemistry  
2. Explain the underlying mechanism of biomolecular interactions, as well as protein-carbohydrate interactions  
3. Demonstrate the mechanism of protein-protein interactions and protein-nucleic acid interactions  
4. Solve problems using analytical thinking skills in performing molecular modeling towards the prediction of protein function  
5. Relate the terminology of biochemistry and pathogenesis with various genetic disorders  
6. Formulate the concept of in silico mutational and drug discovery studies

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues  
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice  
18. Having critical thinking and innovative skills

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<tr>
<th>Module: 6</th>
<th>Pathogenesis</th>
<th>6 hours</th>
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<tbody>
<tr>
<td>Genetic basis of disease- - 3 significant classes of Genetic Disorders - Chromosomal, Monogenic, Multifactorial - Genetic Variation - Types of mutation - Molecular Consequences of Mutation - Hemoglobin Disorders - Molecular basis of Diabetes &amp; Cystic Fibrosis.</td>
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<table>
<thead>
<tr>
<th>Module: 7</th>
<th>In silico mutational studies and Drug design</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Sequence-based approach, structure-based approach, diverse models, Drug resistance mechanism – SBDD – active site-directed drug design - pharmacogenomics.</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues</th>
<th>3 hours</th>
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<tbody>
<tr>
<td>Industry-related / Invited talk</td>
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**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** CAT / Digital-Assignment / FAT

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
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<td>Syllabus version</td>
<td>v. 1</td>
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**Course Objectives:**
1. Recall the concepts central to the study of plant science
2. Apply a comprehensive exposure to the subject of plant physiology
3. Summarize cutting edge technologies employed in contemporary plant biology

**Expected Course Outcome:**
1. Demonstrate the basics of plant biology and the organization of plants
2. Relate physiological mechanisms of plant growth, function, and development
3. Translate the fundamental concepts of plant physiology
4. Outline the plant metabolism
5. Illustrate mineral nutrition in plants
6. Extend a broad overview of the geographical distribution of plants

**Student Learning Outcomes (SLO):** 2,11
1. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning

**Module:1 Water and transpiration** 6 hours

**Module:2 Plant Growth hormones** 6 hours
Plant growth regulators (auxins, gibberellins, cytokinins, ethylene, and abscisic acid) - mechanism of action and Practical application. Mineral nutrition - macro and micronutrients and deficiency symptoms.

**Module:3 Plant Physiology** 6 hours
Photomorphogenesis - photoperiodism, vernalization, phytochromes. Dormancy (seed and bud), seed viability, and germination.

**Module:4 Photosynthesis** 6 hours
Plant pigment system: Absorption and action spectrum – Phosphorescence and fluorescence. Light reaction - Pathways of carbon fixation C3, C4 subtypes, and CAM.

**Module:5 Respiration** 5 hours
Aerobic - Glycolysis, Krebs Cycle, electron transport system, oxidative phosphorylation, respiratory quotient.

**Module:6 Nitrogen assimilation** 6 hours
Role of Nitrogen and sources, Conversion of nitrate to ammonia - assimilation of ammonia.
Molecular nitrogen, mechanism of biological nitrogen fixation.

**Module: 7  Phytogeography**
6 hours
Principles of Phytogeography, Phytogeographical regions of India. Vegetational types in Tamil Nadu. A detailed study of the vegetation types - Evergreen, deciduous, scrub jungle, and mangrove forest.

**Module: 8  Contemporary issues**
4 hours

| Total Lecture hours: | 45 hours |

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** CAT / Assignments / FAT

<p>| Recommended by Board of Studies | 03-08-2017 |
| Approved by Academic Council | No. 46 | Date | 24-08-2017 |</p>
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<td>Pre-requisite</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>+ 2 Biology</td>
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</tbody>
</table>

**Course Objectives:**

1. Demonstrate the methods, principles, and applications of forensic science in criminal investigations
2. Improve basic scientific principles of forensic science applied in solving criminal cases
3. Outline the concepts of forensic sciences such as crime scene investigation, forensic photography, digital forensics, ballistics, fingerprinting, court and police organizational structures, and forensic DNA analysis.

**Expected Course Outcome:**

1. Explain the basics of forensic science
2. Assess the organizational structure and procedures within forensic science
3. Illustrate the concepts, principles, and significance of impression evidence.
4. Summarize the practices behind collection, analysis, and interpretation of evidence.
5. Demonstrate the capabilities, in theory, laboratory techniques in analyzing body fluids, and other evidence analysis.

**Student Learning Outcomes (SLO):**

2. Having a clear understanding of the subject related concepts and contemporary issues
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)

**Module: 1 Historical Background of Forensic Science**

Past and present scenarios. Forensic Science Laboratories, Experts and Divisions, Organizational set up of Forensic Science Laboratories at central and state level. Body Farm.

**Module: 2 Crime Scene Profiling**

Crime Scene: Role of Investigator in evaluation, evidence collection, protection, and documentation of crime scene. Sketching technique, types of Sketches, Searching Methods.

**Module: 3 Evidence and Documentation**


**Module: 4 Ballistics:**

Types, application, forensic ballistic procedures (internal, external, and terminal ballistics) and identification of firearms, Available ballistic databases.

**Module: 5 Blood, Toxicology, Pathology Profiling in Forensic Evaluation**

Serological analysis (blood, saliva, semen, etc.), Blood Splatter- Origin of impact study Abusive Drug types, Poisons, and analysis. DNA fingerprinting in Forensics: Forensic Medicine DNA
fingerprinting: RFLP and PCR. Forensic pathology: Time of death analysis; Entomology and pathology in death analysis.

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Forensic Photography and Digital Criminalistics</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Forensic and Legal proceedings</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forensic and Legal proceedings in India: Legal proceedings in forensics, CSI in India: problems and perspectives</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Case studies &amp; Expert Guest lectures</th>
<th>2 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
</tr>
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</table>

Text Book(s)


Reference Books


Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24.08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIY2004</td>
<td>Biophysics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: None

Syllabus version: v. 1

**Course Objectives:**

1. Analyze physics concepts applied in biology
2. Deduce importance of molecular machines, membrane logistics, and macromolecular transition
3. Utilize various biophysical techniques and their applications

**Expected Course Outcome:**

1. Recall the molecular forces and their interactions and various physical laws
2. Identify the various types of kinetics and models involved in cell dynamics
3. Determine the applied aspects of biophysics through membrane logistics, and networks
4. Recognize macromolecular transition
5. Evaluate the function of molecular machines.
6. Apply the principles and applications of various biophysical methods/techniques

**Student Learning Outcomes (SLO):**

2. Having a clear understanding of the subject related concepts and contemporary issues
5. Having design thinking capability
18. Having critical thinking and innovative skills

**Module: 1 Chemical and Physical setup of the cell**

Intra and intermolecular forces, chemical bonds, bond length, bond angle, dipole moment, electrostatic interactions and Hydrogen bonding interactions, small molecules, and macromolecules.

**Module 2 Mathematical Biophysics**

Boltzmann Distribution, Fick's law, Graham's law, Gibbs free energy, Reynolds number, Fokker–Planck equation, Gibbs–Donnan effect, Nernst equation

**Module 3 Cell functioning models**

Michaelis-Menten kinetics, Goldbeter-Koshland kinetics, Hodgkin–Huxley model, Vector field models, Bifurcation theory, Deterministic and Stochastic models

**Module 4 Methods in Structural Biology**

Mass Spectrometer, NMR, Circular dichroism, XRD, FTIR, SEM and TEM

**Module 5 Macromolecular transition**

Polymer elasticity and stretching, Effects of physical factors on Polymers, Allostery

**Module 6 Molecular machines and enzymes**

Enzyme saturation kinetics, Catalytic transition, Energy landscape, Cytoskeletal-rotary polymerization -rotary motors
Module: 7  Membrane logistics and Bioelectrical networks  7 hours
Osmotic effects, Membrane potential, Ion pumping, Chemiosmotic mechanism in mitochondria. Action potential, Ohmic conductance, Voltage gating, Neuromuscular junction

Module: 8  Contemporary Issues:  2 hours
Industry expert lectures on contemporary issues

Total Lecture hours: 45 hours

Text Book(s)

Reference Books

Mode of Evaluation: CAT / Assignment / Quiz / FAT

Recommended by Board of Studies  03-08-2017
Approved by Academic Council  No. 46  Date  24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
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<tr>
<td>BIY2005</td>
<td>Advanced Biochemistry</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: None  Syllabus version: v. 1

**Course Objectives:**
1. Recall the structure, composition, and functions of various biomolecules.
2. Demonstrate the properties of biomolecules involved in various metabolic pathways.
3. Extend the significance of these biomolecules to solve biotechnological problems.

**Expected Course Outcome:**
1. Discuss the structure of glycans, membrane lipids, and proteoglycans.
2. Summarize the structure of glycosaminoglycans and bacterial polysaccharides.
3. Compare the biological functions of macromolecules, amino acids, and protein.
4. Elaborate the higher-order organization of proteins and function.
5. Relate the organization and functions of biomembranes.
6. Illustrate the transport of vital molecules across the membrane.
7. Assess the significance of redox reactions in cellular metabolism and the importance of bioenergetics.

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject-related concepts and contemporary issues.
11. Having an interest in lifelong learning.

**Module: 1 Carbohydrates**
Classification, Stereochemistry, N-Glycans, O-Glycans, Glycosphingolipids, Glycophospholipid Anchors, Proteoglycans

**Module: 2 Glycobiology**
Glycosaminoglycans, Classes of Golgi-derived glycans, Sialic acids, Bacterial polysaccharides

**Module: 3 Amino acids**
Types of amino acids. Metabolism of phenylalanine, tyrosine, tryptophan, and sulfur-containing amino acids, inborn errors of amino acids metabolism.

**Module: 4 Protein Science**
Primary, secondary, tertiary, and quaternary structures of protein, protein folding and dynamics, molecular chaperones. Proteins architecture and functions.

**Module: 5 Bio-membranes & cellular transport**

**Module: 6 Metabolic diversity**
Energy from the oxidation of inorganic electron donors, Iron oxidation, Methanotrophy and
methylotrophy, Nitrate and sulfate reduction, Acetogenesis, Methanogenesis, Fermentation-energetics, and redox constraints, Examples: Calvin cycle, Reverse citric cycle.

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Bioenergetics</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of thermodynamics, Bioenergetics, and oxidative phosphorylation, Mitochondrial bioenergetics, Electron transport complexes: Complex I (NADH-Q reductase), Complex II (Succinate-Q reductase), Complex III (ubiquinol-cytochrome C reductase), Complex IV (cytochrome c Oxidase).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture by industrial expert</td>
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</tr>
</tbody>
</table>

Total Lecture hours: 45 hours

**Text Book(s)**


**Reference Books**


Mode of Evaluation: CAT / Assignments / FAT

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24-08-2017
Course code | Course title | L | T | P | J | C | Syllabus version
---|---|---|---|---|---|---|---
BIY2006 | Clinical Biochemistry | 2 | 0 | 0 | 4 | 3 | v.1

Pre-requisite | None

Course Objectives:
1. The purpose of this course is to relate the safety, quality assurance and quality control in Clinical Biochemistry
2. Compare the changes in the levels of biochemical analytes under normal and abnormal conditions and to correlate test results with patient conditions
3. Analyze the pathophysiological processes and their manifestations that determine the health and disease states of the human body

Expected Course Outcome:
1. Perceive factors that affect the analytical results of a specimen from its collection to processing stage
2. Deduce the functioning and dynamics of a clinical laboratory
3. Outline fundamental scientific principles underpinning laboratory medicine and core cellular and molecular processes underlying health and disease
4. Apply logical, systemic thinking and high-level critical analysis to solve problems using diagnostic techniques and methodologies in the chosen areas of clinical laboratory specialization
5. Build advanced knowledge of core clinical specialty disciplines such as laboratory medicine and advanced management skills
6. Relate pathophysiology of disease in the study of body functions
7. Summarize recent updates on laboratory diagnostic methods

Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
18. Having critical thinking and innovative skills

Module:1 Basic Concepts of Clinical Biochemistry 4 hours
Methods for collection, handling, and analysis of clinical samples. Quality control in biochemical analysis: commonly measured analytes and normal values.

Module:2 Diseases Related to Carbohydrate Metabolism 4 hours
Blood Glucose regulation; hypo and hyperglycemia, Diabetes mellitus-types, clinical features, GTT.

Module:3 Inborn errors of amino acid metabolism 4 hours
Aminoacids-Cystinuria, phenylketonuria, alkaptonuria, albinism, and tyrosinemia.

Module:4 Lipids and Lipoproteins 4 hours
Cholesterol, plasma lipoproteins-structure, types, and functions, hyper and hyperlipoproteinemia, risk factors for atherosclerosis and fatty liver.
### Module: 5 | Liver function tests  
Metabolism of bilirubin, jaundice-types, clinical features, and test for bile pigments in blood and urine.  

| 4 hours |

### Module: 6 | Kidney function tests  
Clearance principle, Clearance tests- urea, creatinine, and insulin.  

| 4 hours |

### Module: 7 | Gastric function tests  
The stimulus for the secretion of gastric juice, gastric juice – constituents and composition. Gastric sampling, gastric function tests using a test meal, tubeless gastric analysis, and analysis of gastric contents.  

| 4 hours |

### Module: 8 | Recent topics in clinical biochemistry  
Lectures by doctors  

| 2 hours |

### Total Lecture hours: 30 hours

#### Text Book(s)

#### Reference Books

#### Project: ‘J’ Component
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

| Recommended by Board of Studies | 03-08-2017 |
| Approved by Academic Council     | No. 46     | Date | 24-08-2018 |
Course Objectives:
1. Outline the basic principles and different model systems used in developmental biology.
2. Infer the establishment of the body plan invertebrates and their corresponding cellular and genetic mechanisms
3. Assess modern implications of developmental biology by imparting knowledge regarding gene knockout animals, microarray and teratogens

Expected Course Outcome:
1. Explain the contributions of sperm and egg to the zygote and structure informing function
2. Apply critical thinking and logical analysis in the assessment of embryonic developmental events including germ layer development, extra-embryonic membranes, embryo implantation, and significance of placental formation.
3. Determine when cells become specified, fate determined, and initiate organ development.
4. Utilize the principles and techniques of molecular biology to identify the genes involved in embryo development
5. Translate the knowledge on cellular mechanisms of development to identify the genetic and molecular elements involved in the development of an embryo
6. Outline principles of sex determination occur during embryo development

Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and contemporary issues
18. Having critical thinking and innovative skills

Module: 1 Gametes structure and fertilization  6 hours
Structure of sperm and egg. Egg contents and membrane structure concerning fertilization and embryogenesis. Gametes binding and recognition in mammals, gamete fusion, and the prevention of polyspermy. Events that occur in external and internal fertilization with one example up to embryo formation.

Module: 2 Differential gene expression and embryogenesis  6 hours
Different methods of differential gene expression that occur during embryo development. Mechanism of cellular differentiation. Different types of cell to cell communication in embryogenesis

Module: 3 Techniques to study embryo development  7 hours
I am using mutants, microarray, Transgenic, and knockout mice to study the role played by a gene in embryo development.

Module: 4 Cleavage & Gastrulation  6 hours
Cleavage: Characteristics of cleavage, the role played by Cyclins and CDKs. Patterns of embryonic cleavage in Frog, drosophila, and mammals. Gastrulation: Events that occur in the embryo during the transition from cleavage to gastrulation. Mid gastrula phase, cell movement,
asymmetry in egg, cell differentiation, and gastrula formation. Ectoderm, Mesoderm, and Endoderm.

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Cellular differentiation and organogenesis</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mechanism of differentiation and organogenesis, With the example of Neurulation, limb, and Eye development.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Axis specification</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Genetics of axis specification with the mechanism. Establishment of left-right body axis with one example.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Sex determination and role of environment on embryogenesis</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Genetic and environmental sex determination. Role of sex chromosomes and genes involved in sex determination in mammals. Ethics in the pre-natal sex determination of humans. Regulation of normal development by the environment, disruption of normal development by teratogens.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Topics: Lectures by experts</th>
<th>2 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Total Lecture hours:</strong></th>
<th>45 hours</th>
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</thead>
</table>

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

Recommended by Board of Studies | 03-08-2017
Approved by Academic Council | No. 46 | Date | 24-08-2017
Course code | Course title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
BIY2008 | Biological Databases | 2 | 0 | 2 | 4 | 4

Pre-requisite | None

Syllabus version | v. 1

Course Objectives:
1. Appraise different formats and data-types of molecular sequence and structures
2. Demonstrate the significance of resources before starting the research
3. Interpret biological data in a meaningful way complimentary to biological research

Expected Course Outcome:
1. Identify data resources and fetch the right content from open-source biology databases
2. Utilize the appropriate database and allied tools to solve the puzzles in biological research
3. Analyze nucleotide and protein data from various databases
4. Build adequate skills to challenge the upcoming big-data content analysis and interpretation
5. Examine the data from biology and perform a pattern search
6. Design database to slice and dice the biological data from different biological data resources and bridge the ontological information in research.

Student Learning Outcomes (SLO): 2,20
2. Having a clear understanding of the subject related concepts and contemporary issues
20. Having a good digital footprint

Module:1 | Important contributions | 4 hours
Submission of sequences to the database, sequence formats, conversion of one sequence into another.

Module:2 | Regulatory databases | 4 hours
Regulatory sequence databases-TRANSFAC, the exon-intron database (EID).

Module:3 | Secondary protein databases | 4 hours
Pfam-protein Family, PRINTS & Blocks, ProDom.

Module:4 | Macromolecular databases | 4 hours
MMDB- Molecular Modeling Database, Protein Databank in Europe (PDBe), Mod Base, PDBsum.

Module:5 | Genome Browser | 4 hours
Types of genome browsers, ENSEMBL, UCSC.

Module:6 | Mutation databases | 4 hours
HGMD, Pathway Database-Kyoto Encyclopedia of Genes and Genomes(KEGG Database).

Module:7 | Protein-protein and other molecular interactions | 4 hours
STRING, Drug Bank, Therapeutic Target Database.

**Module:** Contemporary issues: Lecture by experts  
**Total Lecture hours:** 30 hours  

**Text Book(s)**  

**Reference Books**  
2. Most of the topics will be covered using online resources

**Mode of Evaluation:** CAT / Assignment / Quiz / FAT / Project / Seminar

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conversion of sequence from one database format to another using file format converter</td>
<td>3</td>
</tr>
<tr>
<td>2. Extraction of real matrices and identification of promoter motifs by TRANSFAC</td>
<td>3</td>
</tr>
<tr>
<td>3. Identification of protein domains using Pfam</td>
<td>3</td>
</tr>
<tr>
<td>4. MMDB- Molecular Modeling Database</td>
<td>3</td>
</tr>
<tr>
<td>5. Evaluation of comparative protein structure models by Mod Base</td>
<td>2</td>
</tr>
<tr>
<td>6. Comparing genes and genomes with Ensembl</td>
<td>2</td>
</tr>
<tr>
<td>7. Variation data in Ensembl</td>
<td>2</td>
</tr>
<tr>
<td>8. Finding features that regulate genes – the Ensembl Regulatory Build</td>
<td>2</td>
</tr>
<tr>
<td>9. Determining Protein Physico-Chemical Properties using PDBsum</td>
<td>2</td>
</tr>
<tr>
<td>10. Analysis of inherited and complex disease using HGMD</td>
<td>2</td>
</tr>
<tr>
<td>11. Understanding high-level functions and utilities of the biological systemKyotoEncyclopedia of Genes and Genomes</td>
<td>2</td>
</tr>
<tr>
<td>12. Reactions took from KEGG ENZYME and additional reactions taken from the metabolic pathway maps in KEGG PATHWAY using KEGG REACTION</td>
<td>2</td>
</tr>
<tr>
<td>13. Visualization of protein-protein interaction using STRING</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours**  
30 hours

**Projects: ‘J’ Component**

Mode of evaluation: Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46  
**Date** 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
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<th>C</th>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>BIY2010</td>
<td>Plant Biotechnology</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>v. 1.1</td>
</tr>
</tbody>
</table>

**Course Objectives:**
1. Explain the developmental processes operating in plants
2. Demonstrate plant tissue culture methods
3. Analyze biotechnological tools for engineering plants in agriculture and industry

**Expected Course Outcome:**
1. Outline the importance and fundamentals of plant tissue culture
2. Summarize the applications of tissue culture
3. Design vectors for plant transformation
4. Create clean and green transformation protocols
5. Measure the suitability of transgenics to consumers, industrialists, and environment
6. Apply tissue culture techniques and get employed in a plant biotechnology-based industry

**Student Learning Outcomes (SLO):**
1. 2
2. 14

**Module:1 Plant Tissue Culture I**
- 4 hours
- Plant cell culture – history and importance; Explant, sterilization techniques, culture media, their constituents, and culture types; Role of plant growth regulators in tissue culture

**Module:2 Plant Tissue Culture II**
- 4 hours
- Organogenesis; Somatic embryogenesis; Hardening; Somaclonal variation; Applications of tissue culture

**Module:3 Vector components for plant transformation**
- 4 hours
- Selectable markers, reporter genes, promoters, terminators and expression cassettes; Optimization of vector components; Gene silencing

**Module:4 Indirect Plant transformation**
- 4 hours
- Agrobacterium-mediated gene transfer - Ti plasmid, the molecular mechanism of T-DNA transfer and integration, binary, RNAi and Gateway vectors, advantages and disadvantages of Agrobacterium-mediated gene transfer

**Module:5 Direct Plant Transformation Methods**
- 4 hours
- Particle bombardment, protoplast fusion, electroporation, advantages and disadvantages of direct gene transfer; Clean gene technology and plastid transformation

**Module:6 Transgenic Plant Technology I**
- 5 hours
- Case studies on the production of genetically modified plants for herbicide tolerance, biotic and biotic stress tolerance and improvement of quality traits
### Module: 7 | Transgenic Plant Technology II | 3 hours

Molecular pharming; importance and risks of transgenes in the ecosystems; technology protection systems

### Module: 8 | Contemporary issues: | 2 hours

Lecture by an Industrial Expert

| Total Lecture hours: | 30 hours |

#### Text Book(s)


#### Reference Books


#### Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

#### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Media preparation for plant cell culture</td>
<td>4</td>
</tr>
<tr>
<td>2. Preparation of media for bacterial culture</td>
<td>4</td>
</tr>
<tr>
<td>3. Sterilization techniques</td>
<td>2</td>
</tr>
<tr>
<td>4. Instruments required for plant cell culture</td>
<td>2</td>
</tr>
<tr>
<td>5. Explant isolation methods</td>
<td>2</td>
</tr>
<tr>
<td>6. Different methods of sterilization for explants</td>
<td>2</td>
</tr>
<tr>
<td>7. Callus induction</td>
<td>2</td>
</tr>
<tr>
<td>8. Co-culturing of Agrobacterium containing an engineered plasmid</td>
<td>2</td>
</tr>
<tr>
<td>9. Agrobacterium-mediated transformation</td>
<td>2</td>
</tr>
<tr>
<td>10. Screening of transformed plant cells with the help of a marker assay</td>
<td>2</td>
</tr>
<tr>
<td>11. Protoplast isolation and fusion techniques</td>
<td>2</td>
</tr>
<tr>
<td>12. Shoot induction</td>
<td>2</td>
</tr>
<tr>
<td>13. Root induction and Hardening</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Laboratory Hours</strong></td>
<td><strong>30 hours</strong></td>
</tr>
</tbody>
</table>

#### Project

<table>
<thead>
<tr>
<th>‘J’ Component</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test</td>
<td></td>
</tr>
<tr>
<td>Recommended by Board of Studies</td>
<td>03-08-2017</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
<td>No. 46 Date 24-08-2017</td>
</tr>
</tbody>
</table>
### Course Objectives:
1. Relate basic knowledge of enzymology with its useful applications in health care, Environment and industries
2. Illustrate enzyme kinetics and parameters of enzymatic reactions through a practical approach
3. Apply knowledge on mechanistic enzymology.

### Expected Course Outcome:
1. Summarize structure, function, and properties of enzymes
2. Define rate equations for enzyme-catalyzed reaction and how key factors affect enzyme reactions rates
3. Classify the types of enzyme inhibitions and their mechanisms
4. Evaluate enzyme activity and its regulation in maintaining cellular structure and function
5. Analyze enzyme mutations and their role in protein engineering
6. Solve industrial problems using enzymes

### Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and contemporary issues
5. Having design thinking capability
18. Having critical thinking and innovative skills

### Module: 1 Introduction 4 hours
Importance of enzymes, the nature of the enzyme, functional organization of enzyme-domains, (multi-enzyme complex); active site of enzyme-standard features.

### Module: 2 Enzyme classification and nomenclature 4 hours
IUBMB, Kinases, phosphatases, Oxido-reductases, transferases, hydrolases, lyases, isomerases and ligases

### Module: 3 Kinetics 4 hours
Free energy, activation energy, enzyme-substrate complex, transition state, binding energy, enzyme reaction coordinate diagram. Kinetics-. Michaelis – Menten kinetics; kinetic parameters-Km, Vmax, Kcat; Lineweaver Burk plot, Factors affecting enzyme activity; Enzyme inhibition – types of inhibition

### Module: 4 General mechanism of action 4 hours
Catalytic strategies- covalent, general acid-base, approximation, metal ions, protease, restriction endonuclease, kinase, and phosphatase

### Module: 5 Regulation of enzyme activity 4 hours
Mechanisms of enzyme regulation in metabolism- reversible covalent modification, allosteric regulation, proteolytic cleavage, isozymes, compartmentalization

### Module: 6 Methods to obtain mutant enzymes with 4 hours
### desired features

Methods to induce mutations and screening in microorganisms, Site-directed mutagenesis.

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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Application of enzymes</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Industrial processes, molecular biology, diagnostics and therapeutics</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Lecture by industrial expert</td>
<td></td>
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</tbody>
</table>

**Total Hours** | 34 hours |

### Text Book(s)


### Reference Books


### Mode of Evaluation:

CAT / Assignment / Quiz / FAT / Project / Seminar

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination of the activity of Enzymes: Protease, amylase, lipase</td>
<td>4 hours</td>
</tr>
<tr>
<td>Determination of the specific activity of alkaline phosphatase.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Glucose estimation using glucose oxidase.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Determination of Vmax and Km for a given enzyme</td>
<td>4 hours</td>
</tr>
<tr>
<td>Effect of pH on Enzyme activity - pH 2- 10  6. Effect of temperature on Enzyme activity (10- 800C)</td>
<td>4 hours</td>
</tr>
<tr>
<td>Effect of Inhibitors (PMSF, EDTA, Iodoacetate) on enzyme activity</td>
<td>4 hours</td>
</tr>
<tr>
<td>Effect of Substrate concentration on enzyme</td>
<td>4 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours** | 28 hours

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**Project: J component**

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No.46 Date 24-08-2017
**Course code**: BIY 2013  
**Pre-requisite**: Molecular Biology  
**Syllabus version**: v. 1

### Course Objectives:
1. Discuss different endocrine organs and hormones secreted by them
2. Illustrate the molecular mechanism of modulation of gene expression by steroid and non-steroid hormones
3. Assess hormonal dysfunction leading to endocrine disorders and techniques used in molecular endocrinology

### Expected Course Outcome:
1. Compare the physiological role of hormones and the mechanism of regulation of hormone levels in humans
2. Outline how steroid hormones along with its receptors interact with other proteins to regulate gene expression
3. Summarize different signal transduction pathways regulated by non-steroid hormones leading to differential gene expression
4. Determine the molecular reason behind endocrine disorders
5. Evaluate how environmental pollutants disturb the endocrine system
6. Apply the knowledge gained in this subject for researching the field of molecular biology and molecular endocrinology

### Student Learning Outcomes (SLO): 2,11
**2.** Having a clear understanding of the subject related concepts and contemporary issues  
**11.** Having an interest in lifelong learning

#### Module:1 Basic principles 5 hours
- Endocrine organs. Pituitary and hypothalamus as master glands. Characteristics of hormones and types of hormones and their receptors.

#### Module:2 Mechanisms of hormone action and regulation 6 hours
- Negative and positive feedback effect with example. Hormone receptor down-regulation, Desensitization of hormone receptor. Mechanism of hormone elimination from the system

#### Module:3 Extracellular receptors 6 hours
- Types of membrane receptors, its structure, and function: Extracellular domain, Transmembrane domain, Intracellular domain; Role in signal transduction; G-protein linked receptors; Ion channel linked receptor; Enzyme-linked receptor. Role of second messengers in signal transduction

#### Module:4 Steroid receptor 6 hours
- Examples of Nuclear Receptors (NR). NR superfamily – structural organization of NR; domains (N-terminal regulatory domain, DNA binding Domain, Hinge region, Ligand binding Domain, C-terminal domain), hormone response elements, homodimers, and heterodimers. Transactivation and Trans repressor Nuclear receptor co-activators, Nuclear receptor co-repressor and its role in the regulation of gene expression
<table>
<thead>
<tr>
<th>Module:5</th>
<th><strong>Hormones involved in Reproduction</strong></th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th><strong>Endocrine disorders</strong></th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular mechanism of hormone role in causing a) Cancer b) Diabetes c) Reproductive system malfunction and d) Obesity. Hormone, receptor mutations, and related diseases. Environment pollutants as hormone analogues and their effect on human health</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th><strong>Techniques used in Endocrinology</strong></th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orphan receptors and methods to identify ligand for the orphan receptors. CHIP assay, ELISA, RIA, Real-Time PCR, and Microarray.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th><strong>Contemporary issues:</strong> Lecture by industrial experts</th>
<th>2 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Text Book(s)</th>
<th></th>
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</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Park-Sarge OK and Curry Jr TE (2010) Molecular Endocrinology: Methods and protocols springer protocols</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of Evaluation: Written examinations, Projects, and assignments</th>
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<tr>
<th>Recommended by Board of Studies</th>
<th>03-08-2017</th>
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<tbody>
<tr>
<td>Approved by Academic Council</td>
<td>No.46 Date 24-08-2017</td>
</tr>
<tr>
<td>Course code</td>
<td>Course title</td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>BIY2014</td>
<td>Aquatic Biotechnology</td>
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</tbody>
</table>

Pre-requisite: None

Syllabus version: v.1

Course Objectives:
1. Explaining the evolution of marine biology.
2. Summarize aquatic habitats to acquire knowledge
3. Translate the significance of biotechnological implementations in marine and aquatic sector

Expected Course Outcome:
1. Elaborate on the importance of marine and aquatic sector in day to day life
2. Outline how steroid hormones along with its receptors interact with other proteins to regulate gene expression
3. Summarize different signal transduction pathways regulated by non-steroid hormones leading to differential gene expression
4. Determine the molecular reason behind endocrine disorders
5. Evaluate how environmental pollutants disturb the endocrine system.
6. Outline various bioactive compounds isolated to aquatic systems

Student Learning Outcomes (SLO): 2,11,18

2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
18. Having critical thinking and innovative skills

Module: 1 | Introduction to marine and freshwater environments | 4 hours
---|---|---
History of Biotechnology, Importance of Fresh and Sea Waters - Abiotic and biotic factors of aquatic environment - Food chain – Biological characters of aquatic habitats

Module: 2 | Aquatic resources | 4 hours
---|---|---
Culturing of various aquatic living organisms - Fisheries potential of freshwater and salt waters. Capture and culture fisheries

Module: 3 | Diseases in aquaculture | 4 hours
---|---|---
World organization of Aquatic animal health listed diseases in aquaculture - pathogens, signs, and epidemiology.

Module: 4 | Diagnosis of Diseases | 4 hours
---|---|---
Conventional diagnostic methods, Antibody, and nucleic acids based diagnostic methods with examples.

Module: 5 | Aquatic animal health management | 4 hours
---|---|---
Antimicrobials and chemotherapeutics in aquaculture. Probiotics, Case studies, Vaccination and disease control.

Module: 6 | Aquaculture food processing | 4 hours
---|---|---

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Marine conservation</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marine conservation – Threats to marine biodiversity, physical alternations of coastal habitats, marine pollution action plan to conserve marine bio-resources, biofouling, bio-corrosion</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Expert lecture from Aquaculture Industry</th>
<th>2 hours</th>
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</table>

**Total Lecture hours:** 30 hours

**Text Book(s)**

**Reference Books**
2.  

**Project: ‘J’ component**


**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No.46 Date 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>BIY2015</th>
<th>Course title</th>
<th>Biological Spectroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisite</td>
<td>BIY1001 Biochemistry</td>
<td>Syllabus version</td>
<td>v. 1</td>
</tr>
</tbody>
</table>

**Course Objectives:**

1. Discuss spectroscopic techniques such as visible (VIS), fluorescence, near-infrared (NIR), infrared (IR), Raman and nuclear magnetic resonance (NMR) spectroscopy.
2. Infer various spectroscopic tools for biomolecular quantitation and characterization.
3. Formulate interdisciplinary methods to solve biological problems using physical and chemical engineering techniques.

**Expected Course Outcome:**

1. Outline the physics involved in most abundant non-destructive spectroscopic techniques.
2. Apply spectroscopy for on- or at-line process monitoring and quality control in the modern food, pharma or biotech industry.
3. Discuss the practical use of spectroscopy, problems involved and tricks of the trade-in relation to the quantitative use of spectroscopy such as spectroscopic calibration and optimal sample presentation to the spectrometer.
4. Summarize advantages and disadvantages of spectroscopic measurements.

**Student Learning Outcomes (SLO):**

- Having a clear understanding of the subject related concepts and contemporary issues
- 18. Having critical thinking and innovative skills

**Module: 1 Basics of quantum mechanics**

- Schrödinger wave equation; atomic and molecular structures; transition energy states.

**Module: 2 UV-Visible spectroscopy**

- Selection rules; biological chromophores including charge transfer complexes; surface plasmon resonance.

**Module: 3 Fluorescence spectroscopy**

- Biological fluorophores – intrinsic and extrinsic; quenching mechanisms; fluorescence probes; Fluorescence resonance energy transfer.

**Module: 4 Infrared spectroscopy**

- Selection rule; fundamental and harmonic transitions; normal mode analysis; amide bands I and II – characterization and their application; ATR.

**Module: 5 Raman spectroscopy**

- Instrumentation; Strokes and anti stokes – Rayleigh scattering; selection rules; Amide bands I and II; Coherent Anti Stokes Raman Scattering.

**Module: 6 XPS**

- Instrumentation; XPS patterns; Spin orbital Splitting; Quantitative analysis; Chemical effect; Chemical shift.

**Module: 7 1D NMR**

- 6 hours
Boltzmann distribution; coupling constants; dipolar coupling; nuclear overhauled effect; NMR spectra of selected nuclei (H, C, P, F, N). Multidimensional NMR and other advanced Techniques: Multidimensional NMR; application to larger biomolecules; electron paramagnetic resonance, Auger electron spectroscopy

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies**

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<td>03-08-2017</td>
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**Approved by Academic Council**

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<tbody>
<tr>
<td>No. 46</td>
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<tr>
<td>24-08-2017</td>
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<tr>
<td>Course code</td>
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<tr>
<td>BIY2016</td>
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</tbody>
</table>

**Pre-requisite:** None

**Syllabus version:** v. .1

**Course Objectives:**
1. Recall the fundamental concepts of stem cells
2. Dissect mechanistic details about stem cells and regeneration (horizontal and vertical integration)
3. Extend these concepts in the industrial and academic sectors

**Expected Course Outcome:**
1. Relate the fundamental aspects of stem cell technology
2. Illustrate the principles and methodologies about the mechanistic aspects
3. Determine the commonalities and distinguish between embryonic and adult stem cells
4. Apply the knowledge gained in regenerative aspects and therapeutic potential
5. Formulate solutions in a socially and ethically responsible manner concerning the use of stem cells and state-of-the-art technologies

**Student Learning Outcomes (SLO):** 2,10,18

2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
18. Having critical thinking and innovative skills

**Module:1 Introduction**
6 hours
Embryonic stem cells, Blastula, Inner cell mass, Totipotent, pluripotent, multipotent and Induced pluripotent stem cells characterization, potency, self-renewal, cell division, and differentiation

**Module:2 Pathways involved in stem cell proliferation, differentiation, and dedifferentiation**
6 hours
Signal transduction pathways and signaling molecules involved cellular proliferation, differentiation, and dedifferentiation. Relationship between cellular proliferation and differentiation concerning stem cells

**Module:3 Embryonic stem cells**
7 hours
How embryonic stem cells are obtained, in vitro multiplication: embryonic stem cells gene manipulation and nuclear transfer technology.

**Module:4 Adult stem cells**
6 hours
Methods to obtain stem cells from adults (Amniotic fluid, cord blood cells, Mesenchymal stem cells, etc). Induced pluripotent technology (IPS), genes, and their mode of action in inducing stemness in adult cells. Advantages and disadvantages of IPS technology

**Module:5 Organ regeneration using Stem cells**
6 hours
Heart regeneration, angiogenesis, kidney regeneration, a neurodegenerative disorder, spinal cord injury, tissue engineering

**Module:6 Application of stem Cells**
6 hours
Overview of embryonic and adult stem cells for therapy in Neurodegenerative diseases; Parkinson’s, Alzheimer's, Spinal Code Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia, etc.

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>Ethics in using Embryonic stem cells</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human stem cell research: Ethical consideration; Stem cell religion consideration; Stem cell-based theories: Preclinical regulatory consideration, and Patient advocacy.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues: Lectures by experts</th>
<th>3 hours</th>
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<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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Text Book(s)

Reference Books


Recommended by Board of Studies | 03-08-2017 |
Approved by Academic Council | No. 46 | Date | 24-08-2017 |
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
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<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>BIY2017</td>
<td>Neurobiology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Pre-requisite**: None

**Syllabus version**: v. 1

**Course Objectives:**
1. Develop a basic understanding of neuroanatomy
2. Build a basic understanding of neurophysiology
3. Elaborate on the biological basis of behavior

**Expected Course Outcome:**
1. Relate basic brain structure and function from the molecular to the systemic level
2. Illustrate the properties of cells that make up the nervous system including the propagation of electrical signals used for cellular communication
3. Discuss the various aspects of the pathogenesis of the nervous system
4. Interpret the contribution of the nervous system to sensory experiences, thoughts, emotions, and behavior
5. Criticise primary literature at the cognitive, behavioral, and cellular level
6. Formulate a research question based on adequate insights into the current knowledge

**Student Learning Outcomes (SLO):** 2, 10, 18

2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility
18. Having critical thinking and innovative skills

**Module: 1** | What is Neurobiology? | 6 hours
---|---|---
History of Neurosciences, Perspectives in studying the brain, Structure, and function of neurons, glial cells, molecular and cellular organization of neuronal differentiation, characterization of neuronal cells, the blood-brain barrier.

**Module: 2** | Neural Signaling | 6 hours
---|---|---
Electrical Signals of Nerve Cells, Voltage-Dependent Membrane Permeability, Channels and Transporters, Synaptic Transmission, Neurotransmitters, Receptors, and Their Effects, Molecular Signaling within Neurons.

**Module: 3** | Neuro-anatomy | 6 hours
---|---|---
Organization of Central Nervous System, the autonomous nervous system, Peripheral Nervous System, Meninges, and cerebrospinal fluids.

**Module: 4** | Sensation and Sensory Processing | 6 hours
---|---|---

**Module: 5** | Complex Brain Functions | 6 hours
---|---|---
The Association of Cortices, Language and Speech, Sleep and Wakefulness, Emotions, Sex, Sexuality, and the Brain, Memory.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Neurological disorders</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Current techniques in Neurobiology</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optogenetics, Electrophysiology, behavioral analyses, measuring neurochemistry in vivo by microdialysis and amperometry, crayfish sensory or motor neurons.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Module:8 | Contemporary issues: Lecture by industrial experts | 3 hours |

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
### Course Objectives:
1. Create awareness on environmental issues
2. Relate the role of microbes and plants in environmental remediation.
3. Identify appropriate biological approaches for remediation of environmental contaminants.

### Expected Course Outcome:
1. Outline the concept of pollution and bioremediation methods to control it
2. Evaluate the use of different microbes for remediation of pollutants
3. Outline the metabolism of microbes and the genes and enzymes involved in the process
4. Make use of different types of microbes and plants to clean pollutants present in the atmosphere
5. Analyze the conventional wastewater treatment strategies
6. Experiment with biotechnological techniques to remediate the environment

### Student Learning Outcomes (SLO): 2, 11, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
18. Having critical thinking and innovative skills

### Module: 1 | Introduction to bioremediation | 4 hours
- Basics and terminologies in bioremediation, sources of pollution, Nature and Toxic effects of the pollutants on various trophic levels, Permissible limits and its agencies – APHA, EPA and Indian standards

### Module: 2 | Microbes and bioremediation | 4 hours
- Microbes and its degradative capabilities, Screening for useful microbe for the bio-removal of toxic compounds, Bioremediation of specific pollutants - pesticides, Dye, petroleum hydrocarbons and other xenobiotic compounds

### Module: 3 | Metabolism of Microbes | 6 hours
- Metabolism of Microbial degradation, Bacterial resistance mechanism - towards toxic compounds, Detection of candidate genes and enzymes involved in the process of degradation – Application of KEGG pathway in bioremediation

### Module: 4 | Fungal Biodegradation | 3 hours
- Fungal Biodegradation and Phycoremediation, Biodegradation in biofuel production, Co2Sequestration

### Module: 5 | Types of phytoremediation | 4 hours
- Phytoremediation and its types, rhizoremediation strategy and processes, a case study in the removal of heavy metals and other toxic compounds (Chernobyl accident) onsite

### Module: 6 | Wastewater treatment | 4 hours
- Conventional wastewater treatment strategies, Bioreactors - slurry, batch and continuous
processes, Application of GMO’s in Bioremediation, natural gene transfer in the environment

<table>
<thead>
<tr>
<th>Module:7</th>
<th><strong>Application of Proteomics and Metabolomics in bioremediation</strong></th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Superbugs as super savers, engineered enzymes, products involved in biodegradation, Application of Proteomics and Metabolomics in bioremediation</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th><strong>Contemporary issues:</strong> Lecture by industrial expert</th>
<th>2 hours</th>
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<tr>
<th>Total Lecture hours:</th>
<th>30 hours</th>
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**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Project: ‘J’ Component**

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<td>Course code</td>
<td>Course title</td>
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</tr>
<tr>
<td>BIY2019</td>
<td>Molecular Evolution and Phylogeny</td>
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</table>

Pre-requisite: None

Syllabus version: v..1

### Course Objectives:
1. To understand the evolutionary relationship between the various kingdom of life.
2. To gain knowledge on existing algorithmic approaches make the evolutionary and phylogenic prediction more interesting.
3. To develop new methods on evolutionary analysis using biological sequences.

### Expected Course Outcome:
1. To understand the evolutionary relationship between the various kingdom of life.
2. Apply apt algorithmic approaches for specific sequence datasets.
3. Build phylogeny and analyze evolutionary relationships based on different algorithms.
4. Compare different algorithms and optimize them to give a better relationships than the existing ones.
5. Students will compare and contrast different molecular evolution techniques.
6. Gain significant new knowledge about the function of biological molecules and structures.

### Student Learning Outcomes (SLO): 2, 20
- 2. Having a clear understanding of the subject related concepts and contemporary issues.
- 20. Having a good digital footprint.

### Module: 1 Molecular Archeology 7 hours
- Introduction to molecular evolution, driving forces in evolution, evolutionary changes in nucleotide sequences.

### Module: 2 Phylogenetic Trees 7 hours
- Molecular phylogenetics, phylogenetic trees, trees, and distances.

### Module: 3 Phylogeny Algorithms 7 hours
- Measuring genetic change, Genetic distance-Measuring evolutionary change on the tree- kinds of data.

### Module: 4 Methods of reconstruction 6 hours
- Distance matrix methods, Maximum parsimony methods, Maximum likelihood methods.

### Module: 5 Evolutionary Analysis 4 hours
- Models of Molecular evolution, Functional constraints, and the rate of substitution patterns of codon usage and base composition.

### Module: 6 Molecular Evolution theory 5 hours

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M.Sc Intg Biotechnology (5yr.)
Evolutionary clocks, Neutral Theory, Genetic variation within species, Natural selection.

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>Applications of molecular phylogenetics</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organismal phylogeny, what does evolutionary medicine to offer, host-parasite co-speciation?</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Contemporary issues:</th>
<th>4 hours</th>
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<tbody>
<tr>
<td>Lecture by industrial expert</td>
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</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** Written examinations, assignments, and quizzes.

**List of Challenging Experiments (Indicative)**
1. Exploration and retrieval of DNA and Protein Sequence database 2 hours
2. Retrieval of published sequence datasets for evolutionary reports 3 hours
3. Evolutionary tools for molecular data: File format conversion 2 hours
4. Aligning multiple sequences with CLUSTAL-W 3 hours
5. Selecting Evolution and Phylogenetic models 3 hours
6. Phylogenetic analyses of DNA or protein sequences using maximum likelihood. 3 hours
7. A simple user interfaces for creating input files to run BEAST. 2 hours
8. LogCombiner program to combine log and tree files from multiple runs of BEAST 2 hours
9. TreeAnnotator program for summarizing the information in a sample of trees produced by BEAST 3 hours
10. Bayesian Evolutionary Analysis Sampling Trees. 2 hours
<p>| | | |</p>
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<tr>
<td><strong>11</strong></td>
<td>Virus Pathogen Database and Analysis Resource (ViPR) Bacterial dataset analysis.</td>
<td>2 hours</td>
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<tr>
<td><strong>12</strong></td>
<td>ML program for estimating mutation rates using cancer mutation databases.</td>
<td>3 hours</td>
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<tr>
<td><strong>Total Laboratory Hours</strong></td>
<td></td>
<td>30 hours</td>
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**Mode of Evolution: Assignments, Continuous assessment tests and Final assessment test.**

Recommended by Board of Studies: 03-08-2017

Approved by Academic Council: No. 46 Date: 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIY 3002</td>
<td>Environmental Genetics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: None

**Course Objectives:**
1. Relate environmental factors affecting life through interaction with genes/DNA
2. Explain the factors involved in mutagenesis
3. Discuss antimutagens with suitable examples

**Expected Course Outcome:**
1. Perceive the influence of various environmental factors on biological systems through the introduction of changes in DNA sequences
2. Illustrate the roles of chromosomes and genes in heredity
3. Summarize the roles of genes and the environment in the determination of phenotype
4. Categorize the sources of irradiation (e.g., UV x-rays) in the environment and describe their genetic significance
5. Describe sources of mutagenic, carcinogenic, and teratogenic chemicals in the environment and identify their known effects
6. Analyze the human genome and identify common chromosome and gene disorders

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning

<table>
<thead>
<tr>
<th>Module:1</th>
<th>MUTATION</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mutagenesis - Spontaneous and induced mutation – Somatic and germ cell Mutations; Gene mutations and chromosomal mutations. Physical, chemical and biological agents, Interaction of chemical mutagens and radiation with genetic material- electromagnetic spectrum- biological effects of ionizing radiation and ultraviolet rays</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:2</th>
<th>ANTIMUTAGENS</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Modification of mutagenic damage- anti-mutagenesis and de-mutagenesis in yeast, Neurospora, Drosophila- and C. elegans life cycle</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Molecular techniques to induce mutation</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mutagenicity assessment- Salmonella (Ames test), Methods to induce genetic variation in single genes: Insertional mutagenesis - transposon and TDNA mutagenesis; In vitro mutagenesis; Oligonucleotide and PCR mediated site-specific mutagenesis; TILLING; RNAi mutagenesis.</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Techniques to detect mutations</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mouse-cytogenetic procedures and techniques to assess gene mutations. In vitro mammalian systems for mutagenicity evaluation- human lymphocytes, fibroblasts, and Chinese hamster cells in culture- Unscheduled DNA synthesis, Chromosomal aberrations, Sister chromatid exchanges, gene mutation- HGPRT and TK.</td>
<td></td>
</tr>
</tbody>
</table>
### Module: 5
**Mutation induced cancer and congenital disabilities**
7 hours

The interrelationship between mutagenesis and Carcinogenesis, Tests for evaluation. Teratogenesis- Mouse as test system congenital anomalies-teratogens in comparison with mutagens and carcinogens- congenital disabilities in man radiosensitizers.

### Module: 6
**Environmental factors affecting reproduction**
6 hours


### Module: 7
**Mechanisms involved in the protection of genome from environmental mutagens**
7 hours

Various DNA repair mechanisms involved in the protection of genome from mutagens.

### Module: 8
**Contemporary topics:**
2 hours

Lectures by industrial expert

| Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No. 46 Date 24-08-2017
Course code | Course title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
BIY 3003 | Protein Engineering | 2 | 0 | 0 | 4 | 3
Pre-requisite | Syllabus version | v. 1

Course Objectives:
1. Recall the basics concepts of protein engineering
2. Summarize the necessary elements of protein overexpression systems in bacteria.
3. Illustrate the importance of engineering the proteins and their novel applications

Expected Course Outcome:
1. Explain about different techniques for protein analysis
2. Formulate and purify proteins
3. Discuss advanced biophysical techniques for protein analysis, their relative merits and interpret data from those techniques
4. Evaluate the steps required to produce an expression system for a new protein
5. Outline the techniques for modifying proteins
6. Utilize various software for protein visualization and modeling

Student Learning Outcomes (SLO): 2, 11, 18
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
18. Having critical thinking and innovative skills

Module:1 Overview of Protein Structure and Function 4 hours
Properties of proteins; Levels in protein structure – folding pattern, 3D structures; Covalent chemical modification of proteins – covalent and non-covalent forces are determining protein structure; Overview of protein synthesis & degradation.

Module:2 Techniques for the study of proteins structures 4 hours
UV spectroscopy, Circular dichroism, Fluorescence, Mass spectrometry, Nuclear magnetic, Resonance spectroscopy, X-ray diffraction technique.

Module:3 Protein stability and dynamics 4 hours
Factors determining the intrinsic and extrinsic stability of proteins, thermodynamic stability versus kinetic stability of proteins, unfolding and folding of proteins, induced molecular conformational changes in proteins, molecular dynamics of proteins.

Module:4 Design of Recombinant Proteins 4 hours
Types of mutagenesis, Recombinant protein production – Differences in the host cells, Over-expression of proteins, Directed Evolution Strategy, High throughput production, and analysis of recombinants, proteins, inclusion bodies, co-expression of proteins with specific properties, stabilization of proteins.
**Module:5**  **Techniques in Protein Engineering**  **4 hours**
Expressing and analyzing protein in Prokaryotic and eukaryotic systems, Identification and analysis of sequence-specific DNA- binding proteins. Enhanced recovery and folding of recombinant proteins using fusion protein strategies; protein engineering for affinity purification; stabilization of enzymes by protein engineering, engineering specificity of enzymes.

**Module:6**  **Covalent Modifications and Protein Engineering by Semi Synthesis**  **4 hours**
Susceptibility of amino acid side chains for chemical modification, residue-specific modifications, reagents for modifications; cross-linkers in protein modifications; insulin and cytochrome c semi-synthesis; press-stud conjugations; Application of protein conjugates.

**Module:7**  **Peptidomics and Peptidomimetics**  **4 hours**
Engineering antibodies and vaccines; hormones & receptors; Combinatorial Enzyme Engineering. Engineering Proteins for degradation of recalcitrant compounds, Peptidomimetics in Medicinal chemistry, and drug design.

**Module:8**  **Contemporary issues:** Lecture by invited experts.  **2 hours**

| Total Lecture hours: | 30 hours |

**Text Book(s)**

**Reference Books**

**Projects: ‘J’ Components**

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

Recommended by Board of Studies  03-08-2017
Approved by Academic Council  No. 46  Date  24-08-2017
**Course code** | Molecular Modelling and Drug Designing | L | T | P | J | C  
---|---|---|---|---|---|---  
BIY3004 | | 3 | 0 | 2 | 0 | 4  

**Pre-requisite** | None | Syllabus version  
---|---|---  
---|---|---  

**Course Objectives:**
1. Outline preliminary concepts in molecular modeling using molecular dynamics
2. Utilize basic modeling techniques to explore biological phenomena at the molecular level
3. Perceive knowledge in protein-ligand interaction study by docking and visualization tools for molecular dynamics.

**Expected Course Outcome:**
1. Illustrate the concepts of Molecular modeling using Molecular Dynamics
2. Utilize basic modeling techniques to explore biological phenomena at the molecular level
3. Experiment with protein-ligand interaction study by docking.
4. Translate the understanding of visualization tools for molecular dynamics
5. Apply the information gained in various chemistry and biochemistry courses toward solving problems pertinent to drug designing
6. Demonstrate the relative importance of molecular modeling and drug designing

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
18. Having critical thinking and innovative skills

| Module:1 | Quantum mechanics & concepts in molecular modeling | 7 hours  
---|---|---  

Coordinate systems, potential energy surfaces. Introduction to quantum mechanics.

| Module 2 | Force Fields | 7 hours  
---|---|---  

Bond stretching; angle bending, torsional terms; non-bonded interactions; electrostatic interactions; Vander Waals interactions

| Module:3 | Molecular Dynamics and Monte Carlo simulation | 7 hours  
---|---|---  

Design constraints, Potentials in MD simulation, Molecular dynamics algorithms.

| Module:4 | Analysis and Properties | 6 hours  
---|---|---  

Geometry optimization, Vibrational frequencies: potential energy surface, harmonic vs. fundamental frequencies, zero-point vibrational energies.

| Module:5 | Modeling | 5 hours  
---|---|---  

Homology modeling, Ab initio, Protein Threading.

| Module:6 | Drug design | 6 hours  
---|---|---  

Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design.
### Module: 7 Molecular Docking

Docking - molecular modeling in drug design – structure-based drug design – pharmacophores - QSAR.

| Total Lecture hours: | 45 hours |

### Module: 8 Contemporary issues:

Lectures by industrial expert

<table>
<thead>
<tr>
<th>Text Book(s)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
</tr>
</thead>
</table>

Authors, book title, year of publication, edition number, press, place

### Mode of Evaluation: Assignments, Continuous assessment tests and Final assessment test.

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exploration of small molecule and macromolecule database</td>
<td>3</td>
</tr>
<tr>
<td>2. Small molecule drawing and optimization using Chem Sketch</td>
<td>2</td>
</tr>
<tr>
<td>3. Macromolecular visualization using PyMOL</td>
<td>3</td>
</tr>
<tr>
<td>4. Macromolecular visualization using SPDBV</td>
<td>2</td>
</tr>
<tr>
<td>5. Homology modeling of the drug target protein</td>
<td>2</td>
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<tr>
<td>6. Protein structure exploration with active site prediction</td>
<td>2</td>
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<tr>
<td>7. Protein-Protein interaction using HADDOCK</td>
<td>2</td>
</tr>
<tr>
<td>8. Protein-Ligand interaction using Autodock</td>
<td>3</td>
</tr>
<tr>
<td>9. Quantitative structure-activity relationships modeling tools</td>
<td>3</td>
</tr>
<tr>
<td>10. Molecular Mechanics for small molecules</td>
<td>2</td>
</tr>
<tr>
<td>11. Avogadro for molecular mechanics</td>
<td>2</td>
</tr>
<tr>
<td>12. Pharmacophore screening of small molecules</td>
<td>2</td>
</tr>
<tr>
<td>13. Quantitative structure-activity relationship</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Laboratory Hours: 30 hours

Recommended by Board of Studies: 03-08-2017
Approved by Academic Council: No. 46 Date: 24-08-2017
## Course Objectives:
1. Illustrate the cellular and molecular mechanisms that are dysregulated in cancerous cells.
2. Summarize the genomic technologies and develop critical thinking skills in cancer research.
3. Analyze traditional chemotherapy and novel targeted therapeutic approaches.

## Expected Course Outcome:
1. Infer cancer causing mutations and specific therapeutic targets.
2. Compare the biological treatment processes and development of suitable technologies.
3. Determine the challenging sides of using cancer models in cancer research.
4. Interpret the data published in scientific articles.
5. Relate the molecular biology of cancer with clinical aspects of the disease.

### Student Learning Outcomes (SLO):
- 2,18
- 18. Having critical thinking and innovative skills.

<table>
<thead>
<tr>
<th>Module:1</th>
<th>Cell cycle and molecular mechanism of carcinogenesis</th>
<th>7 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Evading apoptosis in cancer</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>The apoptotic mechanism, altered pathways in cancer cells that can evade apoptosis. Pathways are regulating tumor initiation and/or its progression.</td>
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</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Genomic instability</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of genomic instability: instability due to micro and mini satellite sequence, Loss of DNA repair mechanisms, Dysfunction of telomerase. Chromosomal aberrations that cause cancer. Single nucleotide polymorphisms and cancer.</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>Angiogenesis and Metastasis</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor angiogenesis, Clinical significance in invasion, Three-step theory of invasion, Proteinases, and tumor cell invasion.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>Cancer stem cells</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>The stem cell theory of cancer, tumor heterogeneity, Origin of cancer stem cells, and controlling cancer by targeting cancer stem cells.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Module: 6  
**Cancer Therapeutics and Diagnosis**  
7 hours  

## Module: 7  
**In vitro and In vivo models to study cancer**  
5 hours  
Cell culture techniques: MTT assay, colony-forming assay, and matrigel assay. Animal models used to study cancer: Nude mice, Transgenic and knockout mice, Cre mice, and patient-derived xenografts (PDXs).

## Module: 8  
**Contemporary Topics: Lecture by experts**  
2 hours

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
</tr>
</thead>
</table>

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies**  
03-08-2017

**Approved by Academic Council**  
No.46  
Date 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>BIY4002</td>
<td>Food Science</td>
<td>2</td>
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</tbody>
</table>

**Pre-requisite**

**Syllabus version**

v. 1

## Course Objectives:

1. Demonstrate the basic principles involved in food science
2. Illustrate the chemical and physical properties of food
3. Explain the role of microbes in food.

## Expected Course Outcome:

1. Relate the basic concepts of food science and the different components of food.
2. Appraise the physical and chemical characteristics of food for application in various food industries.
3. Demonstrate the association of microbes with foods.
4. Relate the principles of processing in food preservation.
5. Appraise the sensory attributes of food and its evaluation.
6. Evaluate the role of regulatory agencies governing food production and processing.

## Student Learning Outcomes (SLO):

1. Having a clear understanding of the subject related concepts and contemporary issues
2. Having critical thinking and innovative skills

### Module: 1 | Product

Characteristics of raw materials—cereals, legumes, fruits, vegetable nut, meat, dairy, egg, and seafood.

### Module: 2 | Physical characteristics of food

Salient physical properties in foods—viscosity, specific gravity, surface tension. Colloids—sols, gels, emulsions, foams.

### Module: 3 | Chemical characteristics of food

Chemical constituents (macromolecules and bioactive compounds) of food; major chemical changes during food processing.

### Module: 4 | Microbiology of food

Overview of microbes in food; Underlying principles in food spoilage.

### Module: 5 | Principles of food processing

Basic principles of food preservation and processing; emerging techniques in processing and packaging.

### Module: 6 | Sensory properties of food

Significance of sensory characteristics in food; Overview of methods of sensory evaluation.

### Module: 7 | Food quality and analysis

General principles; critical regulatory bodies, quality assurance programs Comparison of methods for proximate analysis; significant minerals, vitamins, and bioactive compounds in food. Case Study—Anti-oxidant analysis in food.
<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues: Lecture by industrial experts</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

**Text Book(s)**


**Reference Books**


Authors, book title, year of publication, edition number, press, place

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Experiment Details</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Determination of Quality of Milk sample by Methylene Blue Dye Reduction (MBRT) Test</td>
<td>2 Hours</td>
</tr>
<tr>
<td>2.</td>
<td>Qualitative Testing of Adulterated food samples</td>
<td>2 Hours</td>
</tr>
<tr>
<td>3.</td>
<td>Examination of spoiled food products</td>
<td>2 Hours</td>
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<tr>
<td>4.</td>
<td>Fermented foods</td>
<td>2 Hours</td>
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<tr>
<td>5.</td>
<td>Examination of wheat flour for gluten</td>
<td>2 Hours</td>
</tr>
<tr>
<td>6.</td>
<td>Determination of Acid Value of Fat sample</td>
<td>2 Hours</td>
</tr>
<tr>
<td>7.</td>
<td>Study of chemical properties of food</td>
<td>2 Hours</td>
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<tr>
<td>8.</td>
<td>Experiment title Bioreactor – demonstration</td>
<td>2 Hours</td>
</tr>
<tr>
<td>9.</td>
<td>Isolation of lactic acid bacteria from foods</td>
<td>2 Hours</td>
</tr>
<tr>
<td>10.</td>
<td>Examination of yeast from foods</td>
<td>2 Hours</td>
</tr>
<tr>
<td>11.</td>
<td>Stages of sugar cookery</td>
<td>2 Hours</td>
</tr>
<tr>
<td>12.</td>
<td>Malting, puffing, and popping of grains</td>
<td>2 Hours</td>
</tr>
<tr>
<td>13.</td>
<td>Visit food processing unit</td>
<td>2 Hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours** 30 Hours

**Project: ‘J’ Component**

CO: 07
<table>
<thead>
<tr>
<th><strong>Recommended by Board of Studies</strong></th>
<th>03-08-2017</th>
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<tbody>
<tr>
<td><strong>Approved by Academic Council</strong></td>
<td>No. 46</td>
</tr>
</tbody>
</table>
Course code | BIY5001  
Course title | Animal Biotechnology  
L | T | P | J | C | 3 | 0 | 0 | 0 | 3  
Pre-requisite | None  
Syllabus version | v. 1  

Course Objectives:
1. Explain the methods of gene manipulations in animal cells and embryonic stem cells  
2. Develop breeding and conservation approaches in animals  
3. Appraise the legal and ethical issues related to animal maintenance.

Expected Course Outcome:
1. Extend the best practices followed during maintenance of cell lines  
2. Apply different techniques to manipulate the genome of animal cells.  
3. Formulate ideas for the production of genetically modified organisms.  
4. Organize different approaches in reproduction technology  
5. Utilize the concept of molecular techniques involved in animal conservation

Student Learning Outcomes (SLO):  
2. Having a clear understanding of the subject related concepts and contemporary issues  
10. Having a clear understanding of professional and ethical responsibility  
18. Having critical thinking and innovative skills

Module: 1  
Animal cell culture and applications  
6 hours  
Primary cells and cell lines. Methods to transform primary cells. Choice of animal cells for protein production, Viral vaccine production. Scale-up of animal cell culture. Applications of animal cell culture with examples.

Module: 2  
Gene transfer methods in animal cells  
6 hours  
Transformation, Transfection, and Electroporation. Selection of cells for stable transfection and continuous production of protein from the transgene. Methods to knockdown the expression of endogenous genes.

Module: 3  
Gene manipulations in Animals  
6 hours  
Embryonic stem cells, gene manipulations in embryonic stem cells, transgenic, knockout, and Cre/LOXP mice. Cloning of animals.

Module: 4  
Animal breeding methods for better traits  
6 hours  
Artificial insemination-estrous synchronization; superovulation; embryo transfer, pregnancy, and parturition control; monitoring reproductive status in animals, in-vitro fertilization, sperm and embryo sexing; pre-implantation genetic diagnosis.

Module: 5  
Conservation of Animals  
6 hours  
Animal and human Genome projects genetic linkage maps; polymorphic DNA markers; Physical map; integrating genetic linkage and physical map; DNA sequencing; Molecular techniques in genetic conservation of Farm Animals, and detection of Animal Diseases.

Module: 6  
Genetically modified animals and their applications  
7 hours
Genetically modified animal models used in biomedical research such as Cancer, Diabetes, Immunology, and Toxicology

**Module: 7  |  Ethics and social problems:**

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<tbody>
<tr>
<td></td>
<td>6 hours</td>
</tr>
<tr>
<td>a) Classification based on genome</td>
<td>b) genetically modified organism</td>
</tr>
</tbody>
</table>

**Module: 8  |  Contemporary topics:** Lecture by industrial experts

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<td></td>
<td>2 hours</td>
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**Total Lecture hours:** 45 hours

**Text Book(s)**

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**Reference Books**

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</table>

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test

**Recommended by Board of Studies** 03-08-2018

**Approved by Academic Council** No. 46 Date 24-08-2017
**Course code**  BIY5002  **Course title**  Gene Therapy  

<table>
<thead>
<tr>
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<td>3</td>
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<td>3</td>
</tr>
</tbody>
</table>

**Pre-requisite**  None  

**Syllabus version**  v. 1

**Course Objectives:**
1. Recall various forms of therapeutic nucleic acids, and compare their significance with those of chemical, protein and cell-based therapies
2. Dissect different methods that are currently available to deliver therapeutic genes into target cells, and distinguish challenges of each method
3. Evaluate various regulatory considerations for a clinical trial, and infer from previously conducted gene therapy clinical trials for specific human diseases

**Expected Course Outcomes:**
1. Relate the principle of gene therapy with its potential use as a future drug
2. Adapt different gene delivery methods based on the nature of the disease, therapeutic threshold, and type of target tissue involved
3. Choose different genetic elements (both viral and non-viral) based on their roles in viral titration, gene expression, and gene silencing
4. Design novel viral vectors by pseudotyping (retrovirus) or serotyping (adenovirus) to broaden their tropism for multiple different tissues
5. Identify potential disease models (both in vitro and in vivo) to test a candidate vector carrying a specific therapeutic gene
6. Criticize severe adverse events of a gene therapy clinical trial due to vector-related genotoxicity and immunotoxicity

**Student Learning Outcomes (SLOs): 2,11,12**
2. Having a clear understanding of the subject related concepts and contemporary issues
11. Having an interest in lifelong learning
12. Having adaptive thinking and adaptability

**Module:1  Introduction to Gene Therapy  5 hours**
- Genes as drugs; Therapeutic nucleic acids: antisense oligonucleotides, ribozymes, aptamers, siRNAs and miRNAs

**Module:2  Physical and Chemical Methods of gene Delivery  5 hours**
- Cellular barriers to gene delivery; Direct inoculation of DNAs and RNAs; Physical methods: electroporation, hydroboration, sonoporation, gene gun, and jet injection; Chemical methods: liposomes and cationic lipids, cationic polymers and proteins

**Module:3  Viral Vectors for Gene Therapy  8 hours**
- Viral genome organization, vector construction, production and properties of gamma retroviral, lent viral, adenoviral and adeno-associated virus vectors; Overview of foamy and herpes simplex virus vectors for gene therapy applications

**Module:4  Overview of Preclinical and Clinical Testing  6 hours**
Therapeutic gene expression in cell lines; Comparison of small and large animal models; Phases of clinical trials; Types of transplant therapies; Gene transfer into stem cells; Regulatory considerations for gene therapy

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Clinical Applications of Gene Therapy I</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gene therapy for severe combined immune deficiencies, X-SCID and ADA-SCID; Gene therapy for cystic fibrosis; Gene therapy for muscular dystrophies; Gene therapy for hemophilia A and B</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Clinical Applications of Gene Therapy II</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gene therapy for cancer; Gene therapy for neurodegenerative disorders, Alzheimer’s and Parkinson’s diseases; Gene therapy for eye diseases, retinitis pigmentosa, and Leber’s congenital amaurosis; Gene therapy for HIV infection</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Ethical and Social Problems of Gene Therapy</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety of clinical experimentation; Germline gene therapy; In utero gene therapy; Gene therapy of the embryo; Gene transfer for the cosmetic appearance and gene doping</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues</th>
<th>2 hours</th>
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<tbody>
<tr>
<td>Gene editing using CRISPR/Cas9 technology; Status of gene therapy in India and abroad</td>
<td></td>
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</tbody>
</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**
2. Elsersawel A (2016) Gene Editing, Epigenetic, Cloning, and Therapy. Author house publishing

**Reference Books**

**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

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**Recommended by Board of Studies** 03-08-2017
**Approved by Academic Council** No. 46 Date 24-08-2017
<table>
<thead>
<tr>
<th>Course code</th>
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<td>BIY 5003</td>
<td>Enzyme Technology</td>
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<th>Syllabus version</th>
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<tr>
<td>None</td>
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**Course Objectives:**
1. Discuss the concepts of food biotechnology
2. Relate the role of biotechnology in the food industry
3. Explain the consumer perception of food biotechnology

**Expected Course Outcome:**
1. Select suitable purification techniques
2. Evaluate the optimization of enzyme activity
3. Infer recent types and advantages of immobilization techniques
4. Outline the modern techniques used in enzyme engineering
5. Categorize applications of enzymes
6. Design new processes with the use of enzymes

**Student Learning Outcomes (SLO):**
2. Having a clear understanding of the subject related concepts and contemporary issues
5. Having design thinking capability
9. Having problem-solving ability—solving social issues and engineering problems

**Module: 1  Enzymes purification**

Introduction of Enzymes, Isolation of Enzymes, Objectives, and strategy in enzyme purification, Choice of source, Methods of homogenization, Methods of separation, Success of purification, Examples of purification procedures

**Module: 2  Large scale production and purification of enzymes**

Methods involved in Large scale production of enzymes and large scale purification of Enzymes, recombinant enzymes.

**Module: 3  Optimization of enzyme activity**

Enzymatic reactions in biphasic liquid systems, The stabilization of enzymes in biphasic aqueous-organic systems, Equilibria in biphasic aqueous-organic systems, Use of aqueous 2-phase systems, Practical examples of the use of enzymes ‘in reverse’.

**Module: 4  Immobilization techniques**

Immobilization of enzymes and cells, Effect of immobilization on enzyme properties, Application of immobilized enzymes and cells, Syrup production from corn starch, L-aminoacids from racemic mixtures, Acrylamide synthesis, Therapeutic applications of immobilized enzymes

**Module: 5  Enzymes in the clinical industry**

Enzymes for clinical diagnosis, Role of biosensors in diagnosis, Use of enzymes to determine the concentration of metabolites of clinical importance. Enzyme inhibitors and drug design, Enzyme therapy: Treatment of genetic deficiency disease, Cancer therapy
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Microbial enzymes in industry</th>
<th>4 hours</th>
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<tr>
<td></td>
<td>Application of microorganisms in brewing, cheese making, organic chemicals, Isolated enzymes in industrial processes</td>
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<table>
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<tr>
<th>Module:7</th>
<th>Modification of enzymes for industrial use</th>
<th>4 hours</th>
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<tr>
<td></td>
<td>Methods to modify enzymes for improvement of enzyme activity as per the industrial requirement with examples</td>
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<tr>
<th>Module:8</th>
<th>Contemporary issues: Lecture by industrial experts</th>
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<table>
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<th>Total Lecture hours:</th>
<th>30 hours</th>
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</table>

**Text Book(s)**

2. Bhatt SM (2011) Enzymology and Enzyme Technology, S Chand publishing India

**Reference Books**

1. books published after 2010 (preferably after 2015) to be given (please give complete bibliography)

**Recommended by Board of Studies**

03-08-2017

**Approved by Academic Council**

No. 46  | Date  | 24-08-2017
## Course Objectives:
1. Discuss the concepts of food biotechnology
2. Relate the role of biotechnology in the food industry
3. Explain the consumer perception of food biotechnology

## Expected Course Outcome:
1. Recall critical concepts in food production and contemporary issues in the field
2. Extend the principles of fermentation and its application in the processing of food
3. Demonstrate the role of enzymes in the food industry
4. Appraise the role of biotechnology in designing novel food products
5. Build quality assurance and control systems for specific food industries
6. Justify the management of food waste, global food trade, and related national and international laws

### Student Learning Outcomes (SLO):

1. Having a clear understanding of the subject related concepts and contemporary issues
2. Having critical thinking and innovative skills

### Module: 1 | Introduction to Food Biotechnology | 3 hours
- Definition; scope in the food industry; Interdisciplines involved; overview of biotechnological methods in the food sector.

### Module: 2 | Microbial biotechnology | 5 hours
- Fermentation - principles, types, starter cultures, advantages, disadvantages. Chemicals used in processing. Case study - fermented milk products;

### Module: 3 | Biotechnology for improved food process | 4 hours
- rDNA chymosin; overview of enzymes in the food industry. Case study-HFCS production through biotechnology.

### Module: 4 | Novel products through biotechnology | 3 hours
- GM foods-regulatory systems, Functional foods; designer foods; nano foods.

### Module: 5 | Molecular food diagnostics | 4 hours
- Molecular methods - overview, types, comparison with conventional techniques. Case study-molecular detection of Salmonella in food matrices.

### Module: 6 | Utilization of food waste | 4 hours
- Characteristics and types of food wastes; value-added products from food wastes.

### Module: 7 | Food biotechnology and Consumerism | 4 hours
- Consumer perception-national and international scenario; factors influencing the consumers, impact on global food trade, import, and export laws.
### Module: 8

**Contemporary issues:** Lectures by experts  

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**Total Lecture hours:** 30 hours

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#### Text Book(s)


#### Reference Books


Authors, book title, year of publication, edition number, press, place

#### Mode of Evaluation:
Assignments, Continuous assessment tests and Final assessment test.

#### Project: ‘J’ Component

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Course code | Environmental Biotechnology | L | T | P | J | C
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BIY5005 | | 2 | 0 | 4 | 3 | 3
Pre-requisite | | | | | | v.1.2

Course Objectives:
1. Elaborate on the various types of pollutants and ways to control them
2. Illustrate microbial-mediated bioremediation and their types
3. Choose suitable methods to protect the environment

Expected Course Outcome:
1. Assess the different types of pollution and the role of biogeochemical cycles in the environment
2. Utilize the knowledge in the field of bioremediation to remediate the environment
3. Demonstrate the types of solid waste and their management
4. Build bioremediation and phytoremediation-mediated environmental cleanup technologies.
5. Formulate GMOs for degradation and bioremediation through extremophiles
6. Examine environmental pollution and develop models to resolve it

Student Learning Outcomes (SLO):
2. Having a clear understanding of the subject related concepts and contemporary issues
10. Having a clear understanding of professional and ethical responsibility

Module:1  | Pollutants and its type | 4 hours
Sources of pollution, Physico-chemical parameters of the pollutants, molecular detection of the microbial community (Metagenomics), Role of living organisms in primary biogeochemical cycles C, N, S, and P - disruption of biogeochemical cycles -Causes and effects. Eutrophication, Environmental Qualitative and Quantitative detection of the toxic compounds from the polluted site.

Module:2  | Microbial mediated Bioremediation | 4 hours
Microbial degradative pathways (Aromatic and aliphatic compounds), metal microbe interactions, Biohydrometallurgy and Biomining, biomagnification, Biosorption, Bioaccumulation and Biodegradation, Bioremoval of xenobiotic compounds

Module:3  | Types of Bioremediation | 4 hours
Bioremediation - In-situ – Bioaugmentation, Bioventing, and other technologies, Ex-situ – solid waste management (Landfarming, composting, and Biopiles)

Module:4  | Bioremediation Techniques | 4 hours
Technologies in bioremediation – Biofilms based removal (Quorum sensing). activated sludge (suspended growth), N and P removal - lagoons, trickling filter (attached growth) - Rotating Biological contactors (RBC)

Module:5  | Phytoremediation | 4 hours
Phytoremediation and its types, rhizome remediation strategy and processes, a case study in the removal of heavy metals and other toxic pollutants

Module:6  | Bioreactors for Bioremediation | 4 hours
Aerobic and anoxic type bioreactor for biodegradation- solid, liquid and air (slurry, batch, and continuous processes), Application of GMO’s in Bioremediation

<table>
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<tr>
<th>Module:7</th>
<th><strong>Extremophiles in bioremediation</strong></th>
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<tbody>
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<td>Microbial habitat in various ecological niches, Extremophiles, and its types, Hydrothermal vent ecosystem and its biotechnological potentials, Ecofriendly Bioproducts</td>
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**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test

**Project: J component**

Recommended by Board of Studies 03-08-2017
Approved by Academic Council No.46 24-08-2017
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**Course Objectives:**
1. Outline the biology and diagnostics for various diseases
2. Appraise host-microbe interactions in causing infectious diseases and different methods of their relative diagnosis and prophylaxis
3. Utilize medical engineering to take up research in challenging areas of therapy and diagnosis

**Expected Course Outcome:**
1. Evaluate the biology of various diseases
2. Discover various diagnostic methods and imaging techniques
3. Assess disease etiology, respective diagnosis, and molecular therapeutic approaches
4. Relate histocompatibility, transplantation and stem cell culture
5. Appraise the principles of teratogenesis
6. Formulate the use of automated systems in therapeutics

**Student Learning Outcomes (SLO):** 2 and 10
10. Having a clear understanding of professional and ethical responsibility

**Module:1 An Introduction to Human Diseases**
- 5 hours

**Module:2 Principles of Diagnosis**
- 7 hours

**Module:3 Host – Microorganism Interaction**
- 6 hours

**Module:4 Transplantation**
- 6 hours

**Module:5 Teratogenesis**
- 5 hours

**Module:6 Diagnostics**
- 7 hours

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M.Sc Intg Biotechnology (5yr.)

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<tr>
<th>Module:7</th>
<th>Medical Engineering and Therapeutics</th>
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<tbody>
<tr>
<td></td>
<td>Antibody (polyclonal &amp; monoclonal) Engineering. Therapeutics such as vitamins, laxatives, analgesics, non-steroidal contraceptives, and biological hormones. Therapeutic proteins &amp; enzymes– Vaccine development – gene therapy.</td>
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**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Assignments, Continuous assessment tests and Final assessment test.

**Recommended by Board of Studies** 03-08-2017

**Approved by Academic Council** No. 46 Date 24-08-2017