## Regulations and Course Curriculum for Master of Science in Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)]

Choice Based Credit System (CBCS) For Batch admitted from 2018-19 and onwards



## VISION

To build a humane society through excellence in education and healthcare

## MISSION

To develop Nitte (Deemed to be University) As a centre of excellence imparting quality education, generating competent, skilled manpower to face the scientific and social challenges with a high degree of credibility, integrity, ethical standards and social concern

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#### No. F.9-13/2007-U.3 (A) Government of India Ministry of Human Resource Development (Department of Higher Education) <u>U.3(A) Section</u>

Shastri Bhawan, New Delhi, Dated the 4<sup>th</sup> June, 2008

#### **NOTIFICATION**

- 1. Whereas the Central Government is empowered under Section 3 of the University Grants Commission (UGC) Act, 1956 to declare, on the advice of the UGC, an institution of higher learning as a deemed-to-be-university;
- 2. And whereas, a proposal was received in February, 2007 from Nitte Education Trust, Mangalore, Karnataka seeking grant of status of deemed-to-be-university in the name of Nitte University under Section 3 of the UGC Act, 1956;
- 3. And whereas, the University Grants Commission has examined the said proposal and vide its communication bearing No. F.26-10/2007(CPP-I/ DU) dated the 10th March, 2008 has recommended conferment of status of 'deemed-to-be-university' in the name and style of Nitte University, Mangalore, Karnataka, comprising A.B. Shetty Memorial Institute of Dental Sciences, Mangalore;
- 4. Now, therefore, in exercise of the powers conferred by section 3 of the UGC Act, 1956, the central Government, on the advice of the University Grants Commission (UGC), hereby declare that Nitte University, Mangalore, Karnataka, comprising A.B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore, shall be deemed to be a University for the Purposes of the aforesaid Act.

Sd/ (Sunil Kumar) Joint Secretary to the Government of India

(True Extract of the Notification)



#### UNIVERSITY GRANTS COMMISSION BAHADUR SHAH ZAFAR MARG NEW DELHI - 110002

No. F.26-5/2008(CPP-1)

Dated: 24th March, 2009

#### **OFFICE MEMORANDUM**

- 1. Whereas the Government of India, Ministry of Human Resource Development, Department of Higher Education vide Notification No. F.9-13/2007-U.3(A) dated 4th June, 2008 declared Nitte University, Mangalore, Karnataka comprising A.B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore as Deemed to be University under Section 3 of UGC Act, 1956.
- 2. And whereas now, the University Grants Commission, on the recommendation of an Expert Committee constituted by the Chairman, UGC has agreed for bringing (i) K.S. Hegde Medical Academy, Deralakatte, Mangalore, (ii) Nitte Usha Institute of Nursing Sciences, Deralakatte, Mangalore, (iii) Nitte Gulabi Shetty Memorial Institute of Pharmaceutical Sciences, Deralakatte, Mangalore, (iv) Nitte Institute of Physiotherapy, Deralakatte, Mangalore under the ambit of Nitte University, Deralakatte, Mangalore.

Sd/ (K.P. Singh) Joint Secretary University Grants Commission

(True Extract of the Notification)



# Nitte University

(Deemed University under Section 3 of UGC Act, 1956) (Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A' Grade by NAAC) University Enclave, Deralakatte, Mangalore – 575 018 Tel: +91-824-2204300/01/02/03 Fax: +91-824-2204305 Website: www.nitte.edu.in E-mail: info@nitte.edu.in

Ref. No. NU/REG/AC/2015-16/180-F

Date: 31-07-2015

#### NOTIFICATION

Sub: Regulations and Course Curriculum for Master of Science in Biomedical Science [M.Sc. (Biomedical Science)]; Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)] and Marine Microbiology and Biotechnology [M.Sc. (Marine Microbiology and Biotechnology)]

In exercise of the powers conferred under Rule No. R. 9 of the MoA, the Academic Council in its 25th meeting held on 30-07-2015 under the agenda item no. AC/13(7)-25/15 has been pleased to approve the Regulations and Course Curriculum for Master of Science in Biomedical Science [M.Sc. (Biomedical Science)]; Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)] and Marine Microbiology and Biotechnology [M.Sc. (Marine Microbiology and Biotechnology)] course.

The Regulations, scheme and syllabus shall come into force from the academic year 2015-16.

By order,

#### REGISTRAR

(Deemed University) (Deemed University under Section 3 of UGC Act, 1956) (Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A' Grade by NAAC) University Enclave, Deralakatte, Mangalore – 575 018 Tel: +91-824-2204300/01/02/03 Fax: +91-824-2204305 Website: www.nitte.edu.in E-mail: info@nitte.edu.in

#### Prof. Dr. Alka Kulkarni Registrar

Ref: NU/REG/AC-NUCSER/2018-19/056

Date: 13-07-2018

#### **NOTIFICATION**

# Sub: Adoption and implementation of CBCS for M.Sc (Biomedical Science) and M.Sc (Food Safety and Biotechnology)

In exercise of the powers conferred under Rule No.R.9 of the MoA, the Academic Council in its 35<sup>th</sup> meeting held on 03-07-2018 under the agenda item no. AC/8-35/18 has been pleased to approve the adoption and implementation of CBCS for M.Sc (Biomedical Science) and (M.Sc Food Safety and Biotechnology) from the academic year 2018-19.

By Order, Warnie

REGISTRAR

University Enclave, Medical Sciences Complex, T 0824-2204300/01/02/03 E reg@nitte.edu.in Deralakatte, Mangalore – 575 018 D 0824-2204309 W www.nitte.edu.in F 0824-2204305



(Deemed to be University under Section 3 of UGC Act, 1956) (Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A' Grade by NAAC) Mangaluru, Karnataka, India

## Regulations and Course Curriculum For Master of Science in Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)] Choice Based Credit System (CBCS)

#### **Preamble:**

The M. Sc. (Food Safety and Biotechnology) has been instituted in Nitte University Centre for Science Education and Research (NUCSER) from the academic year 2015-16. From the academic year 2018-19, the institute has adopted and implimentated the CBCS for M. Sc. (Food Safety and Biotechnology). The regulations for this programme is formulated as under:

#### 1. Introduction:

- 1.1 These regulations shall be called Nitte (Deemed to be University) Regulations for M.Sc. (Food Safety and Biotechnology) programme and govern the policies and procedures including selection, admission, Imparting of instructions, conduct of examinations evaluation and certification of candidate's performance and all amendments thereto, leading to the award of M.Sc. (Food Safety and Biotechnology) degree. The regulations shall come into effect from the academic year 2018-19.
- 1.2 This set of regulations shall be binding on all the candidates undergoing the said degree programme.
- 1.3 These regulations may be modified from time to time as mandated by the statutes of the University.
- 1.4 This set of regulations may evolve and get refined or updated or amended or modified or changed through appropriate approvals from the Academic Council or the Board of Management from time to time and shall be binding on all parties concerned including the Candidates, Faculty, Staff, Departments and Institute Authorities.

1.5 All disputes arising from this set of regulations shall be addressed to the Board of Management. The decision of the Board of Management is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to jurisdiction of Courts of Mangalore only.

#### 2. Definitions:

Unless the context otherwise requires:

Academic year means two consecutive (one odd + one even) semesters

BoM means Board of Management of Nitte (Deemed to be University)

BoS means Board of Studies in Biological Science

*Course Co-coordinator/Head of the department/ Director* means a full time faculty appointed /nominated by the University for managing the department/Institute and authorize to and responsible for the implementation of the rules and procedures pertaining to the Department /Institute.

*Course:* referred to, as 'papers' is a component of a programme. All courses need not carry the same weight.

- *Core Course:* A course, which should compulsorily be studied by a candidate as a core requirement.
- *Discipline Specific Core course (DSC):* A course, which should be compulsorily be studied by a candidate related to the main discipline/subject of study
- *Elective Course:* A course, which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill.

| • | Discipline Specific Elective<br>Course (DSE): | Elective courses related to the main discipline/subject of study.   |  |  |  |  |  |
|---|---|---|--|--|--|--|--|
| • | Generic Elective Course (GE):                 | An elective course chosen generally from<br>an unrelated discipline/subject with an<br>intention to seek exposure.            |  |  |  |  |  |
| • | Skill Enhancement Courses (SEC):              | These are value-based and/or skill-based<br>and are aimed at providing hands-on-<br>training, competencies, skills etc. Maybe |  |  |  |  |  |

chosen from a pool of courses.

*Credit:* A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of lecture/tutorial or two hours of practical work/project work.

*Credit Based Semester System (CBSS):* The degree is prescribed in terms of number of credits to be completed by the students.

*Credit Point:* It is the product of grade point and number of credits for a course.

*Continuous Internal Evaluation (CIE):* A method of evaluation aimed to assess values, skills and knowledge imbibed by the student during the semester. To be done at Institute level.

*Cumulative Grade Point Average (CGPA):* It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

*Grade Point:* It is a numerical weight allotted to each letter grade on a 10-point scale.

*Letter Grade:* It is an index of the performance of students in a said course. Grades may be denoted by letters like O, S, A+, A, B, C, F and I.

School means any Institution under the ambit of the Nitte (Deemed to be University).

Semester Grade Point Average (SGPA): Measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

*Semester End Evaluation (SEE):* A method of evaluation in the form of grades to determine the objectives of the course at the end of the semester through term papers to show how good or how satisfactory the student in accomplishing the objective of the course.

He includes both genders - He and She.

Institute means Nitte University Centre for Science Education and Research

Regulations means this set of academic regulations

University means Nitte (Deemed to be University)

#### 3. Duration of the programme:

The duration of M.Sc. (Food Safety and Biotechnology) shall be two academic years (4 semesters)

#### 4. Medium of Instruction and Examinations:

The medium of Instruction and Examination shall be in English.

#### 5. Maximum period for completion of the programme:

The maximum period for completion of M.Sc. (Food Safety and Biotechnology) programme is 4 years.

#### 6. Eligibility for Admissions:

A candidate seeking admission to M.Sc. (Food Safety and Biotechnology) programme must have passed minimum three years of Bachelor's degree in Basic/ Applied Biological Sciences (Bio-medical/ Bio-science/ Biotechnology/ Biochemistry/ Microbiology/ Agricultural Sciences/ Food and Nutrition/ Environmental Science/ Veterinary Science/ Fisheries Science/ Medical Imaging Technology/ Operation Theatre Technology/ Medical Lab Technology/ BE-Biotechnology/ B Tech Biotechnology/ Medical/ Dental/ Pharmacy/ and any other equivalent life science degrees of any Board/University or an equivalent examination of any other approved Board or University with not less than 50% marks in aggregate.

For candidates belonging to SC/ST or Category I, the minimum percentage of marks shall be a pass in degree or its equivalent examination.

Foreign Nationals and candidates who have qualified from a Foreign University/Board should obtain permission from Nitte (Deemed to be University) prior to the admission for equivalence of the qualification.

#### 7. Selection of Eligible candidates:

Selection to the M.Sc. (Food Safety and Biotechnology) programme shall be on the basis of merit obtained in qualifying examination.

#### 8. Withdrawal -Temporary and Permanent:

#### 8.1 Temporary

- 8.1.1. A candidate who has been admitted to the programme may be permitted to withdraw temporarily for a period of six months or more up to one year on the grounds of prolonged illness, grave calamity in the family etc. provided:
  - a. He applies stating the reason of withdrawal with supporting documents and endorsement by parent/guardian.
  - b. The Institute is satisfied that the candidate is likely to complete his requirement of the degree within maximum time specified.

- c. There are no outstanding dues or demands with the department, library, hostel, Institute etc.
- 8.1.2. The tuition fee for the subsequent year may be collected in advance based on the severity of the case before giving approval for any such temporary withdrawal.
- 8.1.3. Scholarship holders are bound by the appropriate rules applicable.
- 8.1.4. The decision of the Institute/University regarding withdrawal of a candidate is final and binding.

#### 8.2. Permanent

- 8.2.1. A candidate who withdraws admission before closing date of admission for the academic session is eligible for the refund of the deposit only. The fees once paid will not be refunded on any account.
- 8.2.2. Once the admission for the year is closed and if a candidate wants to leave the Institution, he will be permitted to do so and take the Transfer Certificate from the College, if required, only after remitting the tuition fees for the remaining years.
- 8.2.3. Those candidates who have received any scholarship/stipend/other forms of assistance from the Institute shall repay all such amounts in addition to those mentioned in the clause above.
- 8.2.4. The decision of the Institute/University regarding withdrawal of a student is final and binding.

#### 9. Conduct and Discipline:

- **9.1.** Candidates shall conduct themselves within and outside the premises of the Institute in a manner befitting a student.
- **9.2.** As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.
- **9.3.** The following acts of omission and /or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures.
  - 9.3.1. Ragging as defined and described by the Supreme Court/Government.
  - 9.3.2. Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.
  - 9.3.3. Willful damage or stealthy removal of any property/belongings of the Institute/Hostel or of fellow students/citizens.

- 9.3.4. Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
- 9.3.5. Mutilation or unauthorized possession of library books.
- 9.3.6. Noisy or unseemly behavior, disturbing studies of fellow students.
- 9.3.7. Plagiarism of any nature.
- 9.3.8. Hacking of computer systems (such as entering into other person's domain without prior permission, manipulation and/or damage to the computer hardware and software or any other cyber crime, etc.)
- 9.3.9. Any other act of gross indiscipline as decided by the Board of Management from time to time.
- **9.4.** Commensurate with the gravity of offence, the punishment may be: reprimand, fine, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the Institute, rustication for a specific period or even outright expulsion from the institute, or even handing over the case to appropriate law enforcement authorities or the judiciary as required by the circumstances.
- 9.5. For any offence committed in -

(i) a hostel, (ii) a department (iii) a class room, and (iv) elsewhere, the Chief Warden, the Head of the Department and the Asst. Director (Student Affairs)/ Head of the Institution Authorities of the University respectively, shall have the authority to reprimand or impose fine.

- **9.6.** All cases involving punishment other than reprimand shall be reported to the Vice-Chancellor.
- **9.7.** Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the HoD/Director/Principal/Dean of the institute, as the case may be for taking the appropriate action.

#### **10. Graduation Requirements:**

Candidate shall be declared eligible for the award of the degree if he has:

- Fulfilled the degree requirements.
- No dues to the University, Institute, Departments, Hostels, Library, etc.
- No disciplinary action pending against him.

The award of the degree must be recommended by the Board of Management.

#### 11. Convocation:

Degrees will be awarded in person to all the eligible students who have graduated during the preceding academic year at the annual convocation For eligible students who are unable to attend the convocation, degree will be sent by post. Students are required to apply for the convocation along-with prescribed fee within the specified date, after satisfactory completion all degree requirements.

#### **12. Sturucture of the programme:**

- 12.1 The program is structured on choice based credit based system. For the award of degree, a candidate must take a total of 80 credits comprising of 7 Core Courses, 3 Discipline Specific Core Courses, 2 Generic Elective Courses, 1 Discipline Specific Elective course, 1 Skill Enhancement Course and 1 year of project work and 2 Seminars. The electives to be chosen from a pool of courses.
- 12.2 The programme consist of the following:

| Core Courses:                               | 28 credits |
|---|------------|
| Disipline Specific Core Course:             | 12 credits |
| Disipline Specific Elective Courses:        | 03 credits |
| Generic Elective Courses:                   | 06 credits |
| Skill Enhancement Course:                   | 03 credits |
| Seminar:                                    | 02 credits |
| Project Work:                               | 21 credits |
| Co- curricular / extra-curricular activites | 05 credits |

#### 13. Semester wise subjects of study and examination pattern:

|            |         |                                | Credits |   | Marks |        |     |           |                 |                |
|------------|---------|--------------------------------|---------|---|-------|--------|-----|-----------|-----------------|----------------|
| Subject    | Subject | Subject Subject<br>types Title |         |   |       | Theory |     | Practical |                 |                |
| Code       | types   |                                | Т       | Р | SEE   | CIE    | SEE | CIE       | l otal<br>marks | Grade<br>point |
| I SEMESTER |         |                                |         |   |       |        |     |           |                 |                |
| 18MFB11    | C1      | Food Chemistry                 | 2       | 2 | 50    | 20     | 20  | 10        | 100             | 10             |
| 18MFB12    | C2      | Cell and Molecular<br>Biology  | 2       | 2 | 50    | 20     | 20  | 10        | 100             | 10             |
| 18MFB13    | C3      | Biochemistry                   | 2       | 2 | 50    | 20     | 20  | 10        | 100             | 10             |
| 18MFB14    | C4      | Immunology                     | 2       | 2 | 50    | 20     | 20  | 10        | 100             | 10             |
| 18MFB15    | GE      | Generic Elective               | 1       | 2 | 50    | 20     | 20  | 10        | 100             | 10             |

|          | NC1         | GLP and<br>Biosafety*                                    | 0      | 0    | -  | 100 | -  | -   | 100* | -  |  |
|----------|-------------|--|--------|------|----|-----|----|-----|------|----|--|
|          |             | Total credits  | 19     | )    |    |     |    |     |      |    |  |
|          | II SEMESTER |  |        |      |    |     |    |     |      |    |  |
| 18MFB21  | C5          | Food Microbiology  | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB22  | C6          | Bioinformatics and<br>Computational<br>Biology           | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB23  | C7          | Research<br>Methodology &<br>Biostatistics               | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB24  | SEC         | Skill Enhancement<br>Course                              | 0      | 3    | -  | -   | 70 | 30  | 100  | 10 |  |
| 18MFB25  | GE          | Generic Elective   | 1      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
|          | NC2         | Research Ethics and IPR*                                 | 0      | 0    | -  | 100 | -  | -   | 100* | -  |  |
|          |             | Total credits  | 18     | 8    |    |     |    |     |      |    |  |
|          |             | Ι  | II SEM | IEST | ER |     |    |     |      |    |  |
| 18MFB31  | DSC1        | Food Standards,<br>Certifications and<br>Quality Control | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB3.2 | DSC2        | Food Additives and Adulterants                           | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB3.3 | DSC3        | Food Packaging<br>and Storage                            | 2      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB34  | DSE1        | Discipline Specific<br>Elective                          | 1      | 2    | 50 | 20  | 20 | 10  | 100  | 10 |  |
| 18MFB35  | <b>S</b> 1  | Seminar-I  | 0      | 1    | -  | -   | -  | 100 | 100  | 10 |  |
| 18MFB36  | P1          | Project work-I   | 0      | 5    | -  | -   | 80 | 20  | 100  | 10 |  |
|          |             | Total credits  | 2      | l    |    |     |    |     |      |    |  |
|          | IV SEMESTER |  |        |      |    |     |    |     |      |    |  |
| 18MFB41  | S2          | Seminar-II   | 0      | 1    | -  | -   | -  | 100 | 100  | 10 |  |
| 18MBS42  | P2          | Project work-II  | 0      | 16   | -  | -   | 80 | 20  | 100  | 10 |  |
| 18MFB43  | CC          | Co-curricular /<br>Extra curricular<br>activities        | 0      | 5    | -  | -   | -  | -   | 100  | 10 |  |
|          |             | Total credits  | 22     | 2    |    |     |    |     |      |    |  |

T: Theory classes; P: Practical Classes

C: Core course; CC: Co-curricular; CIE: Continuous Internal Evaluation; GE: Generic Electives; SEC: Skill enhancement Course; DSC: Discipline Specific core course; DSE: Discipline Specific Electives; S: Seminer; SEE: Semester End Evaluation; P: Project work; NC: Non- credit courses

\* Non- credit courses. To be mentioned as 'Pass (P)' or 'Fail (F)'. Examination will be conducted at institute level. The marks obtained will not be counted for the computation of SGPA/CGPA.

|                             |  | Cre   | dits |     |      | M         | arks |       |       |  |
|-----------------------------|--|-------|------|-----|------|-----------|------|-------|-------|--|
| Subject                     | Subject Title                                      |       |      | The | eory | Practical |      | Total | Grade |  |
| Code                        |  | Т     | Р    | SEE | CIE  | SEE       | CIE  | marks | point |  |
|                             | I SEMESTER   |       |      |     |      |           |      |       |       |  |
| Generic Electives [Any One] |  |       |      |     |      |           |      |       |       |  |
| 18MFB15-1                   | Toxicology   | 1     | 2    | 50  | 20   | 20        | 10   | 100   | 10    |  |
| 18MFB15-2                   | Food<br>Processing and<br>Preservation             | 1     | 2    | 50  | 20   | 20        | 10   | 100   | 10    |  |
| II SEMESTER                 |  |       |      |     |      |           |      |       |       |  |
| Skill enhanc                | ement Course [An                                   | y One | 2]   |     |      |           |      |       |       |  |
| 18MFB24-1                   | Techniques in<br>Biomedical<br>Science             | 0     | 3    | -   | -    | 70        | 30   | 100   | 10    |  |
| 18MFB24-1                   | Techniques in<br>Food Science                      | 0     | 3    | -   | -    | 70        | 30   | 100   | 10    |  |
| Generic Elec                | ctives [Any One]                                   |       |      |     |      |           |      |       |       |  |
| 18MFB25-1                   | Medical<br>Biotechnology                           | 1     | 2    | 50  | 20   | 20        | 10   | 100   | 10    |  |
| 18MFB25-2                   | Application of<br>Biotechnology<br>in Food Science | 1     | 2    | 50  | 20   | 20        | 10   | 100   | 10    |  |

#### List of elective subjects

| III SEMESTER                            |  |   |   |    |    |    |    |     |    |
|---|--|---|---|----|----|----|----|-----|----|
| Discipline Specific Electives [Any One] |  |   |   |    |    |    |    |     |    |
| 18MFB34-1                               | Nano<br>biotechnology                              | 1 | 2 | 50 | 20 | 20 | 10 | 100 | 10 |
| 18MFB34-2                               | Food<br>Toxicology                                 | 1 | 2 | 50 | 20 | 20 | 10 | 100 | 10 |
| 18MFB34-3                               | Bioprocessing<br>and<br>Fermentation<br>Technology | 1 | 2 | 50 | 20 | 20 | 10 | 100 | 10 |

#### 14. Electives:

- 14.1.1 For an elective course to be offered, atleast 50% of the class should opt for that particular course
- 14.1.2 Electives shall be offered based at the discretion of the institution

#### 15. Co- curricular / extra-curricular activites:

A total of 5 credit points is assigned for extracurricular and co-curricular activities and shall be earned by the students on the basis of their performance in defined activities (Shown below). The assessment of the extracurricular and co-curricular attainment shall be made by the activity coordinators, guides and the heads of the departments on the basis of assessment rubrics defined for each type of activity. The grades obtained by the students shall be sent to the University by the Head of the Institution at the end of fourth semester. A student should participate in a minimum of 4 types of activities and not more than 60 points may be derived from a single type of activity. The marks attained by the students shall be converted into letter grades and grade points as indicated in clause 20.1 of programme regulations, which shall be taken into account while calculating CGPA.

| Sl. No. | Name of the Activity   | Points* | Evidence  |
|---------|--|---------|---|
| 1       | Webinars related to the specialization of the student/program  | 10      | Attendance certificate issued by the organizers                 |
| 2       | Online Certificate Courses related to the specialization of the student/program  | 30      | Completion certificate issued by the organizers                 |
| 3       | Participation in Seminar/ Conference/<br>Workshop/Symposium/Training Programs<br>(related to the specialization of the<br>student) | 10      | Participation certificate issued by the organizers              |
| 4       | Presentation of papers/posters in<br>Conference/Workshop/Symposium<br>(related to the specialization of the<br>student)            | 15      | Participation certificate issued by the organizers              |
| 5       | Publication of research paper in indexed<br>(scopus or web of science) journals as first<br>author                                 | 30      | Acceptance letter from the journal                              |
| 6       | Publication of research paper in indexed<br>(scopus or web of science) journals as co-<br>author                                   | 15      | Acceptance letter from the journal                              |
| 7       | Publication of popular articles in college<br>magazines/ newspapers/ bulletins/ wall<br>magazines                                  | 05      | Proof of publication  |
| 8       | Academic Award/Research Award from StateLevel/National Agencies  | 10      | Award certificate   |
| 9       | Academic Award/Research Award from<br>International Agencies   | 20      | Award certificate   |
| 10      | Active participation in sports as institute<br>representative in inter-University and<br>above                                     | 10      | Certification by student<br>welfare incharge and<br>guide       |
| 11      | Participation in NSS activites of the institute  | 02      | Certification by NSS coordinator and guide                      |
| 12      | Participation in Swacch Bharat Internship  | 05      | Participation certificate<br>issued by competent<br>authorities |

**15.1 Defined activities for Co- curricular / extra-curricular activites:** 

- \* The points mentioned are for each instance of the activity (per activity)
- \* A student should participate in a minimum of 4 types of activities and not more than 60 points may be derived from a single type of activity.

#### 16. Attendance and Monitoring Progress of Studies:

- 16.1 A candidate shall study in the Institution for the entire period as a full time candidate is permitted to work student. No in any outside laboratory/college/hospital/pharmacy etc., while studying. No candidate should join any other course of study or appear for any other degree examination conducted by this University or any other University in India or abroad during the period of registration.
- 16.2 Each semester shall be taken as a unit for the purpose of calculating attendance.
- 16.3 A candidate who has put in a minimum of 75% of attendance in the theory and practical separately and who has fulfilled other requirements of the course shall be permitted to appear for SEE.
- 16.4 A candidate having shortage of attendance in a particular subject in a semester shall not be permitted to write the SEE for that subject. He shall be permitted to appear for SEE for that subject only after fulfilling the attendance requirement.

#### **17. Examination and Assesment:**

There shall be a SEE at the end of each semester.

#### **17.1** Scheme of Examination

Evaluation is based on formative evaluation (CIE) and summative evaluation (SEE).

#### 17.1.1. CIE

The CIE for theory shall be 20 marks and shall be 10 marks for practicals. CIE for theory shall be calculated based on sessional examinations, assignments, seminars, regularity and punctuality. There shall be two sessional examinations and the average of the two shall be considered for calculating the marks from sessionals. The CIE for practicals shall be calculated on the basis of the records of the practicals maintained, assignments etc.

A candidate must secure at least 50% of total marks for CIE in a particular course in order to be eligible to appear in the SEE of that subject.

#### 17.1.2. SEE

A candidate who satisfies the requirements of attendance, progress and conduct shall be eligible to appear for the SEEs. There shall be a SEE at the end of each semester.

To be eligible to appear for SEE a candidate should fulfil all the following conditions:

- a. Undergone satisfactorily the approved program of the study in the course/courses for the prescribed duration;
- b. 75% attendance separately in theory and in practical in each course;
- c. should have the minimum attendance requirement in all courses of that semester for the first appearance;
- d. secured at least 50% of total marks for CIE in a particular course; and
- e. fulfilled any other requirement that may be prescribed by the University from time to time.

#### 17.1.3. Allotment of Marks

For subjects, which have theory and practical component, the theory examination will be for 70, which will include 50 marks for SEE and 20 marks for CIE. Practical marks allotment will be for 30, which will include 20 marks for SEE and 10 for CIE. There will be 10 marks for CIE of practicals done and record maintenance.

For subjects, which do not have University theory examination, the practical examination will be for 100, which will include 70 marks for SEE and 30 marks for CIE, of which 10 marks will be for practical record maintenance. For each subject, the maximum marks allotted is 100, which corresponds to a grade point of 10.

#### 18. Project work / Dissertation:

As a partial requirement of the program, a candidate is required to carry out a research study in a selected area of his study, under the supervision of a faculty Guide. The results of the study shall be submitted to the University in the form a dissertation as per the prescribed format and within the date stipulated by the University. Only a candidate who has put in a minimum of 75% of attendance in the third and fourth semester shall be eligible to submit the dissertation.

The project is aimed at training a postgraduate candidate in research methodology and techniques. It includes identification of the problem, formulation of a hypothesis, review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

#### 18.1. Guide

A Guide shall be a full time faculty in the respective department of the Institute and recognized by University as a Guide for supervision of dissertation work. However, a co-guide can be opted wherever required with prior permission of the Institute and University. The Co-Guide should be a postgraduate teacher recognized by the University as Guide.

A candidate shall submit a synopsis to the University through the Guide and Head of the Institute, not later than nine months from the commencement of the 1<sup>st</sup> year or within the date notified by the University, whichever is earlier.

Once the synopsis is approved and registered by the University no change in the topic or Guide shall be made without the prior approval of the University.

In the event of registered Guide leaving the institute or in the event of the death of the Guide, a change of Guide shall be permitted by the University on the specific recommendation of the Institute.

#### 18.2 Schedule

The following procedure and schedule shall be strictly followed.

#### **18.2.1. Ethical Clearance**

Ethical Clearance should be obtained for a study involving any procedure on human subject. The candidate should apply for the certificate to the Ethics Committee of the Institute, through the Guide and present the study before the Committee for clearance. A copy of the certificate should be forwarded along with the synopsis at the time of approval of synopsis. All such clearance should be sought before commencement of the project work.

#### 18.2.2. Submission of the synopsis

The synopsis of the proposed study in the prescribed format with the clearances from the Ethics Committee (if required) should be submitted to the office of the Controller of Examinations through the Guide, HoD/Course Co-ordinator and Director of the Institute. The synopsis should be submitted before the commencement of the III semester. Once the synopsis is approved and registered by the university no change in the topic or Guide shall be made without the prior approval of the University.

#### **18.2.3** Final submission of the Dissertation

The dissertation complete in all respects and duly certified by the Guide/Co-Guide, Course Coordinator/ HoD and Director of the Institute should be forwarded to the Controller of Examinations as per the date specified by the University.

#### **18.3** Preparation of Dissertation

The written text of dissertation shall be not less than 50 pages and shall not exceed 100 pages (cover to cover). It should be neatly typed with 1.5 line spacing on one side of the paper (A4 size: 8.27" x 11.69") and lightly bound (paper back with flexible cover, no hard bind). E-submission of the dissertation is mandatory as it will be archived in the library in electronic format.

The dissertation should be written under the following headings in order.

- Introduction
- Aims or Objectives, Scope of the study
- Review of literature
- Materials and Methods
- Results (including tables and figures/diagrams, graphs)
- Discussion
- Summary and Conclusions
- References
- Annexures

#### 18.4 Scheme of evaluation

The dissertation will be evaluated for 200 Marks at two levels, once during the end of third semester and once at the end of fourth semester, with 100 marks per semester. The CIE component will be 20%, while the SEE will constitute the remaining 80%.

A mid-term evaluation will be conducted at the end of third semester. The students will have to present a mid-term research seminar with a focus on methodology and research protocol.

The final evaluation will be conducted at the end of fourth semester. The students will have to present the final research seminar highlighting the results of the project. A viva- voce examination shall be held after the submission of final dissertation. The viva-voce examination shall aim at assessing knowledge, logical reasoning, confidence and oral communication skills. If any candidate fails to submit the dissertation on or before the date prescribed, his viva-voce will be conducted during the subsequent semester examination.

The CIE at the end of third and fourth semester will be for the regularity & attendance in the lab, colloquium, methodology, maintenance of record (raw data), periodic discussion with the guide, proper disposal of lab waste, neatness, dissertation preparation and presentation.

The SEE at the end of third and fourth Semester will be done by the University appointed internal and external examiner, with the weightage of 50% for each examiner

#### 18.5 Distribution of marks for project work evaluation

| Project Evaluation | CIE | SEE | Total |  |
|--------------------|-----|-----|-------|--|
|                    | 20  | 80  | 100   |  |

#### **Evaluation pattern for III Semester**

|   |     | S        |          |       |
|---|-----|----------|----------|-------|
| Evaluation parameters                                     | CIE | Internal | External | Total |
|   |     | Examiner | Examiner |       |
| <b>Development of Protocol</b>                            | 20  | -        | -        | 20    |
| <b>Evaluation of Protocol</b><br>(Including presentation) | -   | 40       | 40       | 80    |
| Total   |     |          |          | 100   |

#### **Evaluation pattern for IV Semester**

|   |     | SI       | EE       |       |
|---|-----|----------|----------|-------|
| Evaluation parameters                         | CIE | Internal | External | Total |
|   |     | Examiner | Examiner |       |
| Thesis preparation                            | 20  | -        | -        | 20    |
| Evaluation of thesis<br>(Including Viva-voce) | -   | 40       | 40       | 80    |
| Total   |     |          |          | 100   |

#### **19.** Criteria for Pass and award of degree:

A candidate is declared to have passed the examination in a course if he/she secures 50% of the marks separately in theory (including CIE) and in practical (including CIE)

For a pass in theory, a candidate has to secure a minimum of 50% marks separately in both SEE and CIE. Further, in practical, a candidate has to secure a minimum of 50% marks separately in the University practical examination and CIE for practical.

A candidate who fails in any subject shall have to appear only in that subject in the subsequent examination. However, if the candidate has cleared only theory or only practical for that subject, he is exempted from appearing for the same in subsequent attempts.

#### 20. Academic Performance Evaluation:

#### 20.1 Grading System

The performance of a candidate shall be evaluated according to Letter Grading System, based on both CIE and SEE provided he passes each one separately. The letter grades (O, S, A+, A, B, C, F and I) indicate the level of academic achievement assessed on a 10 point scale (0 to 10).

| Marks<br>Range (%) | Grade<br>Point | Letter<br>Grade | Descriptor  | Classification                     | CGPA           |
|--------------------|----------------|-----------------|-------------|------------------------------------|----------------|
| 90 & above         | 10             | Ο               | Outstanding | First Class<br>with<br>Distinction | 7.50 and above |
| 80-89              | 9              | S               | Excellent   |                                    |                |
| 75-79              | 8              | A+              | Very Good   |                                    |                |
| 65-74              | 7              | А               | Good        | First Class                        | 6.50 -7.49     |
| 60-64              | 6              | В               | Average     | Second Class                       | 6.00 -6.49     |
| 50-59              | 5              | С               | Pass        |                                    | 5.00 -5.99     |
| Below 50           | 0              | F               | Fails       | Fail                               | Less than 5.0  |
| Absent             | 0              | Ι               | Absent      |                                    |                |

For non-credit courses 'Satisfactory' (P) or 'Unsatisfactory' (F) shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

20.1.1 A candidate shall be considered to have completed a course successfully and earned the credits assigned, if he secures an acceptable letter grade in the range O-C. Letter grade 'F' in any course implies failure in that course and no credit is earned. 20.1.2 A candidate having satisfactory attendance at classes and meeting the passing standard at CIE in a course, but remained absent from SEEs shall be awarded 'I' grade in that course.

#### **20.2 Grade Point Averages:**

The overall performance of a candidate will be indicated by Grade Point Average (GPA). For each course grade points will be awarded as per a letter grading system.

Semester Grade Point Average (SGPA) is computed as follows:

 $\sum$  [(course credit) X (Grade point)] for all courses with Letter grades, including F

SGPA = -----

 $\sum$  [(course credits)] for all courses with Letter grades, including F

Cumulative Grade Point Average (CGPA) is computed as follows:

 $\sum$  [(course credit) X (Grade point)] for all courses for all semesters with, Letter grades excluding F

CGPA = -----

 $\sum$  [(course credits)] for all courses for all semesters with Letter grades, excluding F

#### 20.3 Conversion of Grades into Percentage:

Formula for conversion of GPA into percentage:

CGPA earned X10 = Percentage of marks scored Illustration: (CGPA Earned  $8.18 \times 10$ ) = 81.80 %

#### **20.4 Award of Class**

The candidate, who has passed all the courses prescribed, shall be declared to have passed the program. Class will be awarded only to those who pass the entire examination in the first attempt and on the basis of the aggregate of marks scored in individual semester.

- A candidate who secures  $GPA \ge 7.50$  and above in first attempt shall be declared to have passed in 'First Class with Distinction'.
- A candidate who secures  $\text{GPA} \ge 6.50$  or more but less than 7.50 in the first attempt shall be declared to have passed in 'First Class'.
- A candidate who secures GPA ≥ 5.00 or more but less than 6.50 in the first attempt shall be declared to have passed in 'Second Class'.

Candidates who pass the examinations in more than one attempt shall be declared as passed in 'Pass' class irrespective of the percentage of marks secured.

- An attempt means the appearance of a candidate for one or more courses either in part or full in a particular examination.
- A candidate who fails in main examination and passes one or more subjects or all subjects in the supplementary examination is not eligible for award of class or distinction. Passing in supplementary examination by such candidates shall be considered as attempt.
- If a candidate submits application for appearing for the regular examination but does not appear for any of the courses/subjects in the regular University examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled and his appearing in the supplementary examination shall be considered as the first attempt.
- Candidates who pass the subjects in the supplementary examinations are not eligible for the award of Gold Medal or Merit Certificate.

#### 20.5 Carry Over:

A candidate must take the minimum prescribed credits in a given semester. If he fails in one/more courses without repeating all courses in a given semester, he can take those credits in the spilled over semester:

- a) A candidate shall clear the courses of the I Sem to become eligible for promotion to the III Sem.
- b) Similarly, a candidate must clear the courses of the II Sem to become eligible for promotion to the IV Sem.

#### 20.6. Re-totaling:

Re-totaling of marks is permitted only for theory papers. The University, on application within the stipulated time and remittance of a prescribed fee, shall permit a recounting of marks for the subject(s) applied. The marks obtained after re-totaling shall be the final marks awarded.

#### **21.** Supplementary Examinations:

Supplementary examination shall be conducted by the university for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results.

- A candidate detained for lack of attendance, internal assessment marks will be barred from appearing in any one or all course/s for the supplementary examination.
- A candidate dropping from appearance in any or all subjects /courses at regular examination is disallowed from taking dropped subject(s)/course(s) at the supplementary examinations.
- If a candidate submits application for appearing for the examination but does not appear for any of the subjects in the university examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled.
- A candidate who is promoted to the next higher class as per carry over regulations (except where apex bodies do not permit), if he clears the lower year/semester/phase examinations in the main examination is allowed to appear for the higher class examination during supplementary examinations provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled.

A candidate permitted to appear for the supplementary examination can improve his internal assessment marks before he takes the supplementary examination by subjecting himself to internal assessment procedure as practiced in the college.

#### 22. Award of Merit Certificates:

Merit Certificates will be awarded on the basis of overall CGPA of I to IV semester examinations. Further, only those candidates who have completed the program and fulfilled all the requirements in the minimum number of years prescribed (i.e. two years) and who have passed each semester in the first attempt are only eligible for the award of Merit Certificates.

\*\*\*\*

#### **PROGRAM OUTCOMES**

#### At the end of the program, graduates will be able to...

- **PO1:** Acquire knowledge of physical, chemical and microbiological risks associated with foods and their implications in human health.
- **PO2**: Comprehend the technological and science based approaches for production and preservation of foods.
- **PO3:** Address the emerging issues in food safety and food security in public health sector.
- **PO4:** Assess the risks associated with food and correlate with safety standards.
- **PO5:** Develop skills in critical thinking and analysing of scientific data for advanced research in food science.
- **PO6:** Create opportunities for a career in food processing industries, food safety accreditation labs and regulatory agencies.
- **PO7:** Formulate and solve research hypotheses in food science.

| Subject types | Subject title                                      |  |  |  |
|---------------|--|--|--|--|
| I semester    |  |  |  |  |
| C1            | Food Chemistry                                     |  |  |  |
| C2            | Cell and Molecular Biology                         |  |  |  |
| C3            | Biochemistry                                       |  |  |  |
| C4            | Immunology   |  |  |  |
| II semester   |  |  |  |  |
| C5            | Food Microbiology                                  |  |  |  |
| C6            | Bioinformatics and Computational Biology           |  |  |  |
| C7            | Research Methodology & Biostatistics               |  |  |  |
| III semester  |  |  |  |  |
| DSC1          | Food Standards, Certifications and Quality Control |  |  |  |
| DSC2          | Food Additives and Adulterants                     |  |  |  |
| DSC3          | Food Packaging and Storage                         |  |  |  |

# **Core courses (Theory + Practical)**

C: Core course DSC: Discipline specific core course
# Master of Science in Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)] *I Year* Semester I and II

| I SEMESTER |  |  |  |  |
|------------|--|--|--|--|
| C1         | Food Chemistry                           |  |  |  |
| C2         | Cell and Molecular Biology               |  |  |  |
| C3         | Biochemistry                             |  |  |  |
| C4         | Immunology                               |  |  |  |
| GE         | Generic elective                         |  |  |  |
| NC1        | GLP and Biosafety                        |  |  |  |
|            | II SEMESTER                              |  |  |  |
| C5         | Food Microbiology                        |  |  |  |
| C6         | Bioinformatics and Computational Biology |  |  |  |
| C7         | Research Methodology and Biostatistics   |  |  |  |
| SEC        | Skill Enhancement Course                 |  |  |  |
| GE         | Generic elective                         |  |  |  |
| NC2        | Research Ethics and IPR                  |  |  |  |

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# **UNIT III: Fats and Lipids**

polysaccharides.

Classification, function of fat in food and health, sources, requirements, essential and non- essential fatty acids, physicochemical properties, mechanism of lipid oxidation,

Definitions (Health, nutrition, nutrients, food, diet, RDA, balanced diet, malnutrition, undernutrition, overnutrition, optimum nutrition, food adulteration, food additives, food fortification), relationship between nutrition and health, factors effecting food intake determinants of health- heredity, environment, life style behavior. Proximate analysis and functional properties.

Energy: Unit of energy, food as a source of energy, definition of calorie and joules, BMI, BMR. Water: Functions, sources, requirement, water balance, dehydration, water activity in foods; sorption phenomena.

Classification, sources, dietary importance, functions in food and health, requirement, physicochemical and functional properties, properties of starch in foods (gelatinization and retrogradation), modified polysaccharides, resistant starch. Enzymatic degradation of

#### **UNIT II: Chemistry of Carbohydrate**

THEORY **Total Lectures: 32 UNIT I: Introduction to Health and Nutrition** (6 Lectures)

Course Outcomes At the end of the course students will be able to... CO1: Describe the importance of nutrient in human health

**CO2:** Explain the chemistry of the food

**CO3:** Apply the knowledge of foods and measure the proximate analysis of food

**CO4:** Differentiate various nutrients and its influence in food processing and preservation

# **I SEMESTER Course C1: Food Chemistry**

**Preamble:** Food Chemistry is a discipline that helps in understanding the chemistry of food during processing. This course emphasizes on structure of food constituents and relates it to the constituent's function and importance in foods. Student will understand the principles of chemistry and biochemistry into real-world food science and nutrition.

# (6 Lectures)

# (6 Lectures)

25

types of rancidity; measurement of lipid oxidation, nutritional aspects of natural and modified lipids; fat replacers, modification of fats and oils: hydrogenation and inter esterification, winterization and acetylation; transfats.

# **UNIT IV: Protein and Enzymes**

Functions of protein in food and health, sources, requirement, classification of protein and amino acids; functions in food and health, texturized protein, denaturation of protein, gel formation, foam formation, fermentation, germination.

Enzymes: General nature of enzymes, use of exogenous enzymes- carbohydrate, protein and lipids, factors affecting on enzyme action, enzymatic and non-enzymatic browning in foods, application of enzymes in food processing.

# **UNIT V: Vitamins and Minerals**

Classification of vitamins, sources and requirement, role of vitamins in food industry, minerals in human health, food sources and requirements: calcium, phosphorus, iron and iodine, effect of various processing treatments and fortification of foods. Minerals: Role of minerals in food industry, effect of various processing treatments.

# PRACTICALS

# (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Estimation of total lipid content in egg yolk
- 2. Determination of acid number in oil
- 3. Determination of peroxide value
- 4. Determination of free fatty acid
- 5. Calorimetric estimation of sugar by DNSA method
- 6. Estimation of gluten content
- 7. Estimation of protein from food
- 8. Estimation of fat in food
- 9. Estimation crude fiber
- 10. Estimation of ash

#### (8 Lectures)

# (6 Lectures)

| Sl. No.  | Component                             | Marks | Weight | IA Marks |  |  |
|----------|---------------------------------------|-------|--------|----------|--|--|
| 1        | Sessional tests                       |       |        |          |  |  |
|          | Two Written tests<br>(average of two) | 20    |        |          |  |  |
|          | Total                                 | 20    | 0.5    | 10       |  |  |
| 2        | Continuous assessment                 |       |        |          |  |  |
|          | Seminars/Assignments                  | 05    |        |          |  |  |
|          | Regularity and<br>Punctuality         | 05    |        |          |  |  |
|          | Total                                 | 10    | 1.0    | 10       |  |  |
| Total Cl | 20                                    |       |        |          |  |  |

# **Continuous Internal Evaluation (CIE) – Theory**

# **Continuous Internal Evaluation (CIE) – Practical**

| Sl. No.  | Component                       | IA Marks |
|----------|---------------------------------|----------|
| 1        | Involvement in practicals       | 05       |
| 2        | Record maintenance and neatness | 05       |
| Total Cl | E marks                         | 10       |

# Semester End Evaluation (SEE)

# 1. Theory Paper

| Type of question | No. of<br>questions<br>to be set | Number of<br>questions to be<br>answered | Marks per question | Total |  |
|------------------|----------------------------------|--|--------------------|-------|--|
| Answer in Detail | 2                                | 1  | 10                 | 10    |  |
| Answer in Brief  | 7                                | 5  | 5                  | 25    |  |
| Short Answers    | 5                                | 5  | 3                  | 15    |  |
| Total marks      |                                  |  |                    |       |  |

\*Duration of examination: 3 hours

# 2. Practical Paper

| Type of question | No. of<br>questions | Marks per question | Total |
|------------------|---------------------|--------------------|-------|
| Major Experiment | 1                   | 8                  | 8     |
| Minor Experiment | 1                   | 4                  | 4     |
| Spotters         | 3                   | 1                  | 3     |
| Viva voce        | -                   | 5                  | 5     |
| Total marks      | 20                  |                    |       |

- 1. Food Biochemistry, 1<sup>st</sup>edition (1991), C. Alias and G.I.S.B.N. Lindeu; Ellis Horwood, New York, ISBN: 978-1-4615-2119-8.
- 2. Food Analysis: Theory and Practice, 1<sup>st</sup> edition (1995), Y. Pomeranz and R. Meloon; Westport, An AVI Publication. New York, ISBN: 978-81-8128-825-7.
- 3. Food Chemistry, 4<sup>th</sup>edition (2006), Fennema's, CRC press. New York, ISBN: 978-1-4822-0812-2.
- 4. Food Chemistry, 1st edition (2005), H. D Belitz, Springer Verlag, Academic Press. ISBN: 978-3-540-69935-4.
- 5. Food Sciences, 5<sup>th</sup>edition (1996), N. Potter and J.H. Hotchikiss,CBS publishers and Distributors, New Delhi, ISBN: 81-239-0472-X.
- 6. Food Chemistry, 1<sup>st</sup>edition (2010), H. K. Chopra and S. P. Parmjit, Alpha Science International Limited, ISBN: 978-81-8487-039-8.
- Food Science, 6<sup>th</sup>edition (2015), B. Srilakshmi,New age International, New Delhi, ISBN: 978-81-224-3809-3.
- 8. Foods- Facts and Principles, N. S. Manay, and Shakuntala; 3rd edition (2008), New Age International (P), ISBN: 978-81-224-2215-3.
- 9. Food Science and Nutrition, R. Sunetra; 2nd edition (2012), Oxford University Press, ISBN: 0-19-807886-2.

# I SEMESTER Course C2: Cell and Molecular Biology

**Preamble:** The principal aim of this course is to introduce the students to classical and modern concepts in cell and molecular biology and its applications in biomedical research. In particular, it focuses on identifying key components that constitute living cells and to integrate the field of biochemistry, molecular cell biology and genetics. This course provides a basic and comprehensive grounding in multidisciplinary science of modern and classical biomedical science.

#### **Course Outcomes**

At the end of the course students will be able to ...

- **CO1:** Demonstrate the use of modern cell-related techniques
- **CO2:** Explain the structure/function of DNA, replication, damage and repair of DNA of cell
- **CO3:** Describe the structure/function of RNA, transcription and synthesis of polypeptide chain of cell
- CO4: Perform techniques used in molecular biology
- CO5: Perform the extraction of DNA, RNA and protein
- CO6: Identify molecules using gel electrophoresis techniques
- CO7: Recognize the structure and function of nucleic acids
- CO8: Describe the regulation of prokaryotic and eukaryotic genes

#### THEORY

#### **UNIT I: Membrane Structure and Transport**

Chemical composition of membrane, structure and function of membrane protein, membrane lipid and fluidity, lipid rafts, deformation of membranes

Transport across membrane: Transport of small molecules: Passive and active transport (P, V, F and ABC transporters); transport of large molecules: endocytosis and exocytosis

Protein sorting and vesicular trafficking: Transport of molecules into and out of the nucleus, transport of proteins into mitochondria and chloroplasts, transport from the ER through Golgi apparatus to lysosomes

# **Total Lectures 32**

(6 lectures)

**UNIT II: Cytoskeleton, Interaction of Cells and their Environment** (4 lectures) Cytoskeleton: Cytoskeleton proteins. Microfilaments: types, structure and function, Intermediate: structure and function, Microtubule: structure and functional organization, Cell interaction: Interaction between cell and extracellular matrix (ECM): ECM proteins (collagens, elastin, proteoglycans, fibronectins and laminins); Interaction between cells: Tight junction, anchoring junction, gap junction, Cell adhesion molecules: selectins, cadherins, immunoglobulins

#### UNIT III: Cell Signalling, Cell Cycle and Cell Death (6 lectures)

Cell Signalling and communication: general principle of communication, Cell surface receptors, G-protein mediated signalling, camp, receptors tyrosine kinases, second messengers, Cell cycle: overview, model organism and methods to study cell cycle, regulation of cell cycle, Cell death: apoptosis, necrosis, caspases, cell death pathways

**UNIT IV: Replication of DNA in Prokaryotes and Eukaryotes** (4 Lectures) Chemical composition of DNA/RNA. DNA structure, DNA denaturation and renaturation. DNA replication: Mechanism of DNA replication in prokaryotes and eukaryotes. Transposable elements in prokaryotes and eukaryotes, Mechanisms of transposition.

# UNIT V: Transcription in Prokaryotic and Eukaryotic (6 Lectures)

Structural features of prokaryotic and eukaryotic RNA - rRNA, tRNA, mRNA. Prokaryotic transcription: promoters and regulatory elements; RNA polymerase; initiation, elongation and termination; transcriptional regulation-positive and negative; operon concept-*lac* and *trp* operons.

Eukaryotic transcription; promoters and regulatory elements; RNA polymerase structure and assembly; RNA polymerase I, II, III; initiation, elongation and termination.

Post-transcriptional modifications: 5'-cap formation, 3'-end processing, splicing, RNA editing, catalytic RNA. Regulatory RNA: antisense RNA, micro RNA, RNA interference. RT-PCR.

#### UNIT VI: Translation in Prokaryotic and Eukaryotic (6 Lectures)

Genetic code: salient features, Universal genetic code; Wobble hypothesis. Translation: Mechanism of initiation, elongation and termination of translation process. Regulation of protein synthesis, Polyribosomes, Post-translational modifications; Transport of proteins and molecular chaperones; protein stability and degradation pathways.

# PRACTICAL

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Safety consideration in a molecular biology laboratory
- 2. Reagents/chemical preparation (Buffer, Molar, Normal, percent solution)
- 3. Microscopy-as a tool in cell biology
- 4. Staining techniques in cell biology
- 5. Cell culture preservation and revival
- 6. Cell viability assay: MTT/trypan blue test
- 7. Observation of various stages of cell cycle
- 8. Extraction and quantification of genomic DNA from prokaryotic and eukaryotic cell
- 9. Extraction and quantification of plasmid DNA from bacterial cell
- 10. Quantitative estimation of DNA/RNA using spectrophotometer.
- 11. Polymerase chain reaction (PCR) assay and variants
- 12. Extraction, quantification of total RNA and Reverse transcriptase PCR
- 13. Agarose gel electrophoresis of PCR product
- 14. Extraction of protein prokaryotic and eukaryotic cell
- 15. Separation of proteins by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE)

| Sl. No.                  | Component                  | Marks | Weight | IA Marks |
|--------------------------|----------------------------|-------|--------|----------|
| 1                        | Sessional tests            |       |        |          |
|                          | Two Written tests          | 20    |        |          |
|                          | (average of two)           | 20    |        |          |
|                          | Total                      | 20    | 0.5    | 10       |
| 2                        |                            |       |        |          |
|                          | Seminars/Assignments       | 05    |        |          |
|                          | Regularity and Punctuality | 05    |        |          |
|                          | Total                      | 10    | 1.0    | 10       |
| Total CIE marks (Theory) |                            |       | 20     |          |

# **Continuous Internal Evaluation (CIE) - Theory**

# **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.      | Component                       | IA Marks |
|--------------|---------------------------------|----------|
| 1            | Involvement in practicals       | 05       |
| 2            | Record maintenance and neatness | 05       |
| Total CIE ma | arks                            | 10       |

#### Semester End Evaluation (SEE)

#### 1. Theory Paper

| Type of question | No. of questions<br>to be set | Number of<br>questions to<br>be answered | Marks<br>per<br>question | Total |  |  |
|------------------|-------------------------------|--|--------------------------|-------|--|--|
| Answer in Detail | 2                             | 1  | 10                       | 10    |  |  |
| Answer in Brief  | 7                             | 5  | 5                        | 25    |  |  |
| Short Answers    | 5                             | 5  | 3                        | 15    |  |  |
| Total marks      |                               |  |                          |       |  |  |

\*Duration of examination: 3 hours

# 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |  |
|------------------|------------------|--------------------|-------|--|--|
| Major Experiment | 1                | 8                  | 8     |  |  |
| Minor Experiment | 1                | 4                  | 4     |  |  |
| Spotters         | 3                | 1                  | 3     |  |  |
| Viva voce        | -                | 5                  | 5     |  |  |
| Total marks      |                  |                    |       |  |  |

- Molecular biology of the cell, 6<sup>th</sup> edition (2014), B. Alberts., A. Johnson., J. Lewis., D. Morgan and M. Raff, Garland Science, New York, USA. ISBN:978-0815344322.
- Molecular cell biology, 7<sup>th</sup> edition (2013), H. Lodish., A. Berk., C.A. Kaiser and M. Krieger, W H Freeman and Company, New York, USA. ISBN:9781429234139.

- 3. Cell: molecular approach, 6<sup>th</sup> edition (2013), G.M. Cooper and R.E. Hausman, ASM Press, USA. ISBN:978-0878939640.
- 4. Cell and Molecular Biology, 7<sup>th</sup> edition (2013), G. Karp, John Wiley, New York, USA. ISBN: 9781118301791.
- 5. Cell biology, 2<sup>nd</sup> edition (2008), T.D. Pollard and W.C. Earnshaw, Saunders, USA. ISBN:9781416022558.
- 6. Lehninger Principles of Biochemistry. 6<sup>th</sup> edition (2013), D.L. Nelson and M.M. Cox, W. H. Freeman and Company, NY, USA ISBN-10: 1429234148
- 7. Cell and Molecular Biology. 3<sup>rd</sup> edition (2010), S.C Rastogi, New Age International Publishers, India, ISBN: 8122430791

# I SEMESTER Course C3: Biochemistry

**Preamble:** The course highlights the importance of Biochemistry in all our lives and helps to understand the biochemical basis of life and to describe metabolic pathways of biomolecules. This would enable the student to know the disease processes to understand clinical problems. This course introduces the concepts of various biomolecules, metabolic pathways and disorders of metabolism. Also, students gain knowledge on metabolism of biomolecules in various tissues of the human body in normal healthy individuals which helps to understand the regulation of biomolecules under various circumstances. The experiments are designed towards developing problem solving ability of the students through analysis and objective scientific reasoning.

#### **Course Outcomes**

At the end of the course students will be able to...

- CO1: Review the importance of biochemistry in biomedical science
- CO2: Illustrate the structure of biomolecules
- **CO3:** Estimate the concentrations of various biomolecules by qualitative and quantitative analysis
- CO4: Identify disorders associated with metabolism of biomolecule

#### THEORY

#### **UNIT I: Carbohydrate**

Classification and biological importance of carbohydrates; carbohydrate metabolism: glycolysis, Krebs cycle, hexose degradation pathways, gluconeogenesis, glycogenesis and glycogenolysis pathway and its regulation. Disorders of glycogen metabolism, interrelation of carbohydrates with other metabolism.

# UNIT II: Lipid

Classification and biological importance of lipid, triglycerides, phospholipids, glycolipids, sulpholipids; metabolism and regulation: fatty acid synthesis, oxidation of fatty acids, ketogenesis; structure of cholesterol and its metabolism; lipoprotein role in lipid storage; hormones, steroids.

#### **Total Lectures: 32**

#### (7 Lectures)

(7 Lectures)

#### **UNIT III: Protein and Enzymes**

Protein structure: primary, secondary, tertiary and quaternary; protein folding, Ramachandran plot; metabolism of proteins and its regulation; transamination, urea cycle; structure and function of haemoglobin, myoglobin, and immunoglobulins. Vitamins: water and lipid soluble, vitamin deficiency diseases.

Enzymes: characteristic feature, nomenclature, classification, theories of enzyme specificity, factors affecting the rate of enzyme catalysed reaction, enzyme kinetics: Michaelis-Menten equation, Lineweaver-Burke plot; enzyme Inhibition: competitive, non-competitive and uncompetitive inhibitions.

#### UNIT IV: Nucleic acid and Bioenergetics

#### (8 Lectures)

Purine and pyrimidine, structure of DNA, RNA and its types; nucleic acid metabolism: De Novo and salvage pathway. Inborn errors of metabolism.

Bioenergetics: electron transport chain, oxidative phosphorylation, inhibitors of electron transport chain and oxidative phosphorylation.

# PRACTICALS

# (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Qualitative analysis of carbohydrate, protein and non-protein nitrogen
- 2. Estimation of reducing sugar by dinitrosalicylic acid method
- 3. Estimation of fructose by resorcinol method
- 4. Estimation of glucose by iodometric method
- 5. Determination of pKa value of aminoacid by titrimetric analysis
- 6. Determination of pI of casein from milk.
- 7. Estimation of proteins by Folin-Ciocalteu method and Bradford method
- 8. Separation of pigments by adsorption chromatography, gel filtration chromatography
- 9. A-G ratio by paper chromatography
- 10. Colorimetric estimation of inorganic phosphate by Fiske-Subbarow method
- 11. Estimation of vitamin C by dichlorophenol indophenol method.
- 12. Determination of Km and Vmax of alkaline phosphatase / salivary amylase
- 13. Determine saponification number and peroxide value of Fat
- 14. Estimation of nucleic acids

# (10 Lectures)

# **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                  | Component             | Marks | Weight | IA Marks |  |  |
|--------------------------|-----------------------|-------|--------|----------|--|--|
| 1                        | Sessional tests       |       |        |          |  |  |
|                          | Two Written tests     | 20    |        |          |  |  |
|                          | (average of two)      | 20    |        |          |  |  |
|                          | Total                 | 20    | 0.5    | 10       |  |  |
| 2                        | Continuous assessment |       |        |          |  |  |
|                          | Seminars/Assignments  | 05    |        |          |  |  |
|                          | Regularity and        | 05    |        |          |  |  |
|                          | Punctuality           | 03    |        |          |  |  |
|                          | Total                 | 10    | 1.0    | 10       |  |  |
| Total CIE marks (Theory) |                       |       | 20     |          |  |  |

# **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

# Semester End Evaluation (SEE)

# 1. Theory Paper

| Type of question | No. of       | Number of    | Marks per | Total |
|------------------|--------------|--------------|-----------|-------|
|                  | questions to | questions to | question  |       |
|                  | be set       | be answered  |           |       |
| Answer in Detail | 2            | 1            | 10        | 10    |
| Answer in Brief  | 7            | 5            | 5         | 25    |
| Short Answers    | 5            | 5            | 3         | 15    |
|                  |              |              |           |       |
| Total marks      |              |              |           | 50*   |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |
|------------------|------------------|--------------------|-------|
| Major Experiment | 1                | 8                  | 8     |
| Minor Experiment | 1                | 4                  | 4     |
| Spotters         | 3                | 1                  | 3     |
| Viva voce        | -                | 5                  | 5     |
| Total marks      | ·                |                    | 20    |

- 1. Lehninger: Principles of Biochemistry, 6<sup>th</sup> Edition (2013), D.L. Nelson, and M.M. Cox; Freeman Publishers, ISBN:9781464109621
- 2. Biochemistry, 4<sup>th</sup> Edition (2016), P. Naik; Jaypee Brothers Medical Publishers Private Limited, ISBN: 9789351529897
- 3. Biochemistry, 4<sup>th</sup> Edition (2016), U. Satyanarayana and U. Chakrapani; Elsevier Publishers, ISBN: 9788131236017
- 4. Text Book of Biochemistry, 2<sup>nd</sup> edition (2014), K. Rambabu, P. Sivkumar and P. Kameswari; AITBS Publishers, ISBN:9788174733610
- Text book of Biochemistry for Medical Students, 8<sup>th</sup> edition (2016), D.M Vasudevan, S. Sreekumari and K.Vaidyanath; Jaypee Brothers Medical Publishers Private Limited, ISBN: 9789385999741
- 6. Practical Biochemistry, 3<sup>rd</sup> edition (2014), G. Rajgopal and B.D. Toora; Ahuja publishers, ISBN:9789380316314

# I SEMESTER Course C4: Immunology

**Preamble:** The immune system comprises innate and acquired defense mechanisms against microorganisms. Initial lectures will cover the cells of the immune system, their function, the structure of lymphoid organs and the how cells move around within and between lymphoid organs to bring about crucial interactions. A detailed knowledge of cellular and molecular components of the immune system will be integrated to provide a working understanding of biological mechanisms important in health and disease.

#### Course Outcomes

At the end of the course students will be able to...

- CO1: Discuss the different organs, cells and molecules of immune system
- **CO2:** Illustrate various types of immune response.
- CO3: Discuss different antigens and antibodies and their interactions.
- CO4: Describe various types of vaccines and vaccination methods.
- **CO5:** Demonstrate practical skills in undertaking simple immunological experiments.
- **CO6:** Gather information on research activities in the field of immunology and their applications.

#### THEORY

# **UNIT I: Cells and Organs of Immune System**

Historical perspective, general concepts of the immune system Cells involved in the immune system: lymphoid cells, mononuclear cells, granulocytic cells, antigen presenting cells

Organs involved in the immune system: primary and secondary lymphoid organs

# UNIT II: Innate and Adaptive Immune Response

Innate defense response: First line defense: Anatomical barriers, antimicrobial substances, normal flora, surface receptors, adhesion molecules, phagocytosis

Complement system: Components of the complement activation pathways; biological consequence of complement activation, Inflammation

Adaptive immune response: humoral and cellular immunity

Antigens: structure and properties, factors affecting the immunogenicity, epitopes, pattern recognition receptors, haptens, mitogen and superantigens

Antibodies: structure, function and properties of the antibodies, different classes and

# Total Lectures: 32

(4 Lectures)

# (10 Lectures)

subclasses, biological activities of antibodies Production of polyclonal and monoclonal antibody

# **UNIT III: Immunodiagnostic Techniques**

Antigen-antibody interactions: precipitation reactions, agglutination reactions Advance immunological techniques: radioimmunoassay, enzyme-linked immunosorbent assay, Western blotting, immunoprecipitation, flow cytometry, immunofluorescence, immunoelectron microscopy and complement fixation test

# UNIT IV: Major Histocompatibility Complex

Major histocompatibility complex: organization classes and function Antigen processing and presentation by cytosolic and endocytic pathway of MHCs Cytokines: properties, cytokines receptors, cytokine-related diseases

# UNIT V: Vaccines and Immunotherapeutics

Vaccinology: Active and passive immunization; different types of vaccines: live, killed, attenuated, recombinant DNA and protein based vaccines, synthetic peptide vaccines; reverse vaccinology; role of adjuvants

# **UNIT VI: Dysfunctions of Immune System**

Hypersensitivity: type I, II, III and types IV hypersensitivity Immunodeficiency diseases: primary and secondary immunodeficiency Autoimmunity: organ specific autoimmune diseases and systemic autoimmune diseases Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

Cancer immunology: tumor antigen, immune response to tumor, cancer immunotherapy

# PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Preparation of blood smear and differential count
- 3. Antigen identification by agglutination (Widal test)
- 4. Antigen identification by agglutination (ABO typing)
- 5. Precipitation assay: immunodiffusion
- 6. ELISA assay: plate ELISA (direct)

# (5 Lectures)

(3 Lectures)

# (8 Lectures)

# (2 Lectures)

- 7. ELISA assay: plate ELISA (indirect)
- 8. ELISA assay: dot ELISA
- 9. Fluorescent antibody test
- 10. Immunoelectrophoresis assay
- 11. SDS-PAGE analysis of protein samples
- 12. Western blotting analysis

# **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                  | Component             | Marks | Weight | IA Marks |  |  |
|--------------------------|-----------------------|-------|--------|----------|--|--|
| 1                        | Sessional tests       |       |        |          |  |  |
|                          | Two Written tests     | 20    |        |          |  |  |
|                          | (average of two)      | 20    |        |          |  |  |
|                          | Total                 | 20    | 0.5    | 10       |  |  |
| 2                        | Continuous assessment |       |        |          |  |  |
|                          | Seminars/Assignments  | 05    |        |          |  |  |
|                          | Regularity and        | 05    |        |          |  |  |
|                          | Punctuality           | 05    |        |          |  |  |
|                          | Total                 | 10    | 1.0    | 10       |  |  |
| Total CIE marks (Theory) |                       |       |        | 20       |  |  |

# **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.   | Component                       | IA Marks |
|-----------|---------------------------------|----------|
| 1         | Involvement in practicals       | 05       |
| 2         | Record maintenance and neatness | 05       |
| Total CIE | marks                           | 10       |

#### Semester End Evaluation (SEE)

# 1. Theory Paper

| Type of question | No. of questions<br>to be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |  |
|------------------|-------------------------------|--|-----------------------|-------|--|
| Answer in Detail | 2                             | 1  | 10                    | 10    |  |
| Answer in Brief  | 7                             | 5  | 5                     | 25    |  |
| Short Answers    | 5                             | 5  | 3                     | 15    |  |
| Total marks      |                               |  |                       |       |  |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |
|------------------|------------------|--------------------|-------|--|
| Major Experiment | 1                | 8                  | 8     |  |
| Minor Experiment | 1                | 4                  | 4     |  |
| Spotters         | 3                | 1                  | 3     |  |
| Viva voce        | -                | 5                  | 5     |  |
| Total marks      |                  |                    |       |  |

- 1. Cellular and Molecular Immunology. 6<sup>th</sup> Edition (2005), A. K.Abbas and L.Andrew, Philadelphia, PA: Saunders. ISBN: 9781437715286
- Kuby Immunology, 7<sup>th</sup> Edition (2012), J. Owen, J. Punt and S. Stranford, W. H. Freeman and Company, NY. ISBN:9781464119910
- Roitt's Essentials of Immunology, 12<sup>th</sup> Edition (2011), P.J. Delves, S.J. Martin, D.R. Burton and I.M, Roitt Riott's Wiley-Blackwell, London. ISBN: 9781118415771
- Immunology. 2<sup>nd</sup> Edition (2006), C. V. Rao, Narosha Publishing House, India ISBN: 9788173196577

#### **II SEMESTER**

# **Course C5: Food Microbiology**

**Preamble:** Food Microbiology course has been formulated to impart relevant information on the pathogenic microbes associated with foods and the diseases caused by them. It also provides knowledge relating to spoilage of foods by microorganisms and the relevant preservation techniques. The experiments are designed to enable the students to apply modern scientific approaches for detection and diagnosis.

#### Course Outcomes

At the end of the course students will be able to...

- CO1: Illustrate the role of microorganisms in food safety
- **CO2:** Cultivate and enumerate microorganisms from various food samples
- **CO3:** Compare various physical and chemical methods used in the control of microorganisms

#### THEORY

#### **UNIT I: Fundamental Concepts**

Development of food microbiology as a science, parameters of food affecting microbial growth: intrinsic, extrinsic and processing factors, hurdle concept, common food borne bacteria, yeasts and molds.

#### **UNIT II: Food Spoilage and Preservation**

Food spoilage: characteristic features and significance of spoilage of different groups of foods- fruits and vegetables, cereal and cereal products, milk and milk products, sea foods, meat and meat products, packed and canned foods.

Food preservation: Physical methods- temperature, radiation and drying; chemical methods – organic acids, class I and II preservatives; biopreservation.

# UNIT III: Food Borne Infection and Intoxication (14 lectures)

Etiology, pathogen, clinical symptoms, lab diagnosis and prevention of the following pathogens

Bacteria: Clostridium spp., Bacillus cereus, Listeria monocytogenes, Staphylococcus aureus, Escherichia coli, Salmonella spp., Vibrio spp., Campylobacter jejuni and Shigella dysenteriae

# (3 lectures)

(7 lectures)

**Total lectures: 32** 

Mycotoxins: aflatoxin, ochratoxin, fuminosins and ergot alkaloid. Algal toxins Viruses: Hepatitis A, Hepatitis E, Polio virus, Norovirus and Rotavirus. Parasites: *Entamoeba histolytica*, *Giardia lamblia*, *Ascaris lumbricoides*, *Fasciola hepatica* and *Taenia solium*.

# UNIT IV: Detection of Food Borne Pathogens (6 lectures)

Indicator organisms, direct microscopic examination, culture techniques, enumeration methods, dye reduction tests, electrical methods, immunological methods, DNA/RNA method and bioassays.

#### UNIT V: Application of Food Microbiology

(2 lectures)

Prebiotics and probiotics, genetically modified foods, biosensors in food, single cell protein.

# PRACTICALS

- 1. Enumeration of food borne bacteria/fungi.
- 2. Determination of thermal death time (TDT) and thermal death point (TDP).
- 3. Standard qualitative analysis of water: Presumptive, confirmed and completed test.
- 4. Qualitative analysis of water by membrane filter technique.
- 5. Detection of number of bacteria in milk by Breed's count method.
- 6. Dye reduction tests: Methylene blue reductase test and resazurin test.
- 7. Detection and quantification of aflatoxin.
- 8. Isolation and identification of food borne bacteria (as per FDA's Bacteriological Analytical Manual): *S. aureus, Clostridium,* coliforms, *Salmonella, Vibrio, Bacillus, Shigella, Listeria.*
- 9. Study of antimicrobial activity of preservatives.

# **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No. | Component                | Marks | Weight | IA Marks |
|---------|--------------------------|-------|--------|----------|
| 1       | Sessional tests          |       |        |          |
|         | Two Written tests        | 20    |        |          |
|         | (average of two)         | 20    |        |          |
|         | Total                    | 20    | 0.5    | 10       |
| 2       | Continuous assessment    |       |        |          |
|         | Seminars/Assignments     | 05    |        |          |
|         | Regularity and           | 05    |        |          |
|         | Punctuality              | 05    |        |          |
|         | Total                    | 10    | 1.0    | 10       |
| Total C | Total CIE marks (Theory) |       |        |          |

# **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.   | Component                       | IA Marks |
|-----------|---------------------------------|----------|
| 1         | Involvement in practicals       | 05       |
| 2         | Record maintenance and neatness | 05       |
| Total CIE | marks                           | 10       |

# Semester End Evaluation (SEE)

# 1. Theory Paper

| Type of<br>question | No. of<br>questions to be<br>set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|---------------------|----------------------------------|--|-----------------------|-------|
| Answer in<br>Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief     | 7                                | 5  | 5                     | 25    |
| Short Answers       | 5                                | 5  | 3                     | 15    |
| Total marks         | 50*                              |  |                       |       |

\*Duration of examination: 3 hours

# 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |
|------------------|------------------|--------------------|-------|
| Major Experiment | 1                | 8                  | 8     |
| Minor Experiment | 1                | 4                  | 4     |
| Spotters         | 3                | 1                  | 3     |
| Viva voce        | -                | 5                  | 5     |
| Total marks      |                  |                    | 20    |

- 1. Modern Food Microbiology, 7<sup>th</sup> edition (2014), J.M. Jay, M.J. Loessner and D.A. Golden, Springer; ISBN: 978-0387231808.
- 2. Food Microbiology, 5<sup>th</sup> edition (2017), W.C. Frazier, D.C. Westhoff and N.M. Vanitha, McGraw Hill; ISBN: 978-1259062513.
- 3. Food Microbiology, 4<sup>th</sup> edition (2015), M.R. Adams and M.O. Moss, The Royal Society of Chemistry; ISBN: 978-1849739603.
- Medical Microbiology a guide to microbial infections: pathogenesis, Immunity, Laboratory diagnosis and Control, 18<sup>th</sup> edition (2012), D. Greenwood, R. Slack, J. Peutherer and M. Barer, Elsevier Limited; ISBN: 978-0702040894.
- Ananthanarayan and Paniker's Textbook of Microbiology, 10<sup>th</sup> edition (2017), R. Kanungo, University Press Private Limited; ISBN: 978-9386235250.
- 6. Medical Parasitology, 3<sup>rd</sup> edition (2012), D.R. Arora and B.B. Arora, CBS Publishers and Distributors; ISBN: 978-8123923185.
- 7. Microbiology: A laboratory manual, 10<sup>th</sup> edition (2013), J. Cappuccino and N. Sherman, Pearson Education Inc.; ISBN: 978-0321840226.

# II SEMESTER Course C6: Bioinformatics and Computational Biology

**Preamble:** Bioinformatics is an interdisciplinary field comprising biology, biotechnology and computer science. The course is aimed at analyzing biological data which is critical for understanding life sciences. Vast amount of data generated and stored in public databases need to be analysed. The course also aims at studying and analyzing data which is generated in wet labs. The computational analysis and methods find applications in molecular biology and biotechnology. The students would be able to appreciate the systems approach designed towards understanding disease at the genetic level in various life forms from bacteria to Homo sapiens.

#### **Course Outcomes**

At the end of the course students will be able to ...

- **CO1:** Review the techniques of bioinformatics
- CO2: Apply biological databases to solve problems in research
- **CO3:** Discuss bioinformatics methods using different computational tools
- CO4: Perform sequence analysis
- CO5: Utilize major databases for various in-silico analysis.
- CO6: Predict the outcome of analysis based on statistical parameters
- CO7: Insight into various levels of analysis and review whole genome assembly

#### THEORY

### **UNIT I: Introduction and Biological Databases**

Introduction to Bioinformatics, Introduction to various databases and their classification (primary and secondary databases) e.g. types of biological data General Introduction of Biological Databases- Nucleic acid databases (NCBI, DDBJ &

EMBL)

Protein sequence databases: Uniprot- KB: SWISS -PROT, TrEMBL,

Specialized Genome databases: (SGD, TIGR)

Structure databases (CATH, SCOP and PDBsum)

Repositories for high throughput genomic sequences: EST, STS GSS,

Genome Databases at NCBI, EBI, TIGR, SANGER

3D Structure Database: PDB, Chemical Structure database: Pubchem

Derived databases- Sequence: InterPro, Prosite, Pfam, ProDom, Gene Ontology

# **Total Lectures: 32**

# (10 Lectures)

#### 46

# **UNIT II: Sequence Analysis**

Various file formats for bio-molecular sequences: GenBank, FASTA.

Basic concepts of sequence similarity, identity and homology, definitions of homolog, ortholog, paralog

Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series

Sequence-based Database Searches: BLAST, various versions of basic BLAST, Sequence filtering, E value

Sequence alignment: Global alignment, Local alignment, Gap penalty, Dot plots, Dot matrix algorithm, look up tables, Similarity and Homology, Needleman-Wunsch, Smith-Waterman algorithms

Multiple sequence alignment: goal of multiple sequence alignment, consensus sequence ClustalW /MUSCLE; Motif and Domain: Motif databases and analysis tools.

# UNIT III: Phylogenetic Analysis

Basics and tools for phylogenetic analysis, tree-building methods (character and distance based methods), construction of phylogenetic trees and identifying homologs (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method

# UNIT IV: Predicting Protein Structure (Homology modelling) (5 Lectures)

Predicting protein structure and function from sequence; Predicting 3D structure, Structure prediction by homology modelling, Steps in homology modelling, Accuracy check of models.

Visualization of structures using Rasmol and CHIMERA

# **UNIT V: Comparative Genomics**

Comparative genomics: Basic concepts and applications, whole genome alignments: understanding significance. Basic concepts of whole genome sequencing, sequencing platforms.

# PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Information retrieval- referring journals, PubMed & Medline
- 2. Similarity searches in various databases using BLAST program
- 3. Identifying conserved domains in various super-families
- 4. Evolution of protein domains using phylogenetic methods

#### (5 Lectures) and distance

#### (4 Lectures)

### (8 Lectures)

- 5. To design primers for the given gene sequences
- 6. Search tool for retrieval of interacting genes
- 7. KEGG pathway analysis using annotation tool DAVID
- 8. Meta-analysis of microarrays
- 9. Download the atomic coordinates from PDB using the coordinate file and view the molecules using molecular visualization tools- Rasmol, Chimera
- 10. To build protein models using Swiss-model and validation
- 11. Annotation of ligand binding site in protein structure
- 12. To predict gene using gene finding tools
- 13. To search for exons using genome viewing tools
- 14. SNP extraction from UCSC browser and its effect on protein structure

| Sl. No. | Component             | Marks | Weight | IA Marks |  |
|---------|-----------------------|-------|--------|----------|--|
| 1       | Sessional tests       |       |        |          |  |
|         | Two Written tests     | 20    |        |          |  |
|         | (average of two)      |       |        |          |  |
|         | Total                 | 20    | 0.5    | 10       |  |
| 2       | Continuous assessment |       |        |          |  |
|         | Seminars/Assignments  | 05    |        |          |  |
|         | Regularity and        | 05    |        |          |  |
|         | Punctuality           |       |        |          |  |
|         | Total                 | 10    | 1.0    | 10       |  |
| Total C | E marks (Theory)      |       |        | 20       |  |

#### **Continuous Internal Evaluation (CIE) – Theory**

#### **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.      | Component                       | IA Marks |
|--------------|---------------------------------|----------|
| 1            | Involvement in practicals       | 05       |
| 2            | Record maintenance and neatness | 05       |
| Total CIE ma | arks                            | 10       |

#### **Semester End Evaluation (SEE)**

### 1. Theory Paper

| Type of question | No. of<br>questions<br>to be set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |
| Short Answers    | 5                                | 5  | 3                     | 15    |
| Total marks      |                                  |  |                       | 50*   |

\*Duration of examination: 3 hours

# 2. Practical Paper

| Type of question | No. of    | Marks per question | Total |
|------------------|-----------|--------------------|-------|
|                  | questions |                    |       |
| Major Experiment | 1         | 8                  | 8     |
| Minor Experiment | 1         | 4                  | 4     |
| Spotters         | 3         | 1                  | 3     |
| Viva voce        | -         | 5                  | 5     |
| Total marks      |           |                    | 20    |

- Discovering genomics, proteomics and bioinformatics. 2<sup>nd</sup> edition (2007), A.M.Campbell and L.J. Heyer; Cold Spring Harbor Laboratory Press, Pearson, ISBN:9788131715598
- Bioinformatics sequence and genome analysis, 2<sup>nd</sup>Edition. (2004), D.W.Mount; Cold Spring Harbour Laboratory Press. CBS Publishers, ISBN:0879697121
- 3. Bioinformatics: Concepts, skills and applications. 2<sup>nd</sup> edition (2014), S.C., Rastogi, N.Mendiratta, P.C.Rastogi, P. (2014) C B S publishers, ISBN:8123914822
- 4. Developing Bioinformatics Computer Skills. 1<sup>st</sup>edition. (2013), C. Gibas and P. Jambeck. O'Reilly Media, ISBN:9788173662423
- 5. Molecular Modelling-Principles and Applications, 2<sup>nd</sup> edition (2003), A.R. Leach; Pearson Education Limited, UK, ISBN: 9780582382107

# **II SEMESTER**

#### **Course C7: Research Methodology and Biostatistics**

**Preamble:** Statistical concepts are indispensable for carrying out and understanding biological hypothesis, experimentation as well as validations. It is aimed at creating awareness about the applications of statistics in biological sciences including medical and para-medical sciences along with building confidence in students to logically test their Research data with an appropriate set of test of significance. Use of open source software and web material is encouraged as the course intends to give wings to the students.

#### **Course Outcomes**

At the end of the course students will be able to ...

**CO1:** Organize and conduct research in a more appropriate manner.

CO2: Identify various sources of experimental designs and their applications.

CO3: Review statistical data collected in biomedical research.

CO4: Develop skill about summarizing, presenting and analyzing result data

**CO5:** Comprehend the methods and results published in research paper.

#### THEORY

# **Total Lectures: 32**

#### **UNIT I: Research Methodology, Experimental Designs and Research Tools**

#### (8 Lectures)

Introduction to research methodology - Research processes, quantitative and qualitative research, Structure of a research proposal, Ethics in research, writing of references, Plagiarism and publishing of a report

Types of research designs - Randomized experimental design, Quasi- experimental design, and Non – experimental designs

Experimental design - Two group experimental design, Factorial design, Cross over design, Randomized block designs, and Latin square design

Descriptive and analytical study designs - Case reports, Case series, Cross – sectional, Case control, Cohort, and Randomized controlled trials

Development of research tools - Steps in developing a questionnaire; Contents, structure, format and sequence of a questionnaire, pilot study, evaluation of a questionnaire, difference between questionnaire and schedule.

Concept of Validity - Content validity, Face validity, Criterion validity, Concurrent validity, and Construct validity

Concept of Reliability – Test retest reliability, Equivalent-Forms or Alternate-Forms Reliability, Cronbach's alpha, and Split-Half Reliability

UNIT II: Data Collection, Presentation and Sampling Techniques (8 Lectures) Measures of agreement - Intra class correlation coefficient, Kappa Statistic, Sensitivity, specificity and Receiver Operating Characteristics (ROC) analysis Measurement and scaling techniques - Nominal scale, ordinal scale, ratio scale, interval scale, types of variable, primary data, secondary data, and sources of secondary data Methods of data collection - Personal interview, telephone interview, self-administered questionnaire survey, mail questionnaire, and focus group discussion Presentation of data - Tabular representation of data, graphical representation of data: Histogram, Frequency polygon, Ogive, Line diagram, Pie diagram, and bar diagrams Descriptive statistics - Mean, Median, Mode, Range, Quartiles, Deciles, Percentile, Variance, Standard Deviation, Coefficient of Variation, Mean Deviation, and their respective relative measures

Sampling techniques - Sampling frame, Statistic, Parameter, Probability sampling – simple, stratified, systematic, cluster, and sampling; non probability sampling – purposive, judgment, snowball, quota sampling, and characteristics of a good sample Concept of probability - Probability of standard distributions and their applications, The Binomial distribution and Poisson distribution

# UNIT III: Distribution, Test of Significance and Measures of Associations

#### (8 Lectures)

Normal distribution - Properties and its importance, standard normal distribution, use of standard normal probability table, sampling distribution, standard error of mean, and standard error of proportion, Confidence intervals, and Sample size determination

Test of significance - Types of hypothesis, P - value, type I & II errors, statistical and clinical significance, Power of the test, Parametric tests – Z test, one sample t test, two sample t test, paired t test, One way Analysis of Variance, repeated measures ANOVA. Non parametric tests - Mann Whitney U test, Wilcoxon sign rank test, Kruskall Wallis test and Friedman's ANOVA test

Measures of association - Chi square, Odds Ratio, Mantel- Haenszel Odds ratio, Relative Risk, Risk difference, and Number Needed to Treat.

# **UNIT IV: Correlation and Regression, Applications of Statistical Tools**

#### (8 Lectures)

Correlation and regression analysis - Scatter diagrams, Pearson correlation, Spearman's correlation, Simple and multiple linear regression models Introduction to Binary logistic regression models and survival analysis Role of statistical packages in health science research

# PRACTICAL

# (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- Representation of Statistical data by (a) Histograms (b) Ogive (c) Pie diagrams (d) Frequency curve.
- 2. Determination of Statistical averages/central tendencies- (a)Arithmetic mean (b) Median (c) Mode
- 3. Determination of measures of Dispersion- (a) Mean deviation (b) Standard deviation (c) Coefficient of variation (d) Quartile deviation
- 4. Tests of Significance-Application of following- (a) Chi- Square test (b) t- test (c) Standard error
- 5. Forming frequency table and computation of descriptive statistics of data using computer

| Sl. No.  | Component                          | Marks | Weight | IA Marks |
|----------|------------------------------------|-------|--------|----------|
| 1        | Sessional tests                    |       |        |          |
|          | Two Written tests (average of two) | 20    |        |          |
|          | Total                              | 20    | 0.5    | 10       |
| 2        | Continuous assessment              |       |        |          |
|          | Seminars/Assignments               | 05    |        |          |
|          | Regularity and Punctuality         | 05    |        |          |
|          | Total                              | 10    | 1.0    | 10       |
| Total CI | E marks (Theory)                   |       |        | 20       |

# **Continuous Internal Evaluation (CIE) - Theory**

#### **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

#### **Semester End Evaluation (SEE)**

# 1. Theory Paper

| Type of question | No. of<br>questions to be<br>set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |
|------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |
| Short Answers    | 5                                | 5  | 3                     | 15    |
| Total marks      |                                  |  |                       | 50*   |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |
|------------------|------------------|--------------------|-------|
| Major Experiment | 1                | 8                  | 8     |
| Minor Experiment | 1                | 4                  | 4     |
| Spotters         | 3                | 1                  | 3     |
| Viva voce        | -                | 5                  | 5     |
| Total marks      |                  |                    |       |

- 1. Research Methodology: Methods and Techniques, 3<sup>rd</sup> Edition (2014), C.R.Kothari., New Age international (P) Ltd. ISBN: 9788122436235.
- 2. Biostatistics–A Foundation for Analysis in the Health Science, 7<sup>th</sup> Edition (1999), W.W. Daniel., John Wiley Publications. ISBN: 978-471163862.
- 3. Text book of preventive and social Medicine. 21<sup>st</sup> Edition (2011), Park K. Banarsidas Bhanot Publishers. ISBN: 9788190607995.
- 4. Biostatistics: A Foundation for Analysis in the Health Sciences,10<sup>th</sup> Edition (2013), W.W. Daniel and C. L. Cross., Wiley. ISBN13: 9781118302798.
- Principles of Biostatistics, 2<sup>nd</sup> edition (2000), M. Pagano and K. Gauvrean., Thompson learning. ISBN: 9780534229023. Biostatistical Analysis, 5<sup>th</sup> edition (2009), J. H. Zar., Pearson. ISBN: 9780131008465.

# Master of Science in Food Safety and Biotechnology [M.Sc. (Food Safety and Biotechnology)] *II Year* Semester III and IV

| III SEMESTER |  |  |  |
|--------------|--|--|--|
| DSC1         | Food Standards, Certifications and Quality Control |  |  |
| DSC2         | Food Additives and Adulterants                     |  |  |
| DSC3         | Food Packaging and Storage                         |  |  |
| DSE          | Discipline Specific Elective                       |  |  |
| S1           | Seminar-I  |  |  |
| P1           | Project Work                                       |  |  |
| IV SEMESTER  |  |  |  |
| S2           | Seminar-II   |  |  |
| P2           | Project Work                                       |  |  |

# **Discipline Specific Core (DSC) Course**

III Semester DSC1: Food Standards, Certifications and Quality Control DSC2: Food Additives and Adulterants DSC3: Food Packaging and Storage

# **III SEMESTER**

# **Course DSC1: Food Standards, Certifications and Quality Control**

**Preamble:** Of all functions, quality assurance plays a major role in the food industry and it requires many diverse technical and analytical skills. It requires a continual monitoring of the quality to ensure compliance with compositional standards, microbiological standards, and various government regulations. Hence, this course is designed to impart knowledge on the accreditations procedure, quality assurance and standard limits.

#### **Course Outcomes**

At the end of the course students will be able to... **CO1:** Explain the application of food quality and food safety system CO2: Identify the hazard of the food chain to ensure food safety **CO3:** Examine chemical and microbiological quality of food samples **CO4:** Detect the adulteration in food samples **CO5:** Review of legislative approaches for the management of food safety

#### THEORY

# **UNIT I: Food Ouality**

Objective and importance of quality control, classification of quality attributes and its role in food quality, quality assessment of food materials (fruits, cereals, milk and meat), types of quality characteristics of food, methods used for determination of the quality in food industry, factors in fluencing the quality of food, sample and sampling methods of quality evaluation.

# **UNIT II: Food Sanitation**

Factors contributing to physical, chemical and biological contamination in food chain, prevention and control of food borne hazards, definition and regulation of food sanitation, sources of contamination, personal hygiene-food handlers, cleaning compounds, sanitation methods and pest control, sanitation and safety in food services.

# **UNIT III: Food Safety**

Principles of food safety and quality, quality assurance, Total quality management (TQM). Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Veterinary Practice (GVP), risk analysis, risk

# (4 Lectures)

# (6 Lectures)

(4 Lectures)

**Total Lectures: 32** 

assessment, risk management. Applications of HACCP in food safety, Current challenges to food safety.

# **UNIT IV: Food Laws and Regulations**

Basic concepts of food standards, Role of national regulatory agencies: Food safety and Standards Act:salient provision and prospects, FSSAI, PFA, certification- AGMARK, ISI (BIS). Role of international regulatory agencies: USDA, FDA, BRC, WHO, FAO, Codex Alimentarius commission, WTO agreements: SPS and TBT agreements, ISO and its standards for food quality and safety (ISO 9000, ISO 17025, ISO 22000, and ISO 14000).

# **UNIT V: Food Safety Auditing**

Food surveillance: International and national practices, procedure and protocols, food alerts, traceability and food product recall. Export and import of food in India: introduction, import and export policies, FDA import policy, export-import policy, export control systems. Import intelligence and alert systems, packaging and labelling, specifications and certifications.

# PRACTICALS

# (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Sensory evaluation tests for processed food
- 2. Determination of alkalinity/ hardness of water
- 3. Quantitative analysis of water by membrane filter method
- 4. Study of the microbiological quality of milk by MBR test
- 5. Estimation of vitamins from food samples
- 6. Estimation of benzoic acid/ sorbic acid in food.
- 7. Estimation of alcohol-insoluble solid in canned peas and corn
- 8. Estimation of sulphur dioxide in food
- 9. Determination of potassium bromate/potassium iodate content in bread
- 10. Detection of adulteration in milk and flour
- 11. Total qualitative analysis of tomato ketchup
- 12. Detection of preservatives and artificial sweetening agents in squashes
- 13. Detection and quantification of Aflatoxin B1.
- 14. Designing of HACCP plan for milk processing plant

# (10 Lectures)

# (8 Lectures)

| Sl. No.                  | Component                             | Marks | Weight | IA Marks |  |
|--------------------------|---------------------------------------|-------|--------|----------|--|
| 1                        | Sessional tests                       |       |        |          |  |
|                          | Two Written tests<br>(average of two) | 20    |        |          |  |
|                          | Total                                 | 20    | 0.5    | 10       |  |
| 2                        | Continuous assessment                 |       |        |          |  |
|                          | Seminars/Assignments                  | 05    |        |          |  |
|                          | Regularity and<br>Punctuality         | 05    |        |          |  |
|                          | Total                                 | 10    | 1.0    | 10       |  |
| Total CIE marks (Theory) |                                       |       |        | 20       |  |

# **Continuous Internal Evaluation (CIE) - Theory**

# **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.       | Component                       | IA Marks |
|---------------|---------------------------------|----------|
| 1             | Involvement in practicals       | 05       |
| 2             | Record maintenance and neatness | 05       |
| Total CIE mar | ks                              | 10       |

### **Semester End Evaluation (SEE)**

1. Theory Paper

| Type of question | No. of<br>questions<br>to be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |
|------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |
| Short Answers    | 5                                | 5  | 3                     | 15    |
| Total marks      |                                  | ·  |                       | 50*   |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per<br>question | Total |
|------------------|------------------|-----------------------|-------|
| Major Experiment | 1                | 8                     | 8     |
| Minor Experiment | 1                | 4                     | 4     |
| Spotters         | 3                | 1                     | 3     |
| Viva voce        | -                | 5                     | 5     |
| Total marks      |                  |                       |       |

- 1. Food Quality Assurance Principles & Practices, (2018), I. Alli. 2004. CRC Press, India, ISBN: 9781138034532.
- 2. Principles of Food Sanitation, 5<sup>th</sup>edition (2018), N.G. Marriott, G.W. Schilling and B. Robert; Springer, US, ISBN: 97803870250250.
- 3. Guide to Quality Management Systems for the Food Industry, 1<sup>st</sup>edition (2005), R. Early; Springer, US, ISBN: 9781461358879.
- 4. Total Quality Assurances for the Food Industries, 1<sup>st</sup>edition (2001), W.A Gould; Elsevier-Woodhead Publishers, UK, ISBN: 9781845696009.
## III SEMESTER Course DSC2: Food Additives and Adulterants

**Preamble:** Food additives are substances added to food to preserve flavor or enhance its taste, appearance, or other qualities. With the increasing use of processed foods since the 19th century, food additives are more widely used. However, understanding the recommended usage of additives is important. Food adulteration is the process in which the quality of food is lowered either by the addition of inferior quality material or by extraction of valuable ingredient. According to the provisions of Food Safety and Standards Authority of India, if any person imports or manufactures for sale, or stores or distribute any adulterant, by himself or by any other person on his behalf, shall be liable to penalty.

#### **Course Outcomes**

At the end of the course students will be able to...

CO1: Correlate the structure to the constituents function and importance in foods.

CO2: Solve real-world food science and nutritional problems.

**CO3:** Determine the adulterants in food samples

CO4: Examine the food additives added in the ready food

- CO5: Explain the importance of additives in food preservation
- CO6: Able to discriminate the adulterated and nonadulterated food

#### THEORY

#### **UNIT I: Food Additives and Preservatives**

Categories of food additives, functions and uses of food additives, food additive (citric acid, ascorbic acid, BHA or BHT, monosodium glutamate, hydrolyzed vegetable protein or autolyzed yeast extract, potassium bromate, propyl gallate, sulfites, sodium nitrate, sodium benzoate) natural additives, antimicrobial agent, risk assessment studies, E-numbers.

#### **UNIT II: Food Additives in Processing**

Emulsifiers, stabilizers, thickening and gelling agents with examples, processing aids: acid and defoaming agents and other non-certified agents- detection, meat tenderizing agents, quantification and health hazards, Government regulations of food additives.

#### **Total Lectures: 32**

(6 Lectures)

#### (6 Lectures)

#### UNIT III: Application and Limitations of Food Colorants and Sweeteners

#### (7 Lectures)

(7 Lectures)

Detection, FSSAI limitation and health hazards of certified colourants (brilliant blue, Indigo, carmine, citrus red, fast green, erythrosine, allura red, tartrazine, sunset yellow, lake pigments), natural, certified and non-certified colorants, food sweeteners- high-fructose corn syrup, neotame, sorbitol, aspartame, sucralose and saccharin and non-certified sweeteners, flavor enhancers.

#### **UNIT IV: Process Contaminants**

Pesticides and herbicides (carbamates, organochlorine and organosuplhur, organhalogens, nitrites, hormones, antibiotics, steroids, environmental chemicals - heavy metals, toxic residues, radioactive isotopes). Indirect contaminants- boiler water additives, peeling aids, building and equipment contaminates: lubricants, paint and coatings, contaminants during packaging, storage and transport: cleaners, sanitizers and cross contaminants.

#### **UNIT V: Food Adulteration**

Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Legislations- Prevention of Food Adulteration act 1954 common adulterants, adulterants in cereal and pulses, nonalcoholic beverages, spices, milk, oils and fat, quality testing in pulses, recent trends in food adulteration, and potential toxicity of food adulterants.

#### PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Analysis of flavour/ taints in milk
- 2. Adulteration in cereals and pulses
- 3. Adulteration of milk and milk products
- 4. Adulteration of sugar and preserve
- 5. Adulteration of fats and oils
- 6. Adulteration of non-alcoholic beverages
- 7. Adulteration of spices and condiments
- 8. Quantification of sodium benzoate in foods
- 9. Estimation of benzoic acid in the presence of saccharin in Ready- to-serve Beverages

#### (6 Lectures)

10. Isolation, identification of synthetic food colors

11. Detection of saccharine by salicylic acid method.

| Sl. No.   | Component                  | Marks | Weight | IA Marks |  |  |
|-----------|----------------------------|-------|--------|----------|--|--|
| 1         | Sessional tests            |       |        |          |  |  |
|           | Two Written tests          | 20    |        |          |  |  |
|           | (average of two)           | 20    |        |          |  |  |
|           | Total                      | 20    | 0.5    | 10       |  |  |
| 2         | Continuous assessment      |       |        |          |  |  |
|           | Seminars/Assignments       | 05    |        |          |  |  |
|           | Regularity and Punctuality | 05    |        |          |  |  |
|           | Total                      | 10    | 1.0    | 10       |  |  |
| Total CII | 20                         |       |        |          |  |  |

## **Continuous Internal Evaluation (CIE) - Theory**

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

#### **Semester End Evaluation (SEE)**

## 1. Theory Paper

| Type of<br>question | No. of<br>questions to<br>be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |
|---------------------|----------------------------------|--|-----------------------|-------|
| Answer in<br>Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief     | 7                                | 5  | 5                     | 25    |
| Short Answers       | 5                                | 5  | 3                     | 15    |
| Total marks         | 50*                              |  |                       |       |

\*Duration of examination: 3 hour

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |
|------------------|------------------|--------------------|-------|--|
| Major Experiment | 1                | 8                  | 8     |  |
| Minor Experiment | 1                | 4                  | 4     |  |
| Spotters         | 3                | 1                  | 3     |  |
| Viva voce        | -                | 5                  | 5     |  |
| Total marks      |                  |                    |       |  |

#### SUGGESTED READING

- 1. Food Science, 5<sup>th</sup>edition (1997), N.P. Norman and H.H. Joseph, CBS Publication, New Delhi, ISBN: 81-239-0472-X.
- 2. Food Analysis: Theory and Practice, 1<sup>st</sup>edition (1978), Y. Pomeranz and Mrloan, Westport, connectiant, ISBN: 978-81-8128-825-7
- 3. Food Additives, 2<sup>nd</sup>edition, B. Larry., D. Michael., S. Salminen and H. John, CRC Press, ISBN: 978-1-498-78302-6.
- 4. Food Preservation and Processing, 1<sup>st</sup>edition (1996), M. Kalia and S. Sangita, Kalyani Publishers, New Delhi, ISBN: 1234567143346.
- 5. Foods- Facts and Principles, 3<sup>rd</sup>edition (2008), N.S. Manay and Shakuntala, New Age International, ISBN: 978-81-224-2215-3.

## III SEMESTER Course DSC3: Food Packaging and Storage

**Preamble:** The importance of food packaging hardly needs emphasizing since only a handful of foods are sold in an unpackaged state. Current food packaging must take into consideration the biochemical, chemical, physical, and biological changes that occur during processing, distribution, and storage.

#### **Course Outcomes**

At the end of the course students will be able to... CO1: Classify the different types of food packaging systems CO2: Demonstrate the process of food packaging CO3: Perform chemical leaching test for plastic packaging CO4: Create an awareness on food packaging for social needs

#### THEORY

#### **Total Lectures: 32**

(6 Lectures)

#### **UNIT 1: Introduction to Food Packaging**

Evolution, selection of food package, pack classification, functions of food packaging (containment, protection, convenience and communication), factors for designing a package, laws related packaging. Paper based packaging materials: types of paper (kraft, bleached, greaseproof, glassine), paper products (paper bags, cartons, drums and molded paper containers), and functional properties of paper; testing of paper packaging materials.

#### **UNIT II: Polymer Based Packaging**

Classification of polymers, functional and mechanical properties of thermoplastic polymers; processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing); testingof plastic packages before and after processing. Nano packaging materials.

#### **UNIT III: Metal and Glass Packaging**

Container making processes (end manufacture, three-piece can manufacture and protective and decorative coatings); functional properties of metal containers; tin plate containers-quality control tests. Glass packaging materials: composition and manufacture of glass containers; glass container nomenclature; glass containers-closure functions, closure terminology and construction; properties of glass containers– mechanical, thermal and optical properties; testing of glass containers.

## (6 Lectures)

## (7 Lectures)

#### **UNIT IV: Aseptic Packaging of Foods**

Sterilization of packaging material food contact surfaces & aseptic packaging systems; active food packaging–definition, scope, physical and chemical principles involved. Edible films and coatings, Oxygen absorbents – classification and main types of oxygen absorbents, factors influencing the choice of oxygen absorbents, factors influencing the choice of oxygen absorbents for shelf-life extension of food, advantages and disadvantages of oxygen absorbents.

#### **UNIT V: Ethanol Vapor**

Ethanol vapour generator- advantages and disadvantages, uses of ethicap for shelf-life extension of food, and safety considerations in food packaging – types of food safety problems associated with package, package labellingand food safety. Packaging requirements of selected foods-cereal and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen foods, horticultural products and microwavable foods.

#### PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Alcohol insoluble solids in canned peas and corn
- 2. Bulk density
- 3. Migration test
- 4. Food Labelling
- 5. ERH study
- 6. Determination of viscosity of foods
- 7. Study the dehydration process
- 8. To design layout of a food plant
- 9. Testing of packaging materials
- 10. Demonstration of vacuum/gas packaging of foods

#### (7 Lectures)

## (6 Lectures)

## **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                  | Component            | Marks | Weight | IA Marks |  |  |
|--------------------------|----------------------|-------|--------|----------|--|--|
| 1                        | Sessional tests      |       |        |          |  |  |
|                          | Two Written tests    | 20    |        |          |  |  |
|                          | (average of two)     | 20    |        |          |  |  |
|                          | Total                | 20    | 0.5    | 10       |  |  |
| 2                        |                      |       |        |          |  |  |
|                          | Seminars/Assignments | 05    |        |          |  |  |
|                          | Regularity and       | 05    |        |          |  |  |
|                          | Punctuality          | 05    |        |          |  |  |
|                          | Total                | 10    | 1.0    | 10       |  |  |
| Total CIE marks (Theory) |                      |       |        | 20       |  |  |

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.      | Component                       | IA Marks |
|--------------|---------------------------------|----------|
| 1            | Involvement in practicals       | 05       |
| 2            | Record maintenance and neatness | 05       |
| Total CIE ma | arks                            | 10       |

## **Semester End Evaluation (SEE)**

#### 1. Theory Paper

| Type of<br>question | No. of<br>questions to be<br>set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|---------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail    | 2                                | 1  | 10                    | 10    |
| Answer in Brief     | 7                                | 5  | 5                     | 25    |
| Short Answers       | 5                                | 5  | 3                     | 15    |
| Total marks         |                                  |  |                       |       |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |
|------------------|------------------|--------------------|-------|--|
| Major Experiment | 1                | 8                  | 8     |  |
| Minor Experiment | 1                | 4                  | 4     |  |
| Spotters         | 3                | 1                  | 3     |  |
| Viva voce        | -                | 5                  | 5     |  |
| Total marks      |                  |                    |       |  |

#### SUGGESTED READING

- 1. Food Packaging: Principles and Practice, 2<sup>nd</sup> edition (2006), G. L. Robertson, Taylor & Francis, ISBN: 9781439862414.
- 2. Principles of Foods Packaging, 2<sup>nd</sup> edition (1980), S. Sacharow and R. C. Griffin, Avi Publication Co. Westport, Connecticut, USA, ISBN: 9780870553479.
- 3. Plastics in Packaging, 1<sup>st</sup> edition (1992), A. S. Athalye, Tata Mc Graw–Hill Publishing Co., New Delhi, ISBN: 8788187070022.
- 4. Active Food Packaging, 1<sup>st</sup> edition (1995), M. L. Rooney, Blackie Academic & Professional, Glasgow, UK, ISBN: 9780751401912.
- The Wiley Encyclopedia of Packaging Technology, 1<sup>st</sup> edition (1986), M. Bakker, John Willey & Sons. Inc; New York, ISBN: 978-0-470-08704-6.
- 3. Food Packaging Technology Handbook, 1<sup>st</sup> edition (2003), NIIR Board, National Institute of Industrial Research, ISBN: 8186623779
- 4. Novel Food Packaging Techniques, 1<sup>st</sup> edition (2003), R. Ahvenainen, CRC Press, ISBN: 9781855736757.
- 5. Innovations in Food Packaging, 1<sup>st</sup> edition (2005), J. H. Han, Elsevier Academic Press, ISBN: 9780123946010.
- Food Packaging Technology, 1<sup>st</sup> edition (2003), R. Coles., D. McDowell and M. J. Kirwan, CRC Press, ISBN: 0-8493-97788-X.

**Discipline Specific Elective (DSE) Course** 

III SEMESTER DSE: Nanobiotechnology DSE: Food Toxicology DSE: Bioprocessing and Fermentation Technology

## **DSE:** Nanobiotechnology

**Preamble:** The course is focused on introducing emerging techniques in diagnosis, treatment and drug delivery using nanoparticles. It offers basic foundation in the concepts of synthesis and types of nanostructures, their self-assembling nature and interaction with biomolecules.

#### **Course Outcomes**

At the end of the course students will be able to...

**CO1:** Define the concepts in Nanotechnology

CO2: Demonstrate the applications of Nanotechnology in Diagnosis and Biosensors

CO3: Identity the concerns of safety and regulatory issue of nanomedicine.

CO4: Illustrate the pharmaceutical preparations of nanoparticles.

CO5: Practice handling nanoparticle based products

#### THEORY

## **Total Lectures: 16**

#### **UNIT I: Principles and perspectives**

Introduction to current medical practice - treatment methodology - Principles of nanomedicine – nanomedical perspective and the medical applications – Ethical, safety and regulatory issues of nanomedicine.

#### **UNIT II: Molecular Nanotechnology**

Molecular manufacturing - MEMS - NEMS - BioMEMS - protein Nano arrays - nano fluidics and micro fluidics -self-assembly of nanoparticles for biomedical applications – bacterial structures – cubosomes – dendrimers – DNA nanoparticle conjugates – Bioactive nanomaterials – Au nanoparticles and Cadmium Selenide quantum dots – molecular motors – Nanoparticle and protein interactions.

#### **UNIT III: Biosensors and diagnostics**

Nanomolecular diagnostics and Biosensor Nanodiagnostics - Nanoarrays for diagnostics - detection of single DNA - self-assembled protein nanoarrays- protein nanobiochip - nanoparticles for molecular diagnostics - DNA nanomachines - Nanobiosensor - CNT biosensor - DNA nanosensor - Nanowire biosensor - application of nanodiagnostics.

#### (4 Lectures)

#### (4 Lectures)

(4 Lectures)

#### **UNIT IV: Applications in Pharmaceuticals**

#### (4 Lectures)

Nanopharmaceutical, Nanobiotechnology for drug discovery - protein and peptidebased compounds for cancer and diabetes - drug delivery - nanoparticle based drug delivery - lipid nanoparticles - vaccination - cell therapy -Gene therapy. Bio-compatibility of nanomedical materials

## PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Nanoparticle synthesis through chemical route
- 2. Synthesis of Silver nanoparticles
- 3. Synthesis of Gold nanoparticles
- 4. Ferrofluid synthesis using oleic acid surfactant dissolved in kerosene
- 5. Preparation of thin film by Spray pyrolysis
- 6. Colloidal synthesis of Nanomaterials
- 7. Preparation of Self-Assembled Monolayers (SAM)
- 8. Synthesis of thin film by Sol-Gel method
- 9. Preparation of nanostructures by Spray pyrolyses
- 10. Spin coating method

#### **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                  | Component             | Marks | Weight | IA Marks |
|--------------------------|-----------------------|-------|--------|----------|
| 1                        | Sessional tests       |       |        | ·        |
|                          | Two Written tests     | 20    |        |          |
|                          | (average of two)      | 20    |        |          |
|                          | Total                 | 20    | 0.5    | 10       |
| 2                        | Continuous assessment |       |        |          |
|                          | Seminars/Assignments  | 05    |        |          |
|                          | Regularity and        | 05    |        |          |
|                          | Punctuality           | 05    |        |          |
|                          | Total                 | 10    | 1.0    | 10       |
| Total CIE marks (Theory) |                       |       | 20     |          |

#### **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.      | Component                       | IA Marks |
|--------------|---------------------------------|----------|
| 1            | Involvement in practicals       | 05       |
| 2            | Record maintenance and neatness | 05       |
| Total CIE ma | arks                            | 10       |

#### Semester End Evaluation (SEE)

#### 1. Theory Paper

| Type of<br>question | No. of<br>questions to be<br>set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |
|---------------------|----------------------------------|--|-----------------------|-------|
| Answer in<br>Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief     | 7                                | 5  | 5                     | 25    |
| Short Answers       | 5                                | 5  | 3                     | 15    |
| Total marks         |                                  |  |                       | 50*   |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |
|------------------|------------------|--------------------|-------|--|
| Major Experiment | 1                | 8                  | 8     |  |
| Minor Experiment | 1                | 4                  | 4     |  |
| Spotters         | 3                | 1                  | 3     |  |
| Viva voce        | -                | 5                  | 5     |  |
| Total marks      |                  |                    |       |  |

#### SUGGESTED READINGS

- 1. Nanomedicine, Volume I: Basic Capabilities (1999), A. Robert and Freitas Jr.; Landes Bioscience, Georgetown, TX. ISBN 1-57059-645-X.
- 2. Nanomedicine, Volume IIA: Biocompatibility (2003) A. Robert and Freitas Jr.; Landes Bioscience, Georgetown, TX, ISBN 1570597006, 9781570597008.
- 3. The Hand book of Nanomedicine, (2008) Kewal K. Jain, Humana Press, Springer. ISBN: 1493969668.
- 4. Nanomaterials for medical diagnosis and therapy (2007), S.S.R. Challa Kumar, Viley-VCH, ISBN: 3527313907.

- 5. Nano Medicines (2006), P. Diwanand A. Bharadwaj (Eds); Pentagon Press. ISBN: 8182744059.
- The chemistry of nanomaterials: Synthesis, properties and applications (2004), C.N.R.Rao, A. Muller, A.K.Cheetham (Eds); Wiley VCH Verlag Gmbh & Co, Weinheim. ISBN:3527604170.

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## **DSE:** Food Toxicology

**Preamble:** Food toxicology is the study of the nature, properties, effects, and detection of toxic substances in food or food animal feed and their disease manifestation in humans. This course will provide a general review of toxicology related to food and the human food chain. Fundamental concepts will be covered including dose-response relationships, absorption of toxicants, distribution and storage of toxicants, biotransformation and elimination of toxicants. This course also focuses on the effects/significance of food toxicants on human being.

#### **Course Outcomes**

At the end of the course students will be able to...

- CO1: Summarise the major issues, concepts, and subject areas in food toxicology
- **CO2:** Recognize the nature, type of toxic agents and health hazards and treatment associated with it.
- **CO3:** Estimate toxicants in food samples.
- CO4: Determine LC50/LD50 of food toxicants

**CO5:** Create awareness about toxicants in food and its implications on human health.

#### THEORY

#### **UNIT I: Introduction to Food Toxicology**

Food Toxicology: framework and concept, source and classification of toxic agents; characteristics of exposure, spectrum of undesirable effects, interaction and tolerance; biotransformation and mechanisms of toxicity, evaluation of toxicity.

#### **UNIT II: Natural Toxins in Food**

Natural toxins in food: toxins of plant and animal origin; microbial toxins: bacterial toxins, fungal toxins and algal toxins; occurrence, toxicity and significance; determination of toxicants in foods and their management.

#### **UNIT III: Food Allergies and Sensitivities**

Food allergies and sensitivities: natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions); Safety of genetically modified food: potential toxicity and allergenisity of GM foods. Safety of children consumables.

# (4 Lectures)

**Total Lectures: 16** 

# (3 Lectures)

(3 Lectures)

#### **UNIT IV: Environmental Contaminants**

#### (3 Lectures)

Environmental contaminants: fungicide and pesticide residues in foods; antibiotic residues, heavy metal and their health impacts, detection of environmental contaminants in food.

## **UNIT V: Additives and Toxicants**

## (3 Lectures)

Food additives and toxicants added or formed during food processing: safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso-compounds, heterocyclic amines; dietary supplements and toxicity related to dose: common dietary supplements, relevance of the dose, possible toxic effects.

## PRACTICAL

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Estimation of LC50/LD50 of food toxicant
- 2. Biotoxicity of food toxicants
- 3. Quantitative determination of potassium bromate in food sample
- 4. Quality and safety assessment of food color additives
- 5. Extraction of microbial toxins from sea food
- 6. Detection of aflatoxin from food
- 7. Detection of toxin genes of microorganisms in food
- 8. Detection of antibiotic residues in food
- 9. Detection of heavy metals in environmental samples
- 10. Physico-chemical analysis of water

| Sl. No.                  | Component             | Marks | Weight | IA Marks |
|--------------------------|-----------------------|-------|--------|----------|
| 1                        | Sessional tests       | •     | •      |          |
|                          | Two Written tests     | 20    |        |          |
|                          | (average of two)      | 20    |        |          |
|                          | Total                 | 20    | 0.5    | 10       |
| 2                        | Continuous assessment |       |        |          |
|                          | Seminars/Assignments  | 05    |        |          |
|                          | Regularity and        | 05    |        |          |
|                          | Punctuality           | 05    |        |          |
|                          | Total                 | 10    | 1.0    | 10       |
| Total CIE marks (Theory) |                       |       |        | 20       |

## **Continuous Internal Evaluation (CIE) - Theory**

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.      | Component                       | IA Marks |
|--------------|---------------------------------|----------|
| 1            | Involvement in practicals       | 05       |
| 2            | Record maintenance and neatness | 05       |
| Total CIE ma | arks                            | 10       |

## Semester End Evaluation (SEE)

## 1. Theory Paper

| Type of question | No. of<br>questions to<br>be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |  |
|------------------|----------------------------------|--|-----------------------|-------|--|
| Answer in Detail | 2                                | 1  | 10                    | 10    |  |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |  |
| Short Answers    | 5                                | 5  | 3                     | 15    |  |
| Total marks      |                                  |  |                       |       |  |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of<br>questions | Marks per question | Total |
|------------------|---------------------|--------------------|-------|
| Major Experiment | 1                   | 8                  | 8     |
| Minor Experiment | 1                   | 4                  | 4     |
| Spotters         | 3                   | 1                  | 3     |
| Viva voce        | -                   | 5                  | 5     |
| Total marks      | 20                  |                    |       |

#### SUGGESTED READINGS

- 1. Cassarett and Duoll's Toxicology: The basic science of poison 8<sup>th</sup>edition (2013), D.L. Klassen, McGraw Hill Publishers, NewYork. ISBN: 0071769234
- 2. Food Toxicology (2007) W. Helferichand C.K. Winter, CRC Press, ISBN: 9780849327605
- 3. Introduction to Food Toxicology, 2<sup>nd</sup> edition (2009), T.Shibamoto and L. Bjeldanes, Elsevier Inc., Burlington, MA. ISBN: 9780123742865
- 4. Natural Toxicants in Food (1998), D.H. Watson, CRC Press, LLC. Boca Raton, FL. ISBN: 9781850758624
- Principles of Food Toxicology, 2<sup>nd</sup> edition (2013), P. Tönu, CRC Press, LLC. Boca Raton, FL. ISBN: 9781466504103

## **DSE: Bioprocessing and Fermentation Technology**

**Preamble:** This course will give a comprehensive understanding of the application of different types of fermentation process and the bioreactors used in food production. The course introduces the concept of upstream and downstream processing in fermentation technology involved in processing and production of food.

#### **Course Outcomes**

At the end of the course students will be able to...

- **CO1:** Recognize the importance of bioreactors in food technology
- CO2: Describe different fermentation processes used in food industries
- **CO3:** Quantify organic acid and alcohol

CO4: Demonstrate various downstream processing involved in fermentation process

**CO5:** Identify the basic construction of a bioreactor, fermentation processes and their application in food technology.

#### THEORY

#### **UNIT I: Bioprocess Development**

Steps in bioprocess development, bioreactors, isolation, strain improvement, preservation and maintenance of industrial microorganisms, microbial growth kinetics, media formulation for industrial fermentation, air and media sterilization, design of a fermenter/bioreactor.

#### **UNIT II: Types of Fermentation Process**

Types of fermentation process, types of fermenter/bioreactor, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors),measurement and control of bioprocess parameters (temperature, pH, pressure, agitation), use of computers in bioprocess control systems (data logging, analysis and control),comparison between traditional and modern methods of fermentation, production of alcohol (ethyl alcohol), organic acid (citric acid), antibiotic (penicillin) and enzyme (amylase).

#### **UNIT III: Downstream Processing**

Removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment.

#### (4 Lectures)

(6 Lectures)

**Total Lectures: 16** 

## (6 Lectures)

## PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Production and quantification of citric acid.
- 2. Production and quantification of lactic acid.
- 3. Production and quantification of acetic acid.
- 4. Production and estimation of ethyl alcohol.
- 5. Study of microbial growth kinetics.
- 6. Production of biofuel from microorganisms.
- 7. Downstream processing: centrifugation, filtration and ultrasonication.
- 8. Partial purification of industrially important proteins by ammonium sulphate precipitation.
- 9. Separation of proteins by paper chromatography and thin layer chromatography.
- 10. Strain improvement techniques (physical and chemical method).

#### **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.   | Component                | Marks | Weight | IA Marks |
|-----------|--------------------------|-------|--------|----------|
| 1         | Sessional tests          |       |        |          |
|           | Two Written tests        | 20    |        |          |
|           | (average of two)         | 20    |        |          |
|           | Total                    | 20    | 0.5    | 10       |
| 2         | Continuous assessment    |       |        |          |
|           | Seminars/Assignments     | 05    |        |          |
|           | Regularity and           | 05    |        |          |
|           | Punctuality              | 05    |        |          |
|           | Total                    | 10    | 1.0    | 10       |
| Total CIE | Total CIE marks (Theory) |       |        |          |

#### **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.   | Component                       | IA Marks |
|-----------|---------------------------------|----------|
| 1         | Involvement in practicals       | 05       |
| 2         | Record maintenance and neatness | 05       |
| Total CIE | marks                           | 10       |

#### **Semester End Evaluation (SEE)**

#### 1. Theory Paper

| Type of question | No. of<br>questions to<br>be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |  |
|------------------|----------------------------------|--|-----------------------|-------|--|
| Answer in Detail | 2                                | 1  | 10                    | 10    |  |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |  |
| Short Answers    | 5                                | 5  | 3                     | 15    |  |
| Total marks      |                                  |  |                       |       |  |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |  |
|------------------|------------------|--------------------|-------|--|
| Major Experiment | 1                | 8                  | 8     |  |
| Minor Experiment | 1                | 4                  | 4     |  |
| Spotters         | 3                | 1                  | 3     |  |
| Viva voce        | -                | 5                  | 5     |  |
| Total marks      |                  |                    |       |  |

## SUGGESTED READINGS

- 1. Bioprocessing Technology in Food and Health: Potential Applications and Emerging Scope, 1<sup>st</sup> edition (2018), V.K. Deepak and P.R. Ami; Apple Academic Press, India, ISBN: 9781771886888.
- Principles of Fermentation Technology, 3<sup>rd</sup> edition (2016), P. Stanbury A. Whitaker and S. Hall; Elsevier-Woodhead Publishers, UK, ISBN: 9780444634085.

- 3. Biotechnology: Food Fermentation, 2<sup>nd</sup> edition (1999), V.K. Joshi and A. Pandey; Asiatech Publishers, India, ISBN:8187198052.
- 4. Practical Fermentation Technology,1<sup>st</sup> edition (2008), B. Mcneil and L. M. Harvey; Wiley, ISBN:9780470014349.
- 5. Industrial Microbiology, 2<sup>nd</sup> edition (2016), L.E. Casida; New Age International Publishers, New York, ISBN: 9788122438024.

## **Generic Elective (GE) Course**

I Semester

**GE: Toxicology** 

**GE: Food Processing and Preservation** 

**II Semester** 

**GE: Medical Biotechnology** 

GE: Application of Biotechnology in Food Science

## **Course GE: Toxicology**

**Preamble:** Toxicology is the study of the adverse effect of chemical substance on living systems. The purpose of this course is to provide basic and advance understanding of the toxicology, particularly, in relation to human health. Fundamental concepts will be covered including dose-response relationships, kinetics and dynamics of toxicants, target organ toxicity, teratogenesis, mutagenesis, carcinogenesis, and risk assessment.

#### **Course Outcomes**

At the end of the course students will be able to ...

- **CO1:** Summarise the principles of toxicology
- **CO2:** Discuss types of health hazards associated with these toxic agents and about treatment strategies.
- **CO3:** Recognise the processes and endpoints in the human body associated with exposure to toxic agents.
- **CO4:** Detect the toxic substances in biological and environmental samples.
- CO5: Determine LC50/LD50 of toxicants
- CO6: Create awareness about toxicants and its implications on human health.

#### THEORY

#### **UNIT I: Introduction to Toxicology**

Definitions, scope, history, different branches of toxicology, source and classification of toxic agents. Spectrum of toxic doses: Interactional of chemicals, idiosyncratic reactions, allergic reaction, and tolerance, reversible and irreversible toxicity. Factors affecting toxicity: Species, age, gender, nutritional status, Characteristic of exposure: Route and site, Duration and frequency. Dose-response relationship: Threshold, NOEAL, LOAEL, potency, efficacy, graded and quantal dose response, shape of dose response curve and therapeutic index.

#### **UNIT II: Evaluation of Toxicity**

Epidemiological studies, tests using animal models and cell culture, test of acute and chronic toxicity

#### **Total Lectures: 16**

#### (4 Lectures)

(3 Lectures)

#### **UNIT III: Kinetics of Toxicants**

Deposition of toxicants: absorption: site and mechanism of toxicant absorption, distribution: site and mechanism of toxicant distribution, excretion: route and mechanism, biomagnification and biotransformation: phase I and phase II reaction

#### **UNIT IV: Dynamics of Xenobiotics**

Molecular toxicity: Toxicological consequence on DNA, RNA synthesis and metabolism, toxicogenomics and toxicoproteomics

Biochemical toxicity: ROS & RNS, oxidative stress, lipid peroxidation, protein oxidation, and antioxidant defense mechanism

Biomarker of exposure: potential use and limitation in toxicology

#### UNIT V: Organ and Non-organ Directed Toxicity

Non-organ directed toxicity: Chemical carcinogens, genetic toxicity and developmental toxicity Organ directed toxicity: Neurotoxicity, hepatotoxicity, nephrotoxicity, blood toxicity, reproductive and endocrine system

#### **PRACTICAL:**

## (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Estimation of LC50/LD50 of toxicant
- 2. Assessment of developmental toxicity: growth retardation, gross external malformation
- 3. Micronucleus test for the assessment of genotoxicity
- 4. Testing of cell viability after toxicant exposure
- 5. Biomarker of exposure assessment
- 6. Estimation of Reactive Oxygen Species (ROS)
- 7. Determination of effect of temperature on the toxicity of a pollutant
- 8. Analysis of pesticide residues by finger printing technique
- 9. Detection of heavy metals in environmental samples
- 10. Analysis of water:
  - a. Determination of dissolved oxygen of water
  - b. Determination of Biochemical oxygen demand of water
  - c. Physico-chemical analysis of water

#### (3 Lectures)

(3 Lectures)

## (3 Lectures)

## **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                 | Component                | Marks | Weight | IA Marks |  |
|-------------------------|--------------------------|-------|--------|----------|--|
| 1                       | Sessional tests          |       |        |          |  |
|                         | Two Written              | 20    |        |          |  |
|                         | tests(average of two)    | 20    |        |          |  |
|                         | Total                    | 20    | 0.5    | 10       |  |
| 2 Continuous assessment |                          |       |        | •        |  |
|                         | Seminars/Assignments     | 05    |        |          |  |
|                         | Regularity and           | 05    |        |          |  |
|                         | Punctuality              | 05    |        |          |  |
|                         | Total                    | 10    | 1.0    | 10       |  |
| Total CII               | Total CIE marks (Theory) |       |        |          |  |

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

## Semester End Evaluation (SEE)

## 1. Theory Paper

| Type of question | No. of<br>questions to<br>be set | Number of<br>questions to<br>be answered | Marks per<br>question | Total |  |
|------------------|----------------------------------|--|-----------------------|-------|--|
| Answer in Detail | 2                                | 1  | 10                    | 10    |  |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |  |
| Short Answers    | 5                                | 5  | 3                     | 15    |  |
| Total marks      |                                  |  |                       |       |  |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of<br>questions | Marks per question | Total |
|------------------|---------------------|--------------------|-------|
| Major Experiment | 1                   | 8                  | 8     |
| Minor Experiment | 1                   | 4                  | 4     |
| Spotters         | 3                   | 1                  | 3     |
| Viva voce        | -                   | 5                  | 5     |
| Total marks      | 20                  |                    |       |

#### SUGGESTED READINGS

- Cassarett and Duoll's Toxicology: The basic science of poison 8<sup>th</sup>edition (2013), D.L. Klassen, McGraw Hill Publishers, NewYork. ISBN: 0071769234
- 2. Cassarett and Duoll's Essentials of Toxicology. 2<sup>nd</sup> Edition (2010) C.D. Klaassen and J.B. Whatkins, McGraw Hill Publishers, NewYork. ISBN: 0071622403
- 3. Principles of Toxicology 2<sup>nd</sup>Edition (2006), E.K. Stine and M.T. Brown, Taylor and Francis Publishers, ISBN: 0-8493-2856
- 4. Introduction to Toxicology. 3<sup>rd</sup>Edition (2002) J. Timbrell, Taylor and Francis Publishers. ISBN: 9780415247634
- Lu's Basic Toxicology: Fundamentals, target organs, and risk assessment. 6<sup>th</sup>Edition (2012) S. Kacew and B. Lee, Taylor and Francis Publishers, ISBN: 18418495

## **Course GE: Food Processing and Preservation**

**Preamble:** Innovations in the field of food processing are vital for agro-processing, transforming the raw materials to the finished products at an increased rate of production, productivity and at a reduced cost of production, to meet the demands and reduce the wastage of the produce. This course helps in understanding all the aspects of the unit operations involved in processing the raw materials to the finished products and to explore the food processing industry sector in India, which is one of the largest in terms of production, consumption, export and growth prospects. This course brings out information on reduction of toxins, enhance preservation and bring in variety of nutritious food through scientific approach.

#### **Course Outcomes**

At the end of the course students will be able to...

CO1: Recognise the importance of preservation of food

CO2: Summarise the preservation techniques based on the food types

CO3: Preform techniques in food processing and preservation

CO4: Integrate the knowledge gained to conduct several types of food processing

#### THEORY

#### **UNIT I: Scope and Importance of Food Processing**

Historical developments in food preservation, Role of food additives in preservation (chemical) and household preservation methods, principles of emulsification in food processing (milk, salad dressing and meat sausages).

#### UNIT II: Water Activity and Dehydration

Role of water activity in food preservation, intermediate moisture foods (IMF). Significance of Hurdle technology in food processing. Food frying: General principles, types of frying process. Methods of dehydration and concentration, drying curves; changes in food during dehydration and concentration.

#### **UNIT III: Low Temperature Preservation**

Refrigeration load, chilling and refrigeration, cold storage. changes in foods during refrigeration and storage, Freezing and frozen storage: freezing curves, slow and quick freezing, changes in food during freezing, hazard analysis, thaw indicators.

## **Total Lectures: 16**

(3 Lectures)

(4 Lectures)

#### (3 Lectures)

#### **UNIT IV: Food preservation and High Temperature**

Use and types of high temperature for food preservation, Commercial heat preservation methods (sterilization, pasteurization and blanching), heat treatments and effects on foods, brief concept of different heat processing methods: roasting, frying and baking.

#### **UNIT V: Canning and Non-thermal Preservation**

Cans and container types, spoilage of canned foods, processing of canning of foods, heat penetration. Non-thermal processing: Pulse electrical field, targeted microwave cooking, high pressure, sonication, food preservation by irradiation.

## PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Blanching of food
- 2. Enzymatic browning of fruits and vegetables
- 3. Application of gelatinization in sauce production
- 4. Application of emulsion in mayonnaise preparation
- 5. Effect of frozen storage on colour formation in French fries
- 6. Effect of heat on vegetables and fruits
- 7. Effect of pH in cooking of vegetables samples
- 8. Preparation of fruit squash
- 9. Determination of the best frying temperature for fats and oils
- 10. Stages in candy and caramel preparation

## (3 Lectures)

(3 Lectures)

| Sl. No.                  | Component            | Marks | Weight | IA Marks |  |
|--------------------------|----------------------|-------|--------|----------|--|
| 1                        | Sessional tests      |       |        |          |  |
|                          | Two Written tests    | 20    |        |          |  |
|                          | (average of two)     | 20    |        |          |  |
|                          | Total                | 20    | 0.5    | 10       |  |
| 2 Continuous assessment  |                      |       |        |          |  |
|                          | Seminars/Assignments | 05    |        |          |  |
|                          | Regularity and       | 05    |        |          |  |
|                          | Punctuality          | 05    |        |          |  |
|                          | Total                | 10    | 1.0    | 10       |  |
| Total CIE marks (Theory) |                      |       |        | 20       |  |

## **Continuous Internal Evaluation (CIE) - Theory**

**Continuous Internal Evaluation (CIE) - Practical** 

| Sl. No. | Component                       | IA Marks |
|---------|---------------------------------|----------|
| 1       | Involvement in practicals       | 05       |
| 2       | Record maintenance and neatness | 05       |
|         | Total CIE marks                 | 10       |

#### **Semester End Evaluation (SEE)**

## 1. Theory Paper

| Type of question | No. of<br>questions to<br>be set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |
| Short Answers    | 5                                | 5  | 3                     | 15    |
| Total marks      |                                  |  |                       |       |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of questions | Marks per question | Total |
|------------------|------------------|--------------------|-------|
| Major Experiment | 1                | 8                  | 8     |
| Minor Experiment | 1                | 4                  | 4     |
| Spotters         | 3                | 1                  | 3     |
| Viva voce        | -                | 5                  | 5     |
| Total marks      |                  |                    |       |

#### **SUGGESTED READING:**

- 1. Food Science, 5<sup>th</sup> edition (1997), N. P. Norman and H.H. Joseph, CBS Publication, New Delhi, ISBN: 81-239-0472-X.
- 2. Food Microbiology. 4<sup>th</sup>edition (1996), W.C. Frazier and D.C. Westhoff,Tata McGraw Hill Publication, New Delhi, ISBN: 978-1-25-906251-3.
- 3. Food Preservation and Processing,1<sup>st</sup> edition, (1996), M, Kalia and S Sangita, Kalyani Publishers, New Delhi, ISBN: 1234567143346.
- 4. Food Processing and Preservation,1<sup>st</sup> edition (2002), B Sivasankar,Prentice Hall of India Pvt. Ltd., New Delhi, ISBN: 978-81-203-2086-4.
- Technology of Food Preservation,4<sup>th</sup>edition (1977), N. W. Desrosier, AVI Pub. Co. edition, ISBN: 9780870552328.
- 6. Food Processing and Preservation, 1<sup>st</sup> edition (2005), N Khetarpaul,Dya Publishing House, New Delhi. ISBN: 9781498721752.
- Food Processing Technology: Principle and Practice, 2<sup>nd</sup> edition (2005), P. J. Fellows, CRCpress, ISBN: 9780081019078.

#### **Course GE: Medical Biotechnology**

**Preamble:** This course aims to provide a comprehensive knowledge about medical biotechnology and its broad application in the field of biomedical science including cloning and expression of desired gene, gene manipulations, amplification of DNA by polymerase chain reactions and various cutting edge applications. Student studying this course will gain knowledge about how gene cloning and gene manipulation are applied in modern science and mankind, use of DNA fingerprinting, mutant preparation, probe preparation and hybridization methods and their applications in biomedical field.

#### **Course Outcomes**

At the end of the course students will be able to ...

- CO1: Discuss the process of cloning and expression of gene in Medical Biotechnology
- **CO2:** Perform DNA extraction and estimate the purity.
- **CO3:** Amplify the nucleic acids for disease detection
- **CO4:** Explain the application of modern biotechnological tools in cutting edge research
- **CO5:** Integrate biotechnological approaches to understand disease burden and its application in the field of biomedical science.

#### THEORY

#### **Total Lectures: 16**

#### UNIT I: Enzymes, Vectors, Cloning and Expression of Gene (5 Lectures)

Introduction to medical biotechnology and gene manipulating enzymes.

Cloning vectors: plasmids vectors, bacteriophages as cloning vectors, phagmid vector, cosmid and artificial chromosomes, expression vectors.

Cloning and expression of gene of insert: selection of insert, cloning components, method of cloning, selection and screening of recombinants

DNA sequencing: enzymatic and chemical sequencing of DNA; next generation DNA sequencing

Construction and application of genomic and cDNA libraries.

**UNIT II: Amplification of Nucleic Acids and DNA Fingerprinting** (4 Lectures) Polymerase chain reaction (PCR); Types of PCR: multiplex PCR, nested PCR and reverse transcriptase PCR, random amplified polymorphic DNA, PCR-restriction fragment length polymorphism. DNA fingerprinting and profiling: ribotyping, amplified fragment length polymorphism, micro and minisatellite, short tandem repeats, variable number tandem repeats and single-nucleotide polymorphisms.

Real time PCR: principle, non-specific and specific reporters and its application.

## **UNIT III: DNA Hybridization**

Probes: properties and application. Preparation of probes.

Hybridization techniques: southern hybridization, northern hybridization, fluorescence *in situ* hybridization, microarray and colony hybridization.

## UNIT IV: Application of Medical Biotechnology

Production of recombinant biomolecules: recombinant insulin, recombinant human growth hormones, recombinant factor VIII and recombinant vaccines Concept and applications of gene silencing, gene knockouts and genome editing. Gene therapy- somatic and germline gene therapy, suicide gene therapy

## PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Isolation of plasmid DNA
- 2. DNA digestion using restriction enzymes
- 3. PCR amplification of targeted gene
- 4. PCR-RFLP analysis
- 5. RAPD analysis
- 6. Multiplex PCR
- 7. Nested PCR
- 8. Real time PCR (qPCR)
- 9. Preparation of E. coli competent cells for transformation
- 10. Molecular cloning of gene
- 11. Preparation of enzyme labelled probe
- 12. DNA dot blotting
- 13. Southern and/or colony hybridization
- 14. Generation of auxotrophic mutants

## (4 Lectures)

(3 Lectures)

| Sl. No.                  | Component             | Marks | Weight | IA Marks |
|--------------------------|-----------------------|-------|--------|----------|
| 1                        | Sessional tests       |       |        |          |
|                          | Two Written           | 20    |        |          |
|                          | tests(average of two) | 20    |        |          |
|                          | Total                 | 20    | 0.5    | 10       |
| 2                        | Continuous assessment |       |        |          |
|                          | Seminars/Assignments  | 05    |        |          |
|                          | Regularity and        | 05    |        |          |
|                          | Punctuality           | 05    |        |          |
|                          | Total                 | 10    | 1.0    | 10       |
| Total CIE marks (Theory) |                       |       |        | 20       |

## **Continuous Internal Evaluation (CIE) - Theory**

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

## **Semester End Evaluation (SEE)**

## 1. Theory Paper

| Type of question | No. of<br>questions to<br>be set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail | 2                                | 1  | 10                    | 10    |
| Answer in Brief  | 7                                | 5  | 5                     | 25    |
| Short Answers    | 5                                | 5  | 3                     | 15    |
| Total marks      |                                  |  |                       |       |

\*Duration of examination: 3 hours

#### 2. Practical Paper

| Type of question | No. of<br>questions | Marks per<br>question | Total |
|------------------|---------------------|-----------------------|-------|
| Major Experiment | 1                   | 8                     | 8     |
| Minor Experiment | 1                   | 4                     | 4     |
| Spotters         | 3                   | 1                     | 3     |
| Viva voce        | -                   | 5                     | 5     |
| Total marks      |                     |                       |       |

#### SUGGESTED READINGS

- Gene cloning and DNA Analysis: An introduction. 7<sup>th</sup>edition (2016),T. ABrown, Wiley-Blackwell, ISBN: 9781119072560
- Molecular Cloning: A Laboratory Manual, 4<sup>th</sup> edition (2012), M.R. Green and J. Sambrook Three-volume set by; Cold Spring Harbor Laboratory Press, ISBN: 1936113422
- 3. An introduction to genetic engineering, 3<sup>rd</sup> edition (2013), D.S.T. Nicholl, Cambridge University press. ISBN: 9780521188142
- 4. Principles of gene manipulation and genomics, 7<sup>th</sup> edition (2006), S.B, Primrose and R. Twyman, Wiley-Blackwell. ISBN: 978-1405135443
- 5. Introduction to Biotechnology. 3<sup>rd</sup> edition (2012), W. J. Thieman and M.A. Palladino Pearson publications, ISBN: 9780321766113
- 6. An Introduction to Biotechnology. 1<sup>st</sup> edition (2014), W.T. Godbey,Woodhead Publishing, ISBN: 9781907568282
- Medical Biotechnology, (2014), Bernard R. Glick, Terry L. Delovitch and Cheryl L. Patten ASM Press, ISBN: 9781555817053

#### **Course GE: Application of Biotechnology in Food Science**

**Preamble:** Application of biotechnology in food science help the students to combine the biotechnology application studied in other courses and relate it to food Science. This will give a comprehensive understanding of transgenic food, biotechnological food additive and molecular based detection techniques and regulations. This course would enable to develop an in-depth knowledge of food science and food processing and composition, focusing on biotechnology applied to food.

#### **Course Outcomes**

At the end of the course students will be able to... CO1: Describe the application of biotechnology in food production CO2: Demonstrate the cloning and expression of recombinant protein CO3: Apply biotechnological concept in indigenous food production CO4: Review of protoplast fusion in plant biotechnology

#### THEORY

# **Total Lectures: 16**

#### **UNIT I: Introduction to Food Biotechnology**

Introduction to biotechnology; enzymes and vectors used for genetic modification. Genetic modification of microorganisms & importance of gene cloning in food production, Molecular techniques in food science: nucleic acid hybridization, genetic fingerprinting, DNA sequencing, PCR and their relevance in food production.

#### UNIT II: Application of Biotechnology for Food Production (4 Lectures)

Genetic manipulation: plant and animal cells, cloning and expression of target gene. Traditional biotechnology (fermentation) and modern biotechnology. Biotechnological approaches for production of alcoholic beverages, dairy products, fermented cereal, legume, fruits and vegetables

#### UNIT III: Enzyme Application in Food Industry

Production - amylase, protease, lipase, lactase and pectinase, Use of enzymes in food & beverage industry (e.g. cheese, fruit, juice, wine, meat tenderizing & dairy), dietary diversification and biotechnological approaches. Nutraceutics and food additives derived from biotechnology.

## (4 Lectures)

# (4 Lectures)

#### UNIT IV: Genetically Manipulated (GM) Food Products

#### (4 Lectures)

Concept, Need for GM foods, types and application, ethical issues of concern – safety of GM foods. Different GM foods: golden rice, green factories, super bananas, transgenic multivitamin corn, transgenic oilseed crop, bio cassava, modified potatoes and fish (salmon)

## PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

- 1. Isolation of plasmid DNA
- 2. Digestion of DNA samples using restriction enzymes
- 3. Ligation of DNA fragments
- 4. Demonstration of PCR amplification of DNA
- 5. Cloning of recombinant protein
- 6. Expression of recombinant protein
- 7. Processes of meat tenderization
- 8. Process of wine preparation
- 9. Processes of hydrolysis by proteolytic enzymes.
- 10. Effect of yeast in raising power dough

#### **Continuous Internal Evaluation (CIE) - Theory**

| Sl. No.                  | Component                  | Marks | Weight | IA Marks |
|--------------------------|----------------------------|-------|--------|----------|
| 1                        | Sessional tests            |       |        |          |
|                          | Two Written tests          | 20    |        |          |
|                          | (average of two)           | 20    |        |          |
|                          | Total                      | 20    | 0.5    | 10       |
| 2                        | Continuous assessment      |       |        |          |
|                          | Seminars/Assignments       | 05    |        |          |
|                          | Regularity and Punctuality | 05    |        |          |
|                          | Total                      | 10    | 1.0    | 10       |
| Total CIE marks (Theory) |                            |       |        | 20       |
#### **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No.         | Component                       | IA Marks |
|-----------------|---------------------------------|----------|
| 1               | Involvement in practicals       | 05       |
| 2               | Record maintenance and neatness | 05       |
| Total CIE marks |                                 | 10       |

#### **Semester End Evaluation (SEE)**

#### 1. Theory Paper

| Type of<br>question | No. of<br>questions to be<br>set | Number of<br>questions to be<br>answered | Marks per<br>question | Total |
|---------------------|----------------------------------|--|-----------------------|-------|
| Answer in Detail    | 2                                | 1  | 10                    | 10    |
| Answer in Brief     | 7                                | 5  | 5                     | 25    |
| Short Answers       | 5                                | 5  | 3                     | 15    |
| Total marks         |                                  |  |                       | 50*   |

\*Duration of examination: 3 hours

### 2. Practical Paper

| Type of question | No. of<br>questions | Marks per question | Total |
|------------------|---------------------|--------------------|-------|
| Major Experiment | 1                   | 8                  | 8     |
| Minor Experiment | 1                   | 4                  | 4     |
| Spotters         | 3                   | 1                  | 3     |
| Viva voce        | -                   | 5                  | 5     |
| Total marks      | 20                  |                    |       |

## SUGGESTED READINGS

- 1. Food Biotechnology Principles and Practices, (2012), V. K Joshi and R.S.Singh, I.K. International Publishing house Pvt .Ltd. ISBN 978-93-81141-49-6.
- 2. Biotechnology, (2015), V. Kumar, Saris Publications, ISBN-13: 978-9384826109
- A text book of Biotechnology, 6<sup>th</sup> edition (2014), R.C. Dubey, S Chand & Co, New Delhi. ISBN: 9788121926089
- 4. Basic Biotechnology, 14<sup>th</sup> edition (2007), Rev, Fr, Dr. Ignasimuthu, S.J. Tata Mc Graw Hill Publication Co Ltd., New Delhi, ISBN: 0074621629

- 5. Food Science and Food Biotechnology, (2003). G.F.G. Lopez, and G.V.B. Canovas, CRC Press, Florida, USA. ISBN: 9781566768924
- 6. Biotechnology: Food Fermentation, (2002), V.K.Joshi and A. Pandey, Vol III. Education Publ.
- 7. Biotechnology from A to Z. (2009), W. Bains, Oxford Univ. Press, ISBN: 019-963334-7
- 8. Fundamentals of Food Biotechnology. 2<sup>nd</sup> edition (2015), B.H. Lee, Wiley-Blackwell,ISBN: 978-1-118-38495-42006

# **Skill Enhancement Course (SEC)**

II Semester SEC: Techniques in Biomedical Science SEC: Techniques in Food Science

## **SEC: Techniques in Biomedical Science**

**Preamble:** The course aims to give the student a detailed view of newly developed biotechnical principles and methods of biomedical science. The course provides a basic and technical understanding of the biomedical methods such as biochemical techniques, PCR, hybridizations, immunoassays, blotting and DNA fingerprinting. The course stresses a novel approach to the study of the ocean within its social context and imparts onto students the concept of integrative approach.

#### **Course Outcomes**

At the end of the course students will be able to...

- **CO1:** Explain the principles of various biochemical, immunological and molecular based techniques
- **CO2:** Perform laboratory techniques such as biochemical assays, microscopy, spectrophotometry, gel electrophoresis, blotting and PCR.
- **CO3:** Appraise the role of modern biomedical techniques in addressing issues in health, biomedical research, and product development.

#### Number of sessions: 16 (Each session has 6 hours)

| <b>UNIT I: Biochemical techniques for the microbial identification</b><br>Laboratory 1: Indole, methyl red test, citrate utilization test<br>Laboratory 2: Triple sugar iron test, ONPG, oxidase<br>Laboratory 3: Catalase, urease and bile solubility | (3 sessions) |
|--|--------------|
| UNIT II: Microscopic techniques<br>Laboratory 4: Bright and Dark field microscopy<br>Laboratory 5: Inverted microscopy<br>Laboratory 6: Fluorescence Microscopy  | (3 sessions) |
| <b>UNIT III: Immunological techniques</b><br>Laboratory 7: Immunochromatographic assay<br>Laboratory 8: Enzyme-linked immunosorbent assay  | (3 sessions) |
| UNIT IV: Blotting techniques<br>Laboratory 9: <i>In-situ</i> hybridization<br>Laboratory 10: Western blotting  | (3 sessions) |

### **UNIT IV: Nucleic acid based techniques**

(4 sessions)

Laboratory 11: Conventional PCR

Laboratory 12: Real time PCR quantification

Laboratory 13: Loop-mediated isothermal amplification assay

## **Continuous Internal Evaluation (CIE) - Practical**

| Sl. No. | Component                                    | IA Marks |
|---------|--|----------|
| 1       | Involvement in practicals, timely submission | 10       |
|         | of records                                   |          |
| 2       | Record maintenance and neatness              | 10       |
| 3       | Internal practical evaluation                | 10       |
|         | Total CIE marks                              | 30       |

## Semester End Evaluation (SEE) - Practical

| Type of question | No. of questions | Marks per<br>question | Total |
|------------------|------------------|-----------------------|-------|
| Major Experiment | 1                | 30                    | 30    |
| Minor Experiment | 1                | 20                    | 20    |
| Spotters         | 5                | 1                     | 05    |
| Viva voce        | -                | 15                    | 15    |
| Total marks      |                  |                       | 70    |

## SUGGESTED READINGS

- 1. Basic Microbiology: An Illustrated Laboratory Manural, (2013), B. K.Khuntia, Daya Publishing House, ISBN: 978-81-7035-683-7
- 2. Molecular Diagnostics: Current Research and Applications (2014), T, J. Hugget and O'Grady, J. Caister Academic Press. ISBN: 9781908230645
- Molecular Cloning: A Laboratory Manual, 4<sup>th</sup> edition (2014), R. G.Michael, Cold Spring Harbor Laboratory Press, ISBN: 978-1-93611

## **SEC: Techniques in Food Science**

**Preamble:** Techniques in food analysis is an in-depth analysis of several specific approaches, and an examination of the most innovative applications and future trends. This course helps the student to learn different techniques and its applications and challenges in food analysis from multiple perspectives.

### **Course Outcomes**

At the end of the course students will be able to ...

**CO1:** Explain the principles of various techniques in food analysis **CO2:** Perform the qualitative and quantitative analysis of food components **CO3:** Apply the technical knowledge in food application

#### No of sessions:16 (Each session has 6 hours)

| UNIT I: Proximate Analysis of Food                              | (4 Sessions) |
|---|--------------|
| Laboratory 1: Protein by Kjeldahl method                        |              |
| Laboratory 2: Fat by Soxhlet method                             |              |
| Laboratory 3: Analysis of dietary fiber                         |              |
| Laboratory 4: Mineral estimation by AAS method                  |              |
| UNIT 2: Functional Properties of Food                           | (4 Sessions) |
| Laboratory 1: WHC and OHC of food                               |              |
| Laboratory 2: Emulsification capacity of flours                 |              |
| Laboratory 3: Foaming capacity and stability of different fours |              |
| Laboratory 4: Bulk density                                      |              |
| UNIT 3: Food Processing   | (4 Sessions) |
| Laboratory 1: Factors effecting cake preparation                |              |
| Laboratory 2: Drying curve                                      |              |
| Laboratory 3: Clarification of fruit juice                      |              |
| Laboratory 4: Visit to food processing industries               |              |
| UNIT 4: Quantification and Characterization                     | (4 Sessions) |
| Laboratory 1: HPLC analysis for carotenoids                     |              |
| Laboratory 2: Brix analysis by refractometer (squash)           |              |
| Laboratory 3: SDS-page analysis                                 |              |
| Laboratory 4: Lyophilization of fish protein hydrolysates       |              |

| Sl. No. | Component                         | IA Marks |
|---------|-----------------------------------|----------|
| 1       | Involvement in practicals, timely | 10       |
|         | submission of records             |          |
| 2       | Record maintenance and neatness   | 10       |
| 3       | Internal practical evaluation     | 10       |
|         | Total CIE marks                   | 30       |

#### **Continuous Internal Evaluation (CIE) - Practical**

#### Semester End Evaluation (SEE) - Practical

| Type of question | No. of questions | Marks per<br>question | Total |
|------------------|------------------|-----------------------|-------|
| Major Experiment | 1                | 30                    | 30    |
| Minor Experiment | 1                | 20                    | 20    |
| Spotters         | 5                | 1                     | 05    |
| Viva voce        | -                | 15                    | 15    |
| Total marks      |                  |                       | 70    |

#### **SUGGESTED READING:**

- 1. Pearson's Composition & Analysis of foods, 9<sup>th</sup> Edition (1991), R. S. Kirk, R. Sawyer and H. Egan,Longman scientific & Technical, U.K. ISBN: 9780470216934
- 2. Food Analysis: Theory and Practice, (1978), Y. Pomeranz and C.E. Mrloan, Westport, connectiant: AVI. ISBN: 978-81-8128-825-7
- Bioinstrumentation, 1<sup>st</sup> edition (2011), L. Veerakumari, MJP Publishers, ISBN: 81-8094-018-7
- Principles and Techniques of Biochemistry and Molecular Biology, 7<sup>th</sup> edition (2010), K. Wilson and J. Walker, Cambridge University Press. ISBN: 978-0-521-17874-7
- 5. FoodScience, 5<sup>th</sup>edition(1997),N.P. Norman and H.H. Joseph, CBSPublication, NewDelhi, ISBN: 978-1-4615-4985-7