B.S. Abdur Rahman ™
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2022
Curriculum and Syllabi
(Updated upto April 2023, as per 20th Academic Council)

M.Tech. (Food Biotechnology)

B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2022

CURRICULUM AND SYLLABI

(Updated upto April 2023, as per 20th Academic Council)

M.TECH.
FOOD BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

B.S.Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

SCHOOL OF LIFE SCIENCES

VISION AND MISSION

Vision

To attain new heights in biotechnology education and research, shaping life sciences into a premier precision tool for the future for creation of wealth and ensuring social justice-specially for the welfare of the socially weaker group

Mission

- The mission of the school of life sciences is to maximize the benefits of Biotechnology to the Institute, the nation and the globe
- Being an excellent quality, comprehensive, multidisciplinary school that supports, coordinates, disseminates knowledge to the community
- Apply biotechnology in the areas of social welfare and entrepreneurship

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.TECH. FOOD BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES

- To deliver advanced food biotechnology knowledge and capabilities.
- To educate the necessary skill sets for food production and manufacturing in accordance with industry needs.
- To instill confidence and provide the required environment for basic and practical research in food biotechnology-related fields with societal significance.
- To teach the necessary analytical skills and strategies for addressing issues of varying degrees of complexity.
- To develop the required skills for efficient communication and teamwork to have a successful professional career.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research –based knowledge and research methods including design of experiments, analysis and interpretation of

data and synthesis of the information to provide valid conclusions.

- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES

PSO1: Design, analyze, and develop essential proficiency in the areas of chemistry, microbiology, nutrition, processing, packaging, nutraceuticals, enzymes, global marketing, standards, quality control, and management aspects of the food industry, and apply the knowledge to real-world problems.

PSO2: Apply Food Biotechnology expertise in other fields to discover research gaps and propose optimal solutions.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS 2022

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)

ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.

iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **"Dean of the School"** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

2.0 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

2.2 ADMISSION REQUIREMENTS

2.2.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.

2.2.2 The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

3.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	Aeronautical Engineering	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	Civil Engineering	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
		M. Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. in Civil Engineering / Structural Engineering / B.Arch. or Equivalent degree in relevant field.
3.	Mechanical Engineering	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
		M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
7.	Information Technology	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
8.	Computer Applications	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2level or equivalent degree in relevant field.
9.	Mathematics	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	Physics	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	Chemistry	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
		M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial Biotechnology or Equivalent degree in relevant field.
13.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or)

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	Studies		Any under graduate degree with Part 1 Arabic (or)Any under graduate degree with AalimSanad / Diploma / Certificate in Arabic or Islamic Studies.

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 The PG. programmes consist of the following components as prescribed in the respective curriculum:

i. Core courses
ii. Elective courses
iii. Laboratory integrated theory courses
iv. Project work
v. Laboratory courses
vi. Open elective courses
vii. Seminar
viii. Mini Project
ix. Industry Internship
x. MOOC courses (NPTEL- Swayam, Coursera etc.)
xi. Value added courses

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

3.3.3 For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

3.3.4 The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Range of credits
M.Tech.	76 - 80
MCA	86
M.Sc.	77 - 85
M.Com.	88
M.A.	72

3.3.5 Credits will be assigned to the courses for all programmes as given below:

❖ One credit for one lecture period per week or 15 periods of

lecture per semester.

- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

3.3.6 The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 32	18 to 26
MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, aliter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) with the recommendation of the Head of the

Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

3.4.2 Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 PROJECT WORK

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

5.0 COURSE COMMITTEE

5.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

6.0 CLASS COMMITTEE

6.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted in every semester:

6.2 The composition of the class committee will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department
ii) Faculty members of all courses of the semester
iii) All the students of the class
iv) Faculty advisor and class advisor
v) Head of the Department – Ex officio member

6.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from

the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

6.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi of courses.

6.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

7.0 REGISTRATION AND ENROLLMENT

7.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

7.2 Change of a Course

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.4 A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

8.0 BREAK OF STUDY FROM PROGRAMME

8.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

8.1.1 Medical or other valid grounds

8.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

8.1.3 Debarred due to any act of indiscipline

8.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

8.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

8.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT WORK

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE

REPETITION

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.

10.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

10.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

10.4 A student who has obtained an “I” grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall repeat all the courses of the semester in the subsequent academic year. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.5 The student awarded “I” grade, shall enroll and repeat the course when it is offered next. In case of “I” grade in an elective course either the same elective course may be repeated or a new elective

course may be taken with the approval of the Head of the Department / Dean of the School.

10.6 A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

10.7 If a student with “U” grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the department concerned, based on the availability of faculty members, and subject to a specified minimum number of students registering for each of such courses.

11.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is no provision for any substitute examination and withdrawal from a redo course.

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Weightageof Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

12.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report

submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

12.8 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab components.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However, there is no substitute examination for semester end examination.

13.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from

the date of assessment test. However, the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

14.0 SUPPLEMENTARY EXAMINATION

14.1 Final Year students can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise, students with less credit can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semesters.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall preferably meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
I	0

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

15.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course.

Such a course cannot be repeated by the student for improvement of grade.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of School and it shall be declared by the Controller of Examinations.

15.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fees tothe Controller of Examinations. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as convener, the faculty member of the course and a senior faculty member knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n}C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

"I" grade is excluded for calculating GPA.

"U" and**"I"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks is as follows:

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

15.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the PG programme within the minimum prescribed period of study (except clause 8.1.1)

15.6.2 Eligibility for First Class

A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 8.1.1)

15.6.3 The students who do not satisfy clause 15.6.1 and clause 15.6.2 shall be classified as second class.

15.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

16.0 DISCIPLINE

16.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

16.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

17.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
ii. No disciplinary action is pending against him/her.
iii. Enrolled and completed at least one value added course.
iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

M.TECH. FOOD BIOTECHNOLOGY

CURRICULUM & SYLLABI, REGULATIONS 2022

(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	FCC	LTE 6101	Applied Biostatistics for Biotechnologists	3	1	0	4
2.	PCC	LTE 6111	Chemistry of Foods	3	0	2	4
3.	PCC	LTE 6112	Advanced Nutritional Biochemistry	4	0	0	4
4.	PCC	LTE 6113	Modern Food Microbiology	3	0	0	3
5.	PCC	LTE 6114	Laboratory I (Nutritional Biochemistry/ Food Microbiology)	0	0	4	2
6.	PEC		Professional Elective I	3	0	0	3
7.	CCE	ENE 6181	English for Career Development	1	1	0	2
			Credits				**22**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.		GEE 6201	Research Methodology and IPR	2	0	0	2
2.	PCC	LTE 6211	Technology in Food Packaging	3	0	2	4
3.	PCC	LTE 6212	Applied Food Biotechnology	4	0	0	4
5.	PCC	LTE 6213	Laboratory II (Applied Food Biotechnology/IPR)	0	0	4	2
6.	PEC		Professional Elective II	3	0	0	3
7.	PEC		Professional Elective III	3	0	0	3
8.	PEC		Professional Elective IV	3	0	0	3
			Credits				**21**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective I	3	0	0	3
2.	PCC	LTE 7111	Applications of Enzymes in Food Industry	3	0	0	3
3.	PCC	LTE 7112	Laboratory III (Applications in Enzymes in Food Industry)	0	0	4	2
4.	PEC		Professional Elective V	3	0	0	3
5.	PEC	LTD 7113	Industry Internship	0	0	2	2
6.	PCC	LTE 7211	Project Work Phase I	0	0	18	6**
7.			MOOC course (related to project)	0	0	0	0
			Credits				**13**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	LTE 7211	Project Work Phase II	0	0	36	18**
			Credits				**6 + 18= 24**

Overall Total Credits – 80

\# Industrial training will be undertaken during first year summer vacation for 30 days. The credit will be awarded in the 3rd Semester.

** Credits for project work phase I in III semester to be accounted along with project work phase II in IV semester

Note:

- Enrollment in at least one value added course is mandatory.
- The students shall pursue a MOOC course related to project in the third semester and the progress in this regard, shall be monitored during Project Phase – I reviews.
- The students shall be motivated to pursue the courses in the curriculum [upto 40% of credits in a semester (except project semester)] through NPTEL under SWAYAM.

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
			Semester I				
1.	PEC	LTEY 086	Food Processing Technology	3	0	0	3
2.	PEC	LTEY 087	Flavour Processing Technology	3	0	0	3
3.	PEC	LTEY 088	Post-Harvest Technology of Fruits and Vegetables	3	0	0	3
4.	PEC	LTEY 089	Food Nutrigenomics	3	0	0	3
5.	PEC	LTEY 025	Aromatic and Medicinal Plants	4	0	0	4
6.	PEC	LTEY091	Functional Foods and Nutraceuticals	3	0	0	3
			Semester II				
1.	PEC	LTEY092	Meat Process Technology	3	0	0	3
2.	PEC	LTEY093	Marine Food Process Technology	3	0	0	3
3.	PEC	LTEY094	Food Informatics	3	0	0	3
4.	PEC	LTEY095	Food Product Design and Development	3	0	0	3
5.	PEC	LTEY096	Dairy Technology	3	0	0	3
6.	PEC	LTEY097	Management of Halal Food	3	0	0	3
			Semester III				
1.	PEC	LTEY098	Sanitisation and Waste Management in Food Industries	3	0	0	3
2.	PEC	LTEY034	Regulatory Affairs for Biotechnology	3	0	0	3
3.	PEC	LTEY100	Food Standards and Quality Control	3	0	0	3
4.	PEC	LTEY101	Quality Evaluation of Foods	3	0	0	3
5.	PEC	LTEY102	Food Safety Assessment	3	0	0	3
6.	PEC	LTEY103	Global Food Marketing and Aid Policy	3	0	0	3

SEMESTER I

LTE 6101	APPLIED BIOSTATISTICS FOR BIOTECHNOLOGISTS	L	T	P	C
SDG: 4		3	1	0	4

COURSE OBJECTIVES:

COB1: Students will be able to make informed decisions based on data

COB2: Students will be able to correctly apply a variety of statistical procedures and tests

COB3: Students will know the uses, capabilities and limitations of various statistical procedures

COB4: Students will be able to interpret the results of statistical procedures and tests.

COB5: To learn about analysing the survey results

MODULE I CONCEPTS IN STATISTICS 9

Population and sample, qualitative and quantitative data, nominal, ordinal, ratio,

interval data; cross sectional and time series data; discrete and continuous data. Descriptive statistics and Random variables; Measures of central tendency: mean, median, mode; the uses of measure of central tendency, Measures of spread: range, percentile, standard deviation, some properties of variance and standard deviation, the coefficient of variation, group data.

MODULE II INFERENTIAL STATISTICS 9

Displaying data: frequency table, line graph, bar chart, histograms, stem and leaf plots, dot plot, scatter plot, box plots, frequency distributions; definition of probability, rules for calculating probability, definition from epidemiology, Bayes' theorem, probability in sampling, Bernoulli, Binomial, Poisson; Geometric distributions; Continuous random variables: Normal; Exponential distributions; Standard normal distribution. Counting and Probability, Permutations; Combinations.

MODULE III INTERVAL ESTIMATION 9

Prediction, confidence and tolerance Intervals, distribution free interval,

confidence interval based on normal distribution, confidence interval and sample size, Point and interval estimates; the relation between population and sample, Random-Number tables, randomized clinical trials, estimation of the

Mean of Distribution, estimation of -variance of distribution, binominal distribution and poisson distribution.

MODULE IV HYPOTHSIS TESTING 9

Hypothesis testing: null and alternative hypotheses, decision criteria, critical values, type I and type II errors, Meaning of statistical significance; Power of a test; One sample hypothesis testing: Normally distributed data: z, t and chisquare tests; Binomial proportion testing, nonparametric hypothesis testing, Twosample hypothesis testing; Nonparametric methods: signed rank test, rank sumtest; Kruskal-Wallis test;

MODULE V CURVE FITTING AND ANOVA 9

Regression and correlation: simple linear regression; Least squares method; Analysis of enzyme kinetic data; Michaelis-Menten; Lineweaver-Burk and the direct linear plot; Logistic Regression; Polynomial curve fitting. Analysis of variance: One-way ANOVA, two-way ANOVA. Fixed effect model, Random effect model, the intra class correlation coefficient.

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Gupta.S.C. Fundamentals of Applied Statistic, Sultan Chand & Sons ,New Delhi 2014.
2. Norman T J Bailey, ‖Statistical Methods in Biology — (3rd Edition), Cambridge University Press 1995
3. Gerald van Belle, L.D. Fisher, P.J. Heagerty, and T. Lumney, —Introduction to Biostatistics‖ Second Edition, John Wiley & Sons, New Jersey 2004
4. Wong Limsoon, ‖Essence of biostatistics ‖, NUS Lecture Notes Series 2003.

COURSE OUTCOMES:

CO1: After the completion of the course students will have a detailed understanding of concepts in statistics.

CO2: Understand the principle and applications of different forms of data display.

CO3: Understand the concept of interval estimation

CO4: Understand the principle and applications of making a hypothesis of the data and testing it.

CO5: Have basic knowledge of curve fittng the data and design and categorize the data

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Statement: Learning of various mathematical tools like Matrices, Calculus and Numerical methods will lead to knowledge of applications in biological fields

LTE 6111	CHEMISTRY OF FOODS	L	T	P	C
SDG: 3, 15		3	0	2	4

COURSE OBJECTIVES:

COB1: Students will understand the carbohydrates and its Physical and chemical properties

COB2: Students will understand the proteins and its Physical and chemical properties

COB3: Students will understand the lipids and its Physical and chemical properties

COB4: Students will understand the vitamins and its Physical and chemical properties

COB5: Students will learn the Chemistry of color, flavour and pigments

MODULE I CARBOHYDRATES 9

Nomenclature Classification and structure of carbohydrates, Chemical reactions of carbohydrates. Physical and chemical properties of sugars. Chemistry, properties and preparation of gums & polysaccharides. Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins. Modified Starches, Conversion of starch to sugars; Heteroploysaccharides and Gums.

MODULE II PROTEINS 9

Importance of Proteins. Nomenclature, classification, structure and chemistry of amino acids, peptides and Proteins. Sources and distribution of Proteins. Isolation, identification and purity of proteins. Denaturation. Physical andchemical characteristics of Proteins.

MODULE III LIPIDS 9

Introduction and classification of lipids. Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospholipids and unsaponifiables. Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, hydrogenated fats, shortening agents, confectionary fats etc. Flow chart representation of manufacture of edible oils. Refining of oils and hydrogenation of oils.

MODULE IV VITAMINS 9

Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins –Reasons for the loss of vitamins in foods – Fat-soluble and water-soluble vitamins – Choline, carnitine.

MODULE V CHEMISTRY OF COLORS, PIGMENTS AND FLAVOURS 9

Fat & Water Soluble, Meat Pigments. Chlorophyll & chlorophyll derivatives, Haems and bilins, Carotenoids, annatto, saffron, turmeric- Stability to pH, temperature and other processing conditions - Technology for the production of dried colourants - Caramel colour. Ingredients, Taste, Aroma, Undesirable flavors. Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours.

PRACTICALS

1. Stoichiometric determination and estimations- volumetry and gravimetry
2. Determination of carbonate and bicarbonate in a mixture by PH -metric titration and comparison with visual acid-base titration
3. Quantitative Estimation of Reducing Sugars from food samples
4. Preparation of food relevant organic compounds
5. Estimation of vitamins from natural foods
6. Determination of protein concentration by different methods
7. Emulsification test for lipids from oils of various seeds
8. Estimation of crude fibre content
9. Determination of micronutrients in commercial food samples

L – 45; P – 30; TOTAL HOURS –75

TEXT BOOKS:

1. Meyer L.M. Food chemistry. CBS Publishers & Distributors
2. Fundamentals of Biochemistry, J.L. Jain.
3. Textbook of Biochemistry, Lehninger.
4. Biochemistry, L. Stryer, W.H. Freeman and Company.
5. Outline of Biochemistry, Conn &Stumph.
6. Owen R Fennema : Food Chemistry – III edition Marcel Dekkar Inc. New York (1996).
7. Natural Food Colorants: Science and Technology, By Gabriel J. Lauro, , Frederick John Francis, CRC Press Pub., 2000.
8. Flavor Chemistry and Technology, By Gary Reineccius, Henry B. Heath, 2nd Edn., Taylor and Francis group, CRC Press, 2006.

COURSE OUTCOMES:

CO1: Recognize both major and minor food components.

CO2: Student understand the proteins from foods and its importance

CO3: Students recognize the role of lipids in lipids and its importance's

CO4: Students will understand the importance of vitamins and physical and chemical characteristics.

CO5: Understand the sensory evaluation of the food.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

SDG15: Life on Earth
Statement: This course makes aware of the range of technologies available to that gives knowledge about relation with all the levels of life in the earth

LTE 6112	ADVANCED NUTRITIONAL BIOCHEMISTRY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: The course will also make the student to understand the importance of correct nutrition

COB2: To understand currently important aspects of nutrition in human performance, health, and selected diseases.

COB3: To trace the transformation of energy in food to chemical energy available to cells and stored in cells

COB4: To study the cellular effects of food energy and macronutrients on regulated metabolism, tissue homeostasis, inter-organ relationships, and overall body function

COB5: To study biochemical and physiological influences of ingestion, digestion, absorption, transport and utilization of the macronutrients on overall metabolism.

MODULE I BASICS OF ENERGY METABLISM AND NUTRITION 12

Unit of measuring energy calorific value of food BMR & factors affecting it. SDA of food calculation of energy requirement, balanced diet Definition of energy Unit of energy i.e. calories and joules Energy Balance i.e. positive & negative energy balance Basal Metabolic Rate:- Factors considered while measuring BMR Factors affecting BMR Calculation of energy Definition of Balance diet.

MODULE II CARBOHYDRATES RELATED METABOLISM 12

Glycolysis Reactions of glycolysis Definition of citric acid cycle Reactions of citric acid cycle Pathway of gluconeogenesis Pathway of glycogenolysis Location of HMP Shunt pathway Reaction of HMP Shunt pathway Metabolism and hormonal mechanism of glucose homeostasis, biomedical importance of carbohydrate digestion & absorption of carbohydrate.

MODULE III CHEMSITRY OF PROTEINS AND THEIR RELATED METABOLISM 12

Introduction, definition and classification of proteins, biomedical importance Metabolism: Transformation, Decarboxylation, Ammonia formation & transport Urea cycle Classification of proteins, Urea cycle, Digestion, absorption process, Structure of protein, Functions of protein, Biomedical importance, Denaturation of proteins, Biomedical importance.

MODULE IV CHEMISTRY OF LIPIDS OF LIPIDS AND THEIR RELATED METABOLISM 12

The chemical structure of lipids The Classifications of fats Oxidation of fatty acids Ketosis, Methods of identification of fats Beta oxidation pathway, Biomedical importance Properties of fatty acids Biochemical abnormalities in diabetic ketoacidosis, Biomedical importance Brief outline of metabolism Beta oxidation of fatty acids ketosis Measurements of serum enzyme levels Bile pigment metabolism: Jaundice – its types and their biochemical findings.

MODULE V LIVER FUNCTIONS AND THEIR ASSESSMENT 12

Lipid Metabolism Measurements of serum enzyme levels Bile pigment metabolism: Jaundice – its types and their biochemical findings. Introduction to liver function test, Liver function test, LFT profile Indications of LFT Indications of ranges.

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Ferrier, D.R., Lippincott's Illustrated Reviews: Biochemistry, 5th or 6th Edition, Lippincott Williams & Wilkins, Baltimore, MD 2011 or 2013.

REFERENCES:

1. Bowman, Barbara A. & Russell, Robert M., Present Knowledge in Nutrition, 9th Edition, International Life Sciences Inst. Press, Washington, DC 2006.
2. Robert Murray, Victor Rodwell, David Bender, Kathleen M. Botham, P. Anthony Weil, Peter J. Kennelly, Harper's Illustrated Biochemistry, 28th Edition, LANGE Basic Science, McGraw Hill Companies, Inc. 2009.

COURSE OUTCOMES:

CO1: Understand nutrient metabolism in normal and disease states

CO2: Be able to integrate the regulation of metabolism of nutrients under normal and disease state conditions

CO3: Be able to think critically about nutrient claims and fads using your knowledge of nutritional biochemistry.

CO4: Integrate current research in the area of metabolism and micronutrient function into existing knowledge and formulate new hypotheses to guide future research.

CO5: Understand the biochemical and molecular functions of nutrients we consume

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to that gives knowledge about relation with all the levels of life in the earth

LTE 6113	MODERN FOOD MICROBIOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: The course aims to develop the knowledge of students in the basic area of Food Microbiology**.**

COB2: This course will enable students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

COB3: To give knowledge about the role of microbes in food production

COB4: This is necessary for effective understanding of food processing and technology subjects as well as food safety.

COB5: To educate the important' to students about the microbial Examination of Foods.

MODULE I BASICS OF FOOD MICROBIOLOGY 9

Foods as ecological niches, relevant microbial groups, Microbes found in raw materials and foods that are detrimental to quality, Factors that influence the development of microbes in food, newer and rapid methods for qualitative and quantitative assay demonstrating the presence and characterization of microbes, Stress, damage, adaptation, reparation, death.

MODULE II MICROBIAL GROWTH IN FOOD 9

Microbial growth in food: intrinsic, extrinsic and implicit factors, Microbial interactions, Inorganic, organic and antibiotic additives. Effects of enzymes and other proteins, Combination systems, Adaptation phenomena and stress phenomena, Effect of injury on growth or survival, commercially available databases.

MODULE III MICROBIAL BEHAVIOUR -NEWER METHODS 9

Microbial behaviour against the newer methods of food processing, Adoption and resistance development, Microbes as test organisms, as sensors and as tools for future applications in energy production and food and non-food industrial products.

MODULE IV MODERN METHODS 9

Modern methods of cell culture: synchronous and co- cell culture, continuous cell culture in liquid and solid media, Cell immobilization and applications, Pre and probiotics cultures.

MODULE V MICROBIAL EXAMINATION OF FOODS 9

Detection and Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods – development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulimum& Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Banwart, G.J. Basic Food Microbiology 2nd Edition. CBS Publishers, 1998.
2. Jay, J.M. Modern Food Microbiology. 4th Edition. CBS Publishers, 2003.
3. Khetarpaul, Neelam. Food Microbiology Daya Publishing House, 2006.

REFERENCES:

1. Montville, Thomas J. and Karl R. Matthews Food Microbiology: An Introduction. ASM Press, 2005
2. Pawsey, R. K. Case Studies in Food Microbiology for Food Safety and Quality. The Royal Society of Chemistry, 2001.
3. Forsythe, S.J. The Microbiology of Safe Food. Blackwell Science, 2000.
4. Doyle, Michael P. Food Microbiology: Fundamentals and Frontiers. 2nd Edition, ASM Press, 2001.
5. Adams M. 2006. Emerging Food-borne Pathogens.
6. Woodhead Publ. Adams MR & Moss MO. 2000.
7. Food Microbiology. Panima. Easter MC. 2003.
8. Rapid Microbiological Methods in the Pharmaceutical Industry.
9. Harrigan W. 2003. Laboratory Methods in Food Microbiology. University of Reading, UK, Elsevier.
10. James MJ, Loessner MJ & David A. 2005. Modern Food Microbiology. 7th Ed. Golden Food Science Text Series. Pederson CS.1979.
11. Microbiology of Food Fermentations. AVI Publ. Roberts R .2002.
12. Practical Food Microbiology. Blackwell Publ. Rossmore HW. 1995.
13. Handbook of Biocide and Preservative. Blackie Wood JBB. 1999.
14. Microbiology of Fermented Foods. Vols. I, II. Blackwell.

COURSE OUTCOMES:

CO1: Be able to understand and identify the various microbes associated with foods and food groups

CO2: Be able to understand and identify the role of these microbes in food spoilage, food preservation.
CO3: Understand the role of pathogens in food borne infections. Understand the methods used to detect pathogens in foods.
CO4: Collect, organise, analyse and evaluate modern methods available for the food preservation industry.
CO5: Able to understand the microbial examination of foods related information effectively to use in the industry.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

SDG15: Life on Earth
Statement: This course makes aware of the range of technologies available to that gives knowledge about relation with all the levels of life in the earth

LTE 6114	LABORATORY I (NUTRITIONAL BIOCHEMISTRY/ FOOD MICROBIOLOGY)	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

By the end of this module the students will be able

COB1: To demonstrate the working principle and safety use of the laboratory equipments

COB2: To understand the basis of qualitative and quantities analysis of carbohydrates

COB3: To learn the absolute method for quantification of carbohydrate, lipid, and protein

COB4: To explore the possible methods to identify and detect the microbes contaminating food

COB5: Developing a good knowledge on the various biochemical methods to analyse the quality and hygiene status of food.

EXPERIMENTS

1. SOP for common laboratory instruments
2. Quantitative and qualitative analysis of carbohydrates
3. Separation technique : chromatography - Separation of Amino Acids By Paper Chromatography
4. Determination of Protein Content Using Biuret Method
5. Determination of lipid content in food
6. Qualitative assessment of rancidity in food
7. Estimation of Saponification Number
8. Estimation of Free Fatty Acids
9. Estimation of Iodine Value
10. plating and culturing samples for microbial identification
11. Microscopic observation for microbe identification
12. Pathogen testing
13. Indicator organism testing
14. Spoilage organism testing

P – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Lab manual

COURSE OUTCOMES:

On performing the above experiments students will be able to

CO1: Quantitatively and qualitatively analyse bio molecules in common foods

CO2: Develop an idea about the separation of different biomolecules like amino acids

CO3: learned culture methods to study food microorganisms

CO4: Differentiate food spoiler organism and pathogens

CO5: Familiar with various methods in testing the nutritional and hygiene status of food.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

SDG15: Life on Earth
Statement: This course makes aware of the range of technologies available to that gives knowledge about relation with all the levels of life in the earth

ENE 6181	ENGLISH FOR CAREER DEVELOPMENT	L	T	P	C
SDG: 4 , 8		1	1	0	2

COURSE OBJECTIVES:

COB1: To enable students to learn about the job search, application, and interview process

COB2: To give them an opportunity to explore their global career path, build vocabulary and improve language skills to achieve professional goals

COB3: To produce a professional-looking resume

COB4: To understand networking and interview skills

COB5: To understand the key skills and behaviors required to facilitate a group discussion

Pre-requisites:

The students should have completed a course on English at their Undergraduate level.

MODULE I ENTERING THE JOB MARKET 3+2

Introduction to the Career Development -Job Search Overview-Identifying Your Interests and Skills

Language Focus: Vocabulary and Word Forms Related to Jobs-Choosing the Job that's the Best Fit

Language Focus: Verb Tenses (Present vs. Present Progressive) Understanding Job Descriptions: Reading a Job Advertisement

Language Focus: Phrases to Compare Similarities

Online Learning Opportunities to Extend Your Skills

MODULE II RESUMES 3+2

What is a resume? Why do you need one?

Parts of a Resume-Writing a Resume, Part 1: Name and Contact Information

Listening: Connecting Employers with Job Seekers in Today's Economy

Language Focus: Key Words

Writing a Resume, Part 2: Headline and Summary

Writing a Resume, Part 3: Work Experience

Writing a Resume, Part 4: Education

Language Focus: Action Verbs

Writing a Resume, Part 5: Complete your Resume

MODULE III WRITING A COVER LETTER 3+2

What is a Cover Letter?

Professional Writing: Letter Format
Cover Letter: Paragraph 1- Introducing Yourself
Cover Letter: Paragraph 2- Highlighting Your Skills in the Cover letter
Cover Letter: Paragraph 3- Closing
Language Focus – Present Perfect vs. Past Tense
Professional Writing: Level of Formality
Language Focus: Using Modal Verbs to Write politely
Writing a Cover Letter for a Specific Job

MODULE IV INTERVIEWING FOR A JOB 3+5

Overview of the Job Interview: Answering Typical Interview Questions Language Focus: Asking for Clarification in an Interview-
Sample Interview: Do's and Don'ts Part 1
Sample Interview: Do's and Don'ts Part 2
Sample Video: Responding to an Interview Question

MODULE V GROUP DISCUSSION 3+4

Introduction to Group Discussion - Participating in group discussions – understanding group dynamics - brainstorming the topic - questioning and clarifying - GD strategies- activities to improve GD skills

L-15;T-15;TOTAL HOURS - 30

REFERENCES:

1. R. Byrne, D. Teaching Oral Skill. London: Longman. 1975.
2. Byrne, D.Teaching Writing, London: Longman. 1975.
3. Rani Asoka, DeviVimala. English for Career development: ACourse in Functional English. Orient Longman Pvt. Ltd., India,2004.
4. Anderson, K., Maclean, J. & Lynch, T. Study speaking: A Course in Spoken English for Academic Purposes. Cambridge University Press, UK, 2004.
5. Withrow, J., Brookes, G.& Cummings, M.C.Inspired to write. Reading and Tasks to Develop Writing Skills. Cambridge University Press, U.K., 2004.

COURSE OUTCOMES:

CO1: Identify the steps in the job search process

CO2: Describe themselves and their experiences in a résumé

CO3: Build their job-related vocabulary

CO4: Write a clear cover letter that tells employers why they are the right person for the job

CO5: Take part in Group discussion confidently.

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS O3
CO1	H	H	H	H	L	L	L	M	M	M	M	M	H	H	H
CO2	H	H	H	H	L	L	L	M	M	M	M	M	H	H	H
CO3	H	H	H	H	L	L	L	M	M	M	M	M	H	H	H
CO4	H	H	H	H	L	L	L	M	M	M	M	M	H	H	H
CO5	H	H	H	H	L	L	L	M	M	M	M	M	H	H	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: This course ensures that the students acquire quality education and are also made eligible to obtain productive and decent employment.

GEE 6201	RESEARCH METHODOLOGY AND IPR	L	T	P	C
SDG: 4, 8, 9		2	0	0	2

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To analyze the research design, information retrieval and problem formulation techniques.

COB3: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB4: To execute the effective communications of research findings and apply the ethics in research.

COB5: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

PREREQUISITES:

- Basics of core engineering, probability and statistics.
- Basics of flowchart and algorithm techniques.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN **6**

Research - objectives – types - Research process, solving engineering problems - Identification of research topic - Formulation of research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modeling - Simulation, validation and experimentation.

MODULE II DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA **8**

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Spreadsheet tool - Basic principles of Statistical Computation. Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES **8**

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV INTELLECTUAL PROPERTY RIGHTS 8

The Research Report - Purpose of written report - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism –Thesis writing, - Organization of contents - style of writing- graphs, charts and Presentation tool - Referencing, Oral presentation and defense - Ethics in research - Patenting, Intellectual Property Rights - Patents, Industrial Designs, Copyrights, Trade Marks, Geographical Indications-Validity of IPR, Method of Patenting, procedures, Patent Search.

L –30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Ganesan R., “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
2. George E. Dieter., “Engineering Design”, McGraw Hill – International edition, 2020.
3. Kothari C.R., “Research Methodology” – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb., “Genetic Algorithms for optimization”, Kangal report, No.2001002.
5. Rajkumar S. Adukia, “Handbook on Intellectual Property Rights in India”, TMH Publishers, 2020.
6. Prabhuddha Ganguli. ”Intellectual Property Rights”. 1st Edition, TMH Publishers, 2012.

REFERENCES:

1. Holeman, J.P., ”Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2. Govt. of India, ”Intellectual Property Laws; Acts, Rules & Regulations”, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.
3. R Radha Krishnan & S Balasubramanian, ”Intellectual Property Rights”. 1st Edition, Excel Books, 2012.
4. Derek Bosworth and Elizabeth Webster. ”The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Formulate the research problem

CO2: Design and Analyze the research methodology

CO3: Apply statistical techniques for hypothesis construction

CO4: Analyze and interpret the data to construct and optimize the research hypothesis

CO5: Report the research findings as publications, copyright, trademarks and IPR

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	H	H	H	H	M	L	L	L	L	L	L	L	H	H	H
CO 2	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO 3	H	H	H	H	M	L	L	L	L	L	L	-	H	H	H
CO 4	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H
CO 5	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.
Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements.

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.
Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.
Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

LTE 6211	TECHNOLOGY IN FOOD PACKAGING	L	T	P	C
SDG: 3		3	0	2	4

COURSE OBJECTIVES:

COB1: Understand the properties of food packaging materials and their suitability in extending shelf life of food products

COB2: Impart knowledge on rationale in selecting packaging material for processed food products

COB3: Learn about laws and regulations of packaging materials and labeling of foods

COB4: Learn about the filling techniques in food packaging

COB5: Students will learn about testing and labeling of packaging materials

MODULE I FUNCTIONS OF FOOD PACKAGING MATERIALS 9

Introduction- Science and technology of food packaging- Socio economic needs - functions of food packaging- Food Packaging environments- functions and environments grids-Food packaging systems-Food package development.

MODULE II RIGID AND SEMI RIGID FOOD PACKAGING MATERIALS 9

Paper - different types - corrugated paper boards- definition - types - manufacturing method-paper board products - Polymer - basic concept of polymer- polymerization- plastics versus polymersAdvantages and disadvantages of plastics- polymer properties - molecular weight - chain entanglement- plastics - morphology-definition- different types of food packaging polymers- polymer processing methods- heat sealing - adhesives and labels-Nano composite food packaging materialsbio-degradable food packaging materials- bag in box system of food, Smart packaging, Intelligent packaging, Modified atmospheric packaging and control atmospheric storage.

MODULE III FLEXIBLE FOOD PACKAGING MATERIALS 9

Paper - different types - corrugated paper boards- definition - types - manufacturing method-paper board products - Polymer - basic concept of polymer- polymerization- plastics versus polymersAdvantages and disadvantages of plastics- polymer properties - molecular weight - chain entanglement- plastics - morphology-definition- different types of food packaging polymers- polymer processing methods- heat sealing - adhesives and labels-Nano composite food packaging materialsbio-degradable food packaging materials- bag in box system of food, Smart packaging, Intelligent packaging, Modified atmospheric packaging and control atmospheric storage.

MODULE IV FILLING SYSTEMS 9

Filling of liquid and wet products- to predetermined level and predetermined volume- filling of dry solids- by count- volume-weight - methods of wrapping and bagging- form -fill -seal methodsvarious forms of packaging - vacuum packaging- blister packaging-shrink packaging - stretch packaging.

MODULE V TESTING AND LABELING OF PACKAGING MATERIALS 9

Principles of measuring water vapour transmission rate and gas permeability rate through given flexible film, OUR from food and OTR from film - Testing of packaging materials using - UTMMullen Bursting strength tester- drop tester- Pouch burst tester- cob tester- gauge tester- torque testertear tester- gas analyzer-cushioning materials. Labeling, regulation and traceability. Global migration testing and design aspects.

PRACTICALS:

1. Identification of different types of packaging and packaging materials
2. Determination of tensile strength of given material
3. To perform different destructive tests for glass containers
4. To perform non-destructive tests for glass containers
5. Determination of wax weight
6. Determination of tearing strength of paper
7. Measurement of thickness of packaging materials
8. To perform grease-resistance test in plastic pouches
9. Determination of bursting strength of packaging material
10. Determination of water-vapour transmission rate
11. Demonstration of can-seaming operation
12. Testing of chemical resistance of packaging materials
13. Determination of drop test of food package
14. Visit to relevant industries
15. Introducing the students with the latest trends in packaging consulting the websites and magzines

L – 45; P – 30; TOTAL HOURS – 75

TEXT BOOKS:

1. Paine, Frank A., Paine, Heather Y. Handbook of Packaging. Springer US, 1992. ISBN: 978-1-4615-2810-4
2. S Ranganna. Manual of Analyzing for Fruits and Vegetables Products.Tata McGraw-Hill, 1977

REFERENCES:

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Second Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2005
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.
4. Richard Coles and Mark J. Kirwan, Food and Beverage Packaging Technology, Second Edition, Wiley & Blackwell, 2011.
5. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
6. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, Food Packaging Science and Technology, CRC Press, 2008.

COURSE OUTCOMES:

CO1: Apply the functions of food packaging for socio economic needs

CO2: Select suitable packaging materials for the extension of shelf life of food products

CO3: Apply the new innovation in developing advanced packaging material

CO4: Choose the different filling systems for whole and ground food products

CO5: Analyze the testing and labeling regulatory requirements with respect to food packaging

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

LTE 6212	APPLIED FOOD BIOTECHNOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

The purpose of this course is:

COB1: Provide a programme of education which can enable its graduates to enter a career in the food industry as technologists capable of ensuring the production and marketing of safe and quality foods

COB2: Provide a broadly based technological education whose graduates can also enter into employment in other sectors of the food chain, or related technical sectors, where they can apply their technological skills.

COB3: To provide a framework of the professional disciplines such as medical food, probiotics, fermented milk and food products.

COB4: To develop the students' ability to analyze and solve problems

COB5: Allow individuals to develop their capacity to undertake research into problems relating to the production and marketing of safe and quality foods.

MODULE I INTRODUCTION OF FOOD BIOTECHNOLOGY 12

Food Biotechnology: Introduction & Applications; Methods for the microbiological examination of water and foods; Control of Microbiological quality and safety; Food borne illnesses and diseases; Microbial cultures for food fermentation, their maintenance, strain development.

MODULE II GENETICALLY MODIFIED FOOD 12

GM foods: Introduction and controversies related to GMOs. Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labelling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act–2004. New products and processes in various food commodities including plant and animal products.

MODULE III FOOD QUALITY AND ITS REGULATIONS 12

Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination.

MODULE IV PRODUCTION OF FOOD PRODUCTS 12

Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol; Propagation of baker’s yeasts.Microbial production of vitamins (B2 and B12),

antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms.

MODULE V APPLICATIONS OF APPLIED FOOD BIOTECHNOLOGY **12**

Starter cultures–types, designing and development, micro encapsulation and packaging, scopes and challenge; Development and formulation of novel products such as probiotic foods. Nutrogenomics-concept, working, significance and relevance. Biosensors and novel tools and their application in food science & Technology.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. B. Srilakshmi, Food science, New Age Publishers,2002.
2. James M. Jay, Modern Food Micro-Biology, (2000), 6th edition, An Aspen Publication, Maryland, USA.
3. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003.
4. Lee, B. H. Fundamentals of Food Biotechnology.VCH. 2006.

REFERENCES:

1. G.F.G. Lopez & G.V.B. Canovas, Food Science and Food Biotechnology (2003), CRCPress, Florida, USA
2. Ranganna S, Handbook of Analysis and Quality Control for Fruits and Vegetable Products (1986), 2nd ed. TMH Education Pvt. Ltd.
3. GokogluN.Novel natural food preservatives and applications in seafood preservation: a review.(2019), Journal of Science Food and Agriculture, Voulme 99, Issue 5, Page number 2068-2077.

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: integrate the scientific disciplines relevant to food

CO2: develop newly formulated food and products.

CO3: enquire quality assurance in for public and the environment.

CO4: apply and communicate technological knowledge to meet the needs of industry and the consumer for the production and marketing of safe and quality foods.

CO5: understand the technical skills for presereving and other events involved for food production.

Board of Studies (BoS) : **Academic Council:**

9thBoS of SLS held on 20.08.2022

19th Academic Council meeting
held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintain systems to promote good health and well being.

LTE 6213 **LABORATORY II (APPLIED FOOD BIOTECHNOLOGY/IPR)**

L	T	P	C
0	0	4	2

SDG: 3,12

COURSE OBJECTIVES:

COB1: To learn different type of food packaging systems and materials

COB2: To estimate the quality of different packaging materials

COB3: To determine the strength of different packaging materials.

COB4: To learn different instrumental techniques used in assessing the composition and quality of food.

COB5: To learn different microbiological methods for the estimation of pathogens in food.

PRACTICALS

List of Experiments:

1. Identification of different types of packaging and packaging materials
2. Determination of bursting strength of packaging material
3. Cobb testing
4. Determination of water-vapour transmission rate
5. Demonstration of can-seaming operation
6. Estimation of antioxidant value by ABTS/ FRAP
7. Detection of foodborne pathogenn by conventional microbiological method
8. To carry out fermentation of amylase
9. Application of enzyme in fruit processing and inactivation of the enzyme by blanching
10. HPLC and HPTLC separation demo
11. Agarose gel electrophoresis and 2 D gel electrophoresis demonstration
12. Enzyme assay and factors affecting kinetic study
13. Methods of DNA amplification by PCR and Real-Time PCR demo
14. Gel Purification and amplification of DNA
15. Patent drafting
16. IPR application & documentation.

P – 60 ; TOTAL HOURS –60

REFERENCES:

1. *Food Packaging: Principles and Practice*, Gordon L. Robertson. 2nd Ed., Taylor & Francis, CRC Press, 2005.
2. *Basic Methods for the Biochemical Lab*. Holtzhauer M. Springer, 2006.
3. *Food Packaging Technology*. Richard C., Derek McDowell, Mark J. K. Blackwell Publishers, 2003.

COURSE OUTCOMES:

CO1: Student will be able to select suitable packaging materials for food packaging.

CO2: Student will understand the qualities of packaging materials for specific packaging needs.

CO3: Will be able to estimate the strength of different packaging materials.

CO4: Student will be able to use the methodology of enzyme assay, expressing activity and exemplify the applications of enzymes in food processing.

CO5: Students will be able to handle different instruments such as HPLC, PCR also IPR drafting and filing.

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	M	H	M	L	L	-	L	-	-	-	L
CO2	H	M	H	M	L	L	-	L	-	-	-	L
CO3	H	M	H	M	L	L	-	L	-	-	-	L
CO4	H	M	H	M	L	L	-	L	-	-	-	L
CO5	H	M	H	M	L	L	-	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintaining systems to promote good health and well being.

SDG No. 12

Responsible Production and Consumption

Familiarity with the different packaging materials and methods will help in better management of the quality of food as well minimize the wastage of food. Furthermore, this course will help in designing new and safe food formulations with a consideration of current health challenges.

SEMESTER III

LTE 7111	APPLICATIONS OF ENZYMES IN FOOD INDUSTRY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To understand the Enzyme Classification, Characterization and Production of Enzymes

COB2: To learn the importance of enzymes in food processing

COB3: to learn the immobilization techniques and its use in food industry

COB4: To learn the basics of fermentation process

COB5: To get a practical knowledge about running the fermenter and its scale – up and modes of operation etc

MODULE I INTRODUCTION TO ENZYME 9

Enzymes classification, Properties, Characterization, Production of enzymes and their downstream processing.

MODULE II ENZYMESAND THEIR ROLE IN FOOD PROCESSING 9

Enzymes for starch modification, Enzymes for protein modification, Enzymes for lipid modification, Enzymes as processing aids: Role of enzymes in Dairy Processing (cheese making and whey processing. Role of enzymes in meat processing, Role of enzymes in meat processing (tenderization and flavour development), Fish processing (Deskinning, collagen extraction etc), Egg processing. Role of enzymes in Brewing, Baking (fungal -amylase for bread making; maltogenic -amylases for anti-staling; xylanses and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes.

MODULE III ENZYME IMMOBILIZATION

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

MODULE IV OVERVIEW OF FERMENTATION PROCESSES 9

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes

MODULE V RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Whitehurst, R.J. & Van-Oort, M. Enzymes in Food technology, Second edition, Blackwell Publishing Ltd, 2010
2. Aehle, W. (2007) Enzymes in Industry: Production and application. WileyVCH Verlag GmbH & Co. KGaA, Weinheim
3. Rastall,R (2007) Novel enzyme technology for food applications Woodhead Publishing Limited, Abington Hall, Abington, Cambridge CB21 6AH, England
4. Kalaichelvan, P.T., (2002), Bio process technology, MJP publishers, Chennai
5. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw Hill, 1986.
6. Blanch, H.W. and D.S. Clark “Biochemical Engineering”, Marcal Dekker, Inc., 1997.
7. Lee, James M. “Biochemical Engineering”, Prentice – Hall, 1992.

COURSE OUTCOMES:

CO1: Understand the classification and characteristic features of Enzymes

CO2: Production of Enzymes and their role in food processing

CO3: Imoobilzation of enzymes and their role in food industry

CO4: Understand the concept of basic fermentation processes

CO5: Understanding the application during scaleup operations of fermentation

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTE 7112	LABORATORY III	L	T	P	C
SDG: 3, 15	(APPLICATIONS OF ENZYMES IN FOOD INDUSTRY)	0	0	4	2

COURSE OBJECTIVES:

COB1: To learn basic techniques in analyzing food samples
COB2: To study and differentiate the artificial and natural additives
COB3: To estimate the adulterants in food samples
COB4: To identify different microbes in canned foods.
COB5: To identify different pesticides in food

EXPERIMENTS:

1. Laboratory safety guidelines.
2. Visual examination of growth, description of colony morphology, turbidity and colorimetry.
3. Preparation of smears, use of monochrome staining, gram stain
4. Detection of artificial sweeteners in food,
5. Detection of toxins in canned foods
6. Detection of Pesticides residues in food.
7. Determine the index of microorganisms in milk and canned foods.
8. Alpha-amylase: It is used to solubilize the carbohydrates found in barley and other cereals used in brewing.
9. Lipase: Used to shorten the time for cheese ripening. It is employed in the production of enzyme-modified cheese/butter from cheese curd or butterfat.
10. Papain: used as a meat tenderizer.
11. Cellulase: Conversion of cellulose waste to fermentable feedstock for ethanol or single-cell protein production.
12. Lactase: Additive for dairy products for individuals lacking lactase.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Laboratory Manual of Food Microbiology- I.K. international publishing, Delhi

COURSE OUTCOMES:

CO1: On the completion of the above experiments students will be able to identify different types food adulteration and its effect on health
CO2: On performing the above experiments students will be able to know and perform the routine assays for food quality.
CO3: Students will be able to isolate culture and identify microbes and also to

efficiently use light microscope.

CO4: Students will be able to isolate culture and identify pesticides in food

CO5: Students will be able to isolate culture and identify aldulterants in food

Board of Studies (BoS) :

9thBoS of SLS held on 20.08.2022

Academic Council:

19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTE 7211	PROJECT WORK (PHASE 1)	L	T	P	C
		0	0	18	6

COURSE OBJECTIVES:

- To learn and experiments handled on their own by the students to exhibit their capacity in executing a project work and provide a fruitful solution to a research problem or improving the health and wealth of human beings in the field of food Biotechnology.

GENERAL GUIDELINES:

- ❖ At post-graduate level, project work shall be carried out by the student individually
- ❖ Student shall select a project topic of his/her interest relevant to Food Biotechnology and approach any faculty member of the School of Life Sciences with expertise in that field and get his willingness to supervise the project.
- ❖ Students are permitted to carry out their project in an Industry / Research organization, with the approval of the Dean of the School of Life Sciences. In such cases, the project work shall be jointly supervised by a faculty of the school and a professor/ Scientist from the organization. Proper permission and approvals should be obtained from the industry and documented.
- ❖ The information related to the proposed topic and the faculty member willing to act as a guide shall be informed to the project coordinator within 15 days from the commencement of the semester.
- ❖ Supervisor identified by the student shall be approved by the dean of the School of Life Sciences considering the guidelines followed in the School of Life Sciences to allot supervisor for student projects.
- ❖ The project coordinator, in consultation with Professor in-charge shall give initial approval to start the project.
- ❖ A project review team comprising minimum of two senior faculty members of the department preferably doctorates shall be appointed by the Dean of the School of Life Sciences.
- ❖ Project review schedules, weightage for each review, and rubrics for evaluation will be prepared by the project coordinator in line with the academic calendar and informed to the students in advance. A minimum of three reviews shall be conducted to evaluate the progress of the students. All the members of the review committee shall evaluate the students individually and the mean value shall be taken for grading.

- ❖ Students should meet the supervisor periodically and attend the review committee meetings for evaluating the progress. Proper documents shall be maintained by the supervisor to ensure the attendance and progress of the students.
- ❖ In the project phase I, students are expected to identify a suitable topic, draw the need for present study and scope of the investigation, review at least 25 journal papers in the related field, formulate the experimental/analytical methodology and conduct preliminary studies.
- ❖ At the end of project work phase I, students should submit a report based on the preliminary studies and the future work to be carried out.

COURSE OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Food Biotechnology with a specialization in solving real time problems
- Prepare an appropriate documentation

MOOC COURSE	L	T	P	C
	0	0	0	0

COURSE OBJECTIVES:

To learn the basics principles and concepts of the topic in which a project work is undertaken by the student.

GENERAL GUIDELINES:

- Students shall identify a MOOC course related to his/her project topic in consultation with the project supervisor.
- Student shall register for a MOOC course with minimum two credit offered by any recognized organization during the project phase I.
- Selection and completion of MOOC course by the students shall be endorsed by Head/Dean of the Department.

COURSE OUTCOMES:

Students will be able to

- Familiarize the basic principles and concepts related to the topic of his/her project work.
- Utilize the knowledge gained in the field of study to perform literature review with ease.
- Formulate the experimental / analytical methodology required for the project work

LTE 7211	PROJECT WORK (PHASE 2)	L	T	P	C
		0	0	36	18

COURSE OBJECTIVES:

- To learn and experiments handled on their own by the students to exhibit their capacity in executing a project work and provide a fruitful solution to a research problem or improving the health and wealth of human beings in the field of Food Biotechnology.

GENERAL GUIDELINES:

- Project work phase II is a continuation of phase I following the same guidelines.
- The project coordinator shall arrange to conduct three reviews to ascertain the progress of the work and award the marks based on the performance.
- Detailed experimental investigation / in-depth analytical study /
- Preparation of specimens / testing has to be performed in-line with the scope of the investigation.
- The students are expected to analyse the obtained results and
- Elaborately discuss the same by preparing necessary Figures/Graphs/Tables/Illustrations/images to get an inference.
- The important conclusions need to be drawn and scope for further research also to be highlighted.
- The outcome of project work shall be published in journals /
- conference of National or International importance.
- At the end, students should submit a report covering the various
- aspects of the Project work.
- The typical components of the project report are the Introduction, Need for present study, Scope of the Investigation, Literature review,
- Methodology / Experimental investigation/development of software packages, Results & discussion of experimental and analytical work, Conclusions, References etc.
- The deadline for submission of final Project Report / Thesis /
- Dissertation is within 30 calendar days from the last Instructional day of the semester.
- The project co-ordinator, in consultation with the head of the department and controller of examination, shall arrange for an external expert member to conduct the final viva-voce examination to ascertain the overall performance of the students in Project work.

COURSE OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Food Biotechnology with specialization in to solve real time problems
- Prepare an appropriate documentation

PROFESSIONAL ELECTIVE COURSES

SEMESTER I

LTEY086	FOOD PROCESSING TECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To know the principles and methods involved in the processing of Perishable and non -perishable foods

COB2: To develop skills in the perishable food processing equipment's

COB3: To develop the knowledge on preserving the meat and sea foods

COB4: To develop the knowledge on preserving cereals

COB5: To gain knowledge on preserving spices

MODULE I FRUIT AND VEGETABLE PROCESSING 9

Fruit & Vegetable Processing- Classification, Pre- Processing, Processing & Preservation- Size reduction, Mixing, Separation, Concentration, Freezing & Refrigeration, Drying & Dehydration, Chemicals, Processing by using Pulsed Light and Irradiation; Nutritional losses during Processing, Fruit & Vegetable Intermediate moisture products, Storage.

MODULE II DAIRY PROCESSING 9

Dairy Processing- Milk Pre-Processing; Processing & Preservation - Separation, Homogenization, Pasteurization, Standardization, Sterilization (UHT), Evaporation (Spray Drying), Chilling, Freezing & Refrigeration; Nutritional losses during Processing; Milk Product & By Products; Storage.

MODULE III MEAT AND SEA FOOD PROCESSING 9

Fleshy Food Processing – Meat, Poultry& Egg - Pre-Processing; Processing & Preservation- Smoking, Canning, Drying, Cooling, Canning Pulsed Electric Field processing; Nutritional losses during Processing; Storage.

Sea Food Processing – Types; Pre-Processing; Processing & Preservation- Dielectric, Ohmic and Infra-red heating- Nutritional losses during Processing; Storage.

MODULE IV CEREAL TECHNOLOGY 9

Cereal Technology- Rice- Parboiling and milling methods, High-Pressure Processing, by products of rice milling and their utilization; Wheat- Milling, by-

products of milling, Nutritional losses during Processing; Storage. Conventional and nonconventional foods- Breakfast, Extruded products.

MODULE V SPICE TECHNOLOGY 9

. Spice Technology (Indian) - Classification, Anti-Microbial & Antioxidant Properties, Processing, By-Products of Spices – Extraction of Oleoresin, Essential oil & Spice Blends, Medicinal Value of Spices; Nutritional losses during Processing; Storage.

L – 45; Total Hours – 45

TEXT BOOKS:

1. P.J.Fellows, Food Processing Technology. Principles and Practices, Second Edition, Woodland Publishing Ltd, Cambridge,England,2002.
2. Avantina Sharma, Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP, 2006.
3. Sivasankar, Food Processing and Preservation, Prentice Hall of India Pvt Ltd,
4. NewDelhi.IIIrd Printing, 2005.
5. 4. Peter Zeuthen and Leif Bogh-Sorenson, Food Preservation Techniques, Woodland Publishing Ltd, Cambridge, England, 2005.

REFERENCES:

1. NIIR Board of Food and Technologist, Modern Technology of Food Processing and Agro based industries, National Institute of Industrial Research, Delhi, 2005.
2. Peter zeuthena nd Leif Bogh- Sorensen, Food Preservation Techniques, Wood Head Publishing Ltd., Cambridge, England, 2005
3. Suman Bhatti, Uma Varma, Fruit and vegetable processing organizations and institutions, CBS Publishing, New Delhi, 1st Ediion- 1995.
4. Mirdula Mirajkar, Sreelatha Menon, Food Science and Processing Technology vol-2, Commercial processing and packaging, Kanishka publishers, New Delhi- 2002.

COURSE OUTCOMES:

Students will be able to acquire knowledge on

CO1: Fruits and vegetable processing

CO2: Dairy products processing

CO3: meat and sea food processing

CO4: processing of different type of cereals

CO5: processing of various types of spices

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth
Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 087	FLAVOUR PROCESSING TECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To explore about flavours and processing technology.

COB2: To understand the flavour compounds involved in development of flavour.

COB3: To get overview of mechanisms underlying flavour perception

COB4: To understand the analytical techniques involved in flavour analysis

COB5: To recognize off-flavour defects in foods and strategies of identification.

MODULE I INTRODUCTION 9

Description of food flavours, Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours, Flavour enhancers.

MODULE II CHEMICAL SENSES 9

Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

MODULE III FLAVOUR COMPOUNDS 9

Flavour profiling methods, flavouring components, extraction, evaluation, quality control and standards, formation of flavours in foods, technology, isolation and identification of flavouring materials, synthetic flavouring agents, flavour evaluation, standards / specifications.

MODULE IV FLAVOUR FORMATION 9

Various methods of flavor formation - Enzymatic and non-enzymatic methods, Lipid Oxidation methods of flavour formation, Mechanism of flavour-food interactions, Flavour release on flavour perception.

MODULE V FLAVOURS IN FOOD 9

Flavours in food - vegetable, fruit and spice flavours, flavours of milk and meat products, effect of processing on flavour components, influence of colour and texture on flavor of food, Objectionable flavour in foods and methods of detection, Monitoring Adulteration of Flavours

L – 45; Total Hours – 45

TEXT BOOKS:

1. Fisher, Carolyn and Thomas R. Scott. Food Flavours: Biology and Chemistry. The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. Flavor Chemistry and Technology. CBS Publishers, 1996.
3. Reineccius, Gary. Flavor Chemistry and Technology. II Edition, Taylor and Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. Flavor Chemistry of Ethnic Foods. Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. Food Flavorings. III Edition, Aspen Publications, 1999.

REFERENCES:

1. Hofmann, Thomas. Challenges in Taste Chemistry and Biology. American Chemical Society Publications, 2004.
2. Charalambous, G. Food Flavors: Generation, Analysis and Process Influence. Elsevier, 1995.

COURSE OUTCOMES:

Students will be able toacquire knowledge on

CO1: contribution of different compounds for the development of flavor

CO2: analytical techniques involved in flavor analysis

CO3: identification of off-flavour defects in foods and strategies of detection.

CO4: mechanisms underlying flavour perception.

CO5: role of flavours in food processing.

Board of Studies (BoS) :

9th BoS of SLS held on 20.08.2022

Academic Council:

19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 088	POST-HARVEST TECHNOLOGY	L	T	P	C
SDG: 3, 15	OF FRUITS AND VEGETABLES	3	0	0	3

COURSE OBJECTIVES:

COB1: Students will learn about basics of food consitituents and functions.

COB2: Students will learn about traditonal food preservation

COB3: Students will be exposed to food preservation methods that entertained in industries

COB4: Students will be exposed toaseptic Processing, Packaging & Active Packaging Technology

COB5: Students will be exposed to food fortification

MODULE I INTRODUCTION 9

Food Constituents and Functions, Quality and Safety Aspects of Food, Factors Affecting Quality During Processing and Storage, Role of Water in Food and its Shelf Life, Gelatinization &Retrogradation of Starch.

MODULE II TRADITONAL FOOD PRESERVATION 9

Browning Reactions, Food Proteins, Principles of Food Preservation, Traditional Food Preservation Technologies.

MODULE III FOOD PRESERVATION IN INDUSTRIES-I 9

High Pressure Processing of Food, Membrane Technology, Food Irradiation, Microwave Heating, Radio Frequency Drying, Super Critical Fluid Extraction, Freeze Drying, Food Extrusion Technology.

MODULE IV FOOD PRESERVATION IN INDUSTRIES-II 9

Textured Vegetable Protein (TVP), Aseptic Processing & Packaging, Hurdle Technology, Natural Antimicrobials, Food Lipids: Nature & Occurrence, Extraction of Oil, Refining of Oil, Modified Fats, Rancidity, Natural Antioxidants, Microencapsulation, Food nanotechnology, Respiration & Ripening, Modified Atmospheric Storage (MAP), Active Packaging Technology, Edible coating technology, Multiproduct CA / MA Storage Unit, Grain Storage, Ozonation of Food Grains.

MODULE V FOOD FORTIFICATION 9

Iron Fortified Rice (IFR), Nutri Dal and Fortified Noodles, High Energy RTE Food Paste, Functional Foods and Nutraceuticals, Algae Based Health Foods, Gluten Free Bread and Pasta, Food Powder & Premixes, GMP/GHP in Food Industry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Chadha, K.L. &Pareek, O.P. (Eds.). 1996: Advances in Horticulture,
2. Vol. IV. Malhotra Publ. House, Kriti Nagar, Delhi.
3. Giridhari, Lal, Siddappa, G.S., &Tandon, G.L. 1998: Preservation of
4. Fruits and Vegetables, Publication and Information Division, ICAR.
5. Srivastava, R.P., Sanjeev, Kumar.2006: Fruits and Vegetable
6. Preservation, International book distributing Co Lucknow.
7. Sudheer, K. P. Indira, V. 2007: Postharvest Technology of Horticultural Crops, New India Publishing, Delhi.
8. Verma, L. R & Joshi, V. K. 2000: Postharvest Technology of Fruits and
9. Vegetables, Indus Publishing House, Delhi.

COURSE OUTCOMES:

CO1: Students understand the basics of post harvest of fruits and agriculture goods.

CO2: Students will learn about traditonal food preservation

CO3: Students understand the food preservation methods that entertained in industries

CO4: Students understand a septic Processing, Packaging & Active Packaging Technology

CO5: Acquire knowledge in Food Fortification and GMP in food

Board of Studies (BoS) :

9thBoS of SLS held on 20.08.2022

Academic Council:

19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 089	FOOD NUTRIGENOMICS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn basics of nutrigenomics

COB2: To gain knowledge of how diet and underlying genetics interact to increase susceptibility to disease

COB3: To learn the significance of gene-nutrient interactions

COB4: To learn the importance of dietary chemicals in nutrigenomics

COB5: To explore the applications of nutrigenomics in human health

MODULE I INTRODUCTION 9

Genome an introduction, genome organization and gene structure, Human Genome database, plant genomes, nutrigenomics-introduction-principles of nutrigenomics.

MODULE II NUTRIENT GENETICS 9

Genetic variations-role of SNPs: metabolism and dietary intake requirements - human diseases-FTO variant and adipocity-Copy number variations-AMY1-salivary amylase.

MODULE III GENE NUTRIENT INTERACTIONS 9

Types of gene nutrient interactions: Direct Interactions-Epigenetic interactions-nutrient gene-cancer interactions-diet related carcinogenesis.

MODULE IV NUTRIENTS AND GENE EXPRESSION 9

Dietary chemicals effect on gene expression: Macronutrients-Carbohydrates, Fats-PUFA, Proteins-Amino acids, Micronutrients-Vitamins and Minerals.

MODULE V APPLICATIONS OF NUTRIGENOMICS 9

Diet and the microbiome-personalised nutrition and health-novel biomarkers of Dietary Intake, Implications of animal nutrition, Mini gut and organoids, Limitations of nutrigenomics.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nutrigenomics: concept, advances and applications JagishKourReen*, Alok Kumar Yadav and Jitendra Singh, Asian J. Dairy & Food Res, 34(3) 2015: 205-212

2. Mathers, J.C., (2017). Nutrigenomics in the modern era. *Proceedings of the Nutrition Society*. **76**(3)**,** 265-275.

COURSE OUTCOMES:

CO1: Students understand the basics of post harvest of fruits and agriculture goods.

CO2: Students will learn about traditonal food preservation

CO3: Students understand the food preservation methods that entertained in industries

CO4: Students understand aseptic Processing, Packaging & Active Packaging Technology

CO5: Acquire knowledge in Food Fortification and GMP in food

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 025	AROMATIC AND MEDICINAL PLANTS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the Medicinal and aromatic plants status in world and India

COB2: To know about habit and habitat, geographical and systematics of medicinal plants of India

COB3: To have an idea about important aromatic plants, their industrial uses

COB4: To understand the growth and development process of MAPs

COB5: To understand the cultivation and trade of MAPs

MODULE I INTRODUCTION TO MEDICINAL AND AROMATIC PLANTS 9

MAPs: definition, history, importance and future prospects. Medicinal Plants – past and present status in world and India. MAPs as industrial crops -constraints and remedial measures. Medicinal plant diversity & local healthcare. Medicinal plant conservation – issues and approaches. Medicinal plant conservation areas (MPCA), Non-timber forest products (NTFP),

MODULE II IMPORTANT MEDICINAL PLANTS 9

Important medicinal plants of India with their systematics, geographical distribution and uses. Acoruscalamus, Adhatodavasica, Abrusprecatorius Aloe vera, Phyllanthusamarus, Stevia rebaudiana, Belladona and Cinchona.

MODULE III INTRODUCTION AND SYSTEMATIC OF AROMATIC PLANTS 9

Important aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants. Aromatic and cosmetic products. Raw material for perfumes etc. Cosmetic Industries. Major, minor and less known aromatic plants of India. Taxonomic descriptions and uses of important aromatic plants–citronella, davana, damask rose, geranium, khus grass, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary Palmarosa, vetiver, artemisia, eucalyptus, thyme, marjoram and oreganum. Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curry leaf and saffron.

MODULE IV GROWTHANDDEVELOPMENT OF MAPS 9

Growth and development of MAP crops; Phases of growth; Factors affecting growth and development; Juvenile and reproductive phases; Physiology of

flowering; Photoperiodism; Vernalisation; Maturation and ripening; respiratory climacteric and non-climacteric; physiology and biochemistry of ripening. Senescence; Tuberization, formation of bulbs, rhizomes, corms etc. Role of plant growth regulators with special reference to MAPs; Integrated nutrient management; Weed management; Irrigation systems.

MODULE V CULTIVATION & TRADE OF MAPS 9

History, present status and future prospects of MAPs cultivation in India. Development of agro-techniques of MAPs – including domestication, improved varieties, cultivation packages and economical viability. Selection of elite germ plasm for domestication. Appropriate harvesting techniques and season.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Cultivation of Medicinal and Aromatic Plants by A. A. Farooqi, (2004).
2. Salisbury, F.B. and Ross, C.W.: Plant Physiology,
3. Handbook of Medicinal and Aromatic Plants by S.K. Bhattacharjee (2004).
4. Indian Medicinal Plants by P.C. Trivedi (2009).
5. Hudsont: Plant propagation principles and practices

COURSE OUTCOMES:

CO1: Understand the different Medicinal and Aromatic plants
CO2: Get knowledge about systematics, geographical distribution and uses
CO3: Understand the growth and developmental process of MAPs.
CO4: Understand development of agro-techniques of MAPs
CO5: Gain knowledge on cultivation and trade of MAPs

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Meeting of the Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

LTEY 091	FUNCTIONAL FOODS AND NUTRACEUTICALS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: Students will be exposed to definition and marketing and regulatory aspects of functional foods and Nutraceuticals

COB2: Students will learn the basics of probiotics and its applications

COB3: Students will learn about the polyphenols and Phytoestrogens

COB4: Students will learn about active biodynamic principles in spices

COB5: Students will learn the non-nutrient effect of specific nutrients

MODULE I INTRODUCTION TO FUNCTIONAL FOODS AND NUTRACEUTICALS **9**

Introduction to Functional Foods and Nutraceuticals: Definition, History and Classification Perceived Effects of Functional Foods, Marketing and regulatory issues for functional foods and nutraceuticals Recent developments and advances in the area of nutraceuticals and functional foods.

MODULE II PROBIOTICS **9**

Introduction to Probiotics, Prebiotics and Synbiotics Probiotics: Taxonomy and Important Features of Probiotic Microorganisms Health Effects of Probiotic Microorganism, Probiotics in Various Foods, Quality Assurance of Probiotics and Safety.

MODULE III POLYPHENOLS, PHYTOESTROGENS AND ORGANOSULFUR COMPOUNDS **9**

Polyphenols: Flavonoids, Catechins, Isoflavones, Tannins, Phytoestrogens, Phytosterols, Glucosinolates, Pigments: Carotenoids, Lycopene, Curcumin Organosulphur Compounds-Introduction to Anti-nutritional Factors, Phytates.

MODULE IV ACTIVE BIODYNAMIC PRINCIPLES IN SPICES **9**

An introduction to Active Biodynamic Principles in Spices, Condiments and Plant extracts, Active Biodynamic Principles in Spices, Condiments and Plant extracts: Resveratrol, Kaempferol, Quercetin, Cinnamaldehyde, Crocin, Luteolin, Condiments and Plant extracts - Capsaicin, Piperine, Gingerol, Eugenol, Rosemarinicacid, Apigenine, Thymoquinone.

MODULE V NON-NUTRIENT EFFECT OF SPECIFIC NUTRIENTS 9

Non-Nutrient Effect of Specific Nutrients: Conjugated Linoleic Acid, Omega 3 Fatty acids, Proteins and Peptides and Nucleotides, Vitamins, Minerals.

L – 45; Total Hours –45

TEXT BOOKS:

1. Wildman, R. E. (2016). Handbook of Nutraceuticals and Functional Foods. CRC Press
2. Gibson, G. R. and Williams, M. C. (2001). Functional Foods Concept to Product. CRC Press.
3. Vattem, D.A. and Maitin V. (2016). Functional Foods, Nutraceuticals and Natural Products, Concepts and Applications. DEStech Publications, Inc
4. Gupta, R. C. (2016). Nutraceuticals: Efficacy, Safety and Toxicity. Academic Press

REFERENCES:

1. Saarela M. 2011. Functional Foods: Concept to Product. 2nd edition. Oxford, Cambridge. Woodhead Publishing Ltd
2. Bagchi D. 2014. Nutraceuticals and Functional Foods Regulations in the United States and Around the World 2nd edition. Elsevier.
3. Schmidl MK and Labuza TP. 2000. Essentials of Functional Foods, Functional Foods and Nutraceutical series. Technomic Publishing Co., Inc.
4. Zawistowski J. 2010. Tangible Health Benefits of Phytosterol Functional Foods.
5. J. Smith and E. Charter (Eds) In: Functional Food Product Development. Wiley Blackwell.
6. Zawistowski J and Kitts DD. 2004. Functional Foods – A New Step in the Evolution of Food Development. Clinical Nutrition Rounds. 4:1-6.

COURSE OUTCOMES:

CO1: At the end of the course students learn the definition for functional foods and nutrition and the recent developments in the area.

CO2: Student learn the importance of probiotics

CO3: Students learn the structure and key aspects of poly phenols and phytoestrogens.

CO4: They will learn about active biodynamic principles in spices.

CO5: They learn about non nutrient effect of specific nutrients.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth
Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

SEMESTER II

LTEY 092	MEAT PROCESS TECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To learn the development of meat industries

COB2: To learn about Muscle structure and chemical composition

COB3: To give basic idea on processing and preservation of meat

COB4: To give knowledge about the factors affecting post-mortem changes

COB5: To learn about the various preservation methods

MODULE I DEVELOPMENTS OF MEAT INDUSTRIES 9

Theory, Sources and Developments of meat industries in India and importance in National Economy.

MODULE II MUSCLE STRUCTURE, CHEMICAL COMPOSITION, CARE AND TRANSPORTATION 9

Muscle structure, chemical composition and physico-chemical properties of meat muscle, Abattoir design and layout, Pre-slaughter transport and care and antemortem inspection. Slaughtering of animals and post-mortem inspection and grading of meat, Factors affecting post-mortem changes, properties and shelf life of meat.

MODULE III PROCESSING OF MEAT

Processing and preservation of meat- mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat, Meat tenderization. – principles and methods, Meat emulsions, Technology of manufacture of meat products, Meat plant sanitation and safety By-products utilization of abattoir.

MODULE IV FACTORS AFFECTING POST-MORTEM CHANGES 9

Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features.

MODULE V PRESERVATION OF MEAT 9

Preservation of meataging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.

L – 45; Total Hours –45

TEXT BOOKS:

1. Principles of Meat Science Aberle E.D. Kendall Hunt Publication ISBN: 9780787247201
2. Principles of Meat Technology Singh V. P. New India Publishing Agency, Delhi ISBN: 9789380235554
3. Handbook of Heat and Meat Processing Hue Y.H. CRC Press, New York ISBN: 9781439836835
4. Handbook of Meat, Poultry and Seafood Quality Kerth Wiley Backwell, 2012 SBN: 9780470958322
5. Lawrie, R.A. “Meat Science”, Second Edition. Pergamon Press, Oxford, UK. 1975.

COURSE OUTCOMES:

CO1: To learn the theory, sources, development of meat industries

CO2: Processing and preservation of meat

CO3: Acquire knowledge of Processing the meat

CO4: Grasp the changes in the composition of foods with respect to the type of processing technology used.

CO5: Grasp the knowledge of various preservation methods.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 093	MARINE FOOD PROCESS TECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To educate the students Preservation and Processing of the food

COB2: Develop an understanding of food preservation techniques of drying, dehydration and Irradiation.

COB3: To give knowledge about the importanceFreezing and cold storage techniques of food processing.

COB4: Cultivate an understanding about the importance of packing process in food process technology.

COB5: To educate the students about the fishery by products

MODULE I PRESERVATION AND PROCESSING 9

Importance of preservation and processing of sea foods criteria for assessing freshness handling of fresh materials – on board handling, chilling methods, phenomena of rigor mortis, spoilage changes – causative factors (other than microbial).

MODULE II DRYING AND IRRADIATION 9

Drying and dehydration – conventional and modern methods, relative merits and demerits. Quality changes during drying and storage – functional properties, sensory quality, nutritional value, quality indices, storage life. Salt curing, picking and smoking – methods, merits and demerits – quality changes during processing and storage life – quality standards. Irradiation – source of radiation, methods, merits and demerits, quality changes during processing and storage - quality standards , minimal processing technologies.

MODULE III FREEZING

Freezing and cold storage – process of freezing, types, quality changes during processing and storage. Canning – procedures, quality changes during processing and storage – quality standards. Role of preservatives in processing.

MODULE IV PACKING 9

Packing – function of packaging, special needs in food packaging, packaging materials, types -1 handling fresh fish, retail packing, whole sale packaging, Block frozen packs, IQF, layered and shatter packs, modified atmospheric packaging, vacuum packaging, boil and bag type, cans and containers, air freight packaging, packaging standards for wet shipment and irradiated foods.

Food contact substances – limits. Labeling – information to be included, labeling regulation.

MODULE V FISHERY BY – PRODUCTS 9

Fishery by – products of commerce – surimi, fish protein concentrate, meal and oil production, hydrolysis of fish protein. Cannery waste processing of fish stick water. Animal feeds, fish silage, fish liver preservation, fish gelatin, fish glue, leather from fish skin, chitin and chitosan, pearl essence, use of shells, fertilizer from fishery by products.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Govindan. T.K, "Fish Processing Technology", Oxford and IBH Publishers, New Delhi, 1985.
2. Kreuzer R., 1974. Fishery Products, FAO Fishing News (Books) Ltd., England.
3. Anon, 1979. Handling, Processing and Marketing of Tropical fish, Tropical Products Institute, London.
4. Miller, M.D., 1990. Ciguatera Seafood Toxins, CRC Press.

COURSE OUTCOMES:

CO1: be familiar with preservation and processing of sea foods criteria for assessing freshness maintains the freshness of the sea foods

CO2: categorize food preservation techniques of drying, dehydration and Irradiation

CO3: be familiar with freezing and cold storage techniques used in the sea food processing

CO4: acquire knowledge about the importanceFreezing and cold storage techniques of food processing.

CO5: able to apply knowledge on fishery by-products and its commerce

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth
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LTEY095	FOOD INFORMATICS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the basic scope of Food Informatics

COB2: To get familiarized with food databases

COB3: To learn about the need of ontologies in Food Informatics

COB4: To explore the tools for food database management systems

COB5: To learn the various applications of Food informatics

MODULE I INTRODUCTION 9

Food Informatics-Introduction-Meaning and Scope-Areas of Food Science and Nutrition.

MODULE II NUTRITION DATABASES 9

Important search engines, Data bases in Food Science, Nutrition: Clinical nutrition, community nutrition, Human Nutrition, Dietetics, Institutional food service management. Food processing technology.

MODULE III ONTOLOGIES 9

Data collection, organization in areas of food and nutrition, Need for Ontologies, Major Ontology resources for food informatics-Gene Ontology, Food Ontology, Food Biomarker Ontology.

MODULE IV DATABASE MANAGEMENT 9

Data storage and distribution by using various information technology tools and methods. Database management system. Application of software.

MODULE V APPLICATIONS OF FOOD INFORMATICS 9

Food research, Food nutrient Analysis, Clinical Nutrition care, Inventory management systems-Examples, Challenges of Food Informatics.

L –45; Total Hours –45

TEXT BOOKS:

1. The landscape of nutri-informatics: a review of current resources and challenges for integrative nutrition research. Database, Vol. 00, Article ID baab003
2. Food Informatics and its Challenges and Opportunities- A Review International Journal on Recent Researches in Science, Engineering and

Technology, Vol.5, Issue 9, Sept 2017. ISSN (Print) 2347-6729 ; ISSN (Online) 2348-3105.

3. Jagadish, H. V., and Frank Olken. "Database management for life sciences research." *ACM SIGMOD Record* 33.2 (2004): 15-20.

REFERENCES:

1. McComb, Brenda, et al. "Database Management." Monitoring Animal Populations and their Habitats: A Practitioner's Guide.
2. Nutrition Informatics Hoggle, Lindsey B. et al.Journal of the American Dietetic Association, Volume 106, Issue 1, 134 – 139

COURSE OUTCOMES:

CO1: To appreciate the basics of food informatics

CO2: To appreciate the vast resources of food informatics

CO3: Understanding the usage of ontologies

CO4: Understanding database management system software in food informatics

CO5: Inferring food informatics applications in research problems

Board of Studies (BoS) :

9thBoS of SLS held on 20.08.2022

Academic Council:

19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

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LTEY096	FOOD PRODUCT DESIGN AND DEVELOPEMENT	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To apply different engineering approaches for food product design and development.

COB2: To understand the food properties required in optimal food product design.

COB3: To understand consumer needs and wants for successful product development.

COB4: To apply computer-aided statistical approaches in food product design and optimization.

COB5: To provide knowledge about novel food products with competitive advantages

MODULE I INTRODUCTION TO FOOD PRODUCT DESIGN AND DEVELOPMENT 9

Knowledge base for product development, Product development process, Innovation strategy development, New product success and failure.

MODULE II CONSUMER IN PRODUCT DEVELOPMENT 9

Understanding consumer behaviour and food choice, tackling consumer preferences, Societal setting, Consumer's avoidance and acceptance of new products, integrating consumer needs and wants in product development, Sensory product attributes.

MODULE III FOOD PRODUCT DESIGN USING COMPUTER-AIDED STATISTICAL APPROACHES 9

Modelling of food quality attributes, types of models, applications of models to reactions in foods, Optimization by Response Surface Methodology.

MODULE IV BARRIER TECHNOLOGY FOR FOOD PACKAGING DESIGN 9

Packaging materials as a barrier, Heterogeneous films, Prevention of defects in barrier films, Mechanical behaviour, Wetting behaviour, Migration of other components, edible-barrier films Modified atmosphere packaging, Active packaging, High pressure processing, Intelligent packaging, Modelling in package design.

MODULE V CASE STUDIES IN PRODUCT DEVELOPMENT 9

Development of mango products and their competitive advantage in export markets, Process and management for whey proteins, Wafer Bars elevated in Protein, Emulsified variety sauces.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Food Product Design: An Integrated Approach, Anita R. Linnemann, M. A. J. S. van Boekel Wageningen Academic Publishers, 2007
2. Food product development, Mary Earle, Richard Earle, 2001, Woodhead publisher
3. Methods for developing new food products, FadiAramouni, 2015, Destech publisher

COURSE OUTCOMES:

Students will be able to acquire knowledge on

CO1: Apply different engineering approaches for food product design and development.

CO2: Identify the essential food properties required in optimal food product design.

CO3: Comprehend various consumer needs and wants for successful product development.

CO4: Apply computer-aided statistical approaches in food product design and optimization.

CO5: Develop novel food products with competitive advantages.

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY096	DAIRY TECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To acquaint with the properties and role of various constituents in milk, interaction and changes during processing.

COB2: To explore the importance of various processing techniques.

COB3: To understand the methods of the collection and transportation of milk to the dairy plant.

COB4: To know the processing and packaging materials and machineries for milk and milk products.

COB5: To study the chemistry of milk.

MODULE I INTRODUCTION 9

Definition, Indian Standards, Food and nutritive value of milk, Collection and transportation of Milk, Preservation at farm, Refrigeration. Colostrums and its properties and difference from normal milk, Legal standards of milk, Chemical test, Adulteration in milk and their detection, Elementary knowledge about indigenous and modern dairy products.

MODULE II DAIRY CHEMISTRY 9

Definition and structure of milk, factors affecting composition of milk, Physico-chemical properties of milk, Nutritive value of milk, Coagulation of milk with heat, acid, enzymes and alcohol. Nomenclature and classification of milk proteins, carbohydrates, lipids, Immmunoglobulin and other minor milk proteins, Milk enzymes.

MODULE III MILK PROCESSING TECHNOLOGY 9

Reception and treatment of milk at the dairy plant: Reception, Chilling, Clarification, Separation, Bactofugation and storage. Homogenization – Definition, Effect of homogenization on physical properties of milk.

MODULE IV THERMAL PROCESSING OF MILK 9

Definition, Theoretical basis of sterilization, Description of processes – Pasteurization, Thermization, Sterilization and Ultra-High-Temperature Processing (UHT), Process quality of sterilized milk.

MODULE V SPECIAL MILK 9

Manufacturing of Special Milk – Toned, Doubled Toned, Homogenized milk, Flavoured milk, standardized milk, rehydrated milk, recombinant milk, UHT milk.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Jenness R and Patton S., Principles of dairy chemistry, John Wiley's, USA, 1959.
2. Khurody D. N., Dairying in India, Asia Publishing House, 1974.
3. Sukumar De, Outlines of Dairy Technology, Oxford University Press, India, 1980.
4. Modern Dairy Products, Lampert LH; Chemical Publishing Company. 1970.

REFERENCES:

1. P. F. Fox, Developments in Dairy Chemistry – Vol 1 & 2; Elsivier Applied Science Publishers, London & New York, 1985.
2. Khan A.Q, The technology of milk processing, 1991.
3. Manual for milk plant operations, Washington, 1957.
4. Kessler H.G., Food engineering and Dairy technology, 1981.

COURSE OUTCOMES:

Students will be able toacquire knowledge on

CO1: the chemistry and composition of milk.

CO2: the chemical test required to test adulteration in milk.

CO3: the methods of collection and transportation of milk to the dairy plant.

CO4: the techniques required for processing and packaging of different types of milk and milk products.

CO5: the importance of various processing techniques in dairy industry.

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 097	MANAGEMENT OF HALAL FOODS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

The purpose of this course is:

COB1: To provide an insignt for better explaination about the principles, theories and Islamic rule for Halal

COB2: To equip students with skills to ensure the Shari`ah conformity of products and services in halal industries.

COB3: To provide a framework of the professional disciplines such as Islamic Values, halal certification, halal supply chain management.

COB4: To develop the students' ability to analyze the Halal Food and solve problems

COB5: To allow individuals to develop their knowledge for resolving the Halal food Issues relating to the production and marketing the foods.

MODULE I INTRODUCTION OF HALAL FOOD 9

Basic Understanding of Halal, Definition of Halal food and non-food, principles of Halal food, International role of Halal administration, five ruling in Islamic jurisprudence, Halal slaughtering process

MODULE II HALAL MANAGEMENT SYSTEM 9

Halal control system, Halal Standards, Procedures, Policies, HCCP, and internal committee, Local and Global Halal Food Authority, Contemporary issues in Halal affairs, Halal Platrform, Koshar and Halal food product certification

MODULE III HALAL CERTIFICATION & ACCREDITATION SYSTEM 9

Halal Food Interpretation, Halal Pharmaceuticals, Role of Halal Integrity, Relationship between Halal, Hygienic and Safeness of Food/Consumables, Halal supply chain, International and Indian Certification bodies, WHFC, Jamiat Ulama-i-Hind Halal Trust

MODULE IV GUIDLINES FOR HALAL FOOD PREPARATION

Sources of Halal food and drinks; Land animals, Water animals, Plants, Drinks, Usage of Halal lebels, Hygeine/Sanitation of Halal food preparation, Presentation and Storage of Halal food.

MODULE V HALAL FOOD MARKETS AND ITS PROSPECTS 9

Market Size and major Market Development for Halal Industry, Global Halal Market, Major Market development, Increasing Global Competition, Halal Banking and Finance, Difference between conventional financing and Islamic financing, Halal Auditing Procedures, Halal Monitoring, Traceability & Verification.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yunes Ramadan Al-Teinaz, Stuart Spear, Ibrahim H. A. Abd El-Rahim, The Halal Food Handbook, Ist Edition, John Wiley & Sons Ltd., 2020.
2. Mian N. Riaz, Muhammad M. Chaudry, Handbook of Halal Food Production, Ist Edition, CRC Press, 2019.
3. Azhar ul-Haq Lodhi. Understanding Halal Food Supply Chain, Kindle Edition, HFRC UK Ltd., 2013.

REFERENCES:

1. Khan MI, Aabid H (2016) Understanding “Halal” and “Halal Certification” and Accreditation System”-A Brief Review, Saudi Journal of Business and Management Studies, Volume 1, Issue 5, Page numbr 32-42.
2. Qureshi SS, Jamal M, Qureshi MS, Rauf M, Syed BH,Zulfiqar M, Chand Naila (2012). A Review of Halal Food with special reference to Meat and its trade potential. Issue 22, Page numbr 79-83.
3. Nooreen NAA, Nurul AAA, Nurul AAA, Omar Z, Hassan,WHAH (2015). A review on the Emergence and Growth of Halal Studies. Procedia Economics and Finance, Issue 31, Page numbr 325-332.

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: Demonstrate skills and knowledge in the field of halal products and services.

CO2: Use Islamic principles to analyse and evaluate juridical opinions on halal products and services.

CO3: Use relevant skills learned about halal products.

CO4: Analyse issues and demonstrate skilfulness in planning, executing and evaluating strategies and action plans.

CO5: Demonstrate commitment to ethics, autonomy, and professionalism in the workplace and everyday life.

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being
Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth
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ELECTIVES - SEMESTER III

		L	T	P	C
LTEY 098	**SANITISATION AND WASTE MANAGEMENT IN FOOD INDUSTRIES**				
SDG: 3, 15		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To educate the students on the principles rural water supply and sanitation.

COB2: Develop an understanding of the characteristics of water and wastewater that must be considered during design of a treatment plant.

COB3: Develop understanding of events governing the rural water supply and sanitation.

COB4: To minimize all resource wastages and support growth of company

COB5: To build ecofriendly culture in current generation.

MODULE I **CLASSIFICATION AND CHARACTERIZATION OF FOOD INDUSTRY WASTES** **9**

Introduction: Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.

MODULE II **SANITARY PROCEDURES, PERSONAL HYGIENE, FOOD SAFETY & PEST CONTROL** **11**

Importance of sanitary procedures in Food processing - Special Food Operations – Cleaning procedures -Cleaning & sanitizing, their importance mobile food units, vending machines, street side foods and diseases, Necessity for personal hygiene, health of staff, Personal appearance, sanitary practices habits protective clothing Importance of rest and exercise, Safety at the work place.

MODULE III **TREATMENT METHODS FOR FOOD INDUSTRY LIQUID WASTES** **7**

Treatment methods for liquid wastes from food process industries; Design of activated sludge process, rotating biological contactors, Trickling filters, UASB, Biogas plant.

MODULE IV **TREATMENT METHODS FOR FOOD INDUSTRY SOLID WASTES** **9**

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermi-composting pit.

MODULE V RECOVERY AND REUSE FOR FOOD INDUSTRY WASTES **9**

Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinkingwater treatment, Recovery of useful materials from effluents by different methods.

L – 45; Total Hours –45

TEXT BOOKS:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC &Okun DA; 1986, John Wiley & Sons, Inc.

COURSE OUTCOMES:

CO1: Be able to list the nature of the wastes obtained from different food processing industries.

CO2: Understand the properties of different food industry wastes.

CO3: Able to recognize and communicate common processes which allow the different food processing waste to be converted into valuable products.

CO4: Be able to list the nature of the wastes obtained from different food processing industries

CO5: Students be able to understand recovery and reuse for food industry wastes

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 034	REGULATORY AFFAIRS FOR BIOTECHNOLOGY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: To demonstrate through presentations and in discussions their understanding of different international policies, regulations and agreements that govern the use of biotechnology and show how these can be used as a framework for developing national biosafety laws.

COB2: To demonstrate using specific case-studies an understanding of the effectiveness and reliability of biosafety regulations in governing the use of biotechnology

COB3: To discuss in written essays their understanding of consumer rights and why labelling of genetically modified foods has become such a controversial issue.

COB4: To discuss using presentations and in written essays the influence of politics and science in the regulation of biotechnology.

COB5: To explain in written assignments the risks and benefits of genetic modification from a regulatory perspective

MODULE I INTRODUCTION 9

Validation and Regulatory Affairs in Bio (Pharmaceutical) Manufacturing: An Introduction to FDA Operations & Industry Compliance Regulations, The Fundamentals of Regulatory Compliance with respect to Good Clinical Practice (GCP), Good Manufacturing Practice (GMP) & Good Laboratory Practice (GLP). An Introduction to the Basic Concepts of Process Validation & how it Differs from Qualification (IQ, OQ & PQ) Procedures, A Review of Prospective, Concurrent, Retrospective Validation & Revalidation. ISO 9000 Series & International Harmonization & their effect upon GMP's.

MODULE II VALIDATION 12

Validation of Water & Thermal Systems, including HVAC Facilities & Cleaning Validation. Validation of Active Pharmaceutical Ingredients (APIs) & Aseptic Processes. Validation of Non-Sterile Processes (used in the manufacture of Solids, Liquids, & Semisolid Dosage Forms). Overview of method evolution, FDA and ICH guidelines, Development and validation, Basic statistical concepts, Outliers, Specificity: sample preparation, Specificity: separations, Specificity: detectors, Linearity, Accuracy, Precision, Limits of detection (LOD) and quantification (LOQ), Minimum detectable amount (MDA), Sample stability and method robustness, Window diagrams, System suitability, Statistical process

control for HPLC, Sustainable validation, Troubleshooting out-of control systems, case studies.

MODULE III RISK AND SAFETY APPROACHES 6

Concerns about genetically modified organisms- Socio-political attitudes and values- acceptance of particular applications of genetically modified foods- demand for information about gm- issues of traceability of gm foods and ingredients- non-involvement of public decision making processes- differences in food safety regulation in different jusridictions- integrated assessment tools.

MODULE IV QUALITY AND IMPLEMENTATION 8

Terminology Relating to Quality, Quality Requirement, Customer Satisfaction, Capability; Terms Relating to Management, Management System, Quality Management System, Quality Policy, Quality Objectives, Quality Planning, Quality Control, Quality Assurance, Quality Improvement, Continual Improvement, Effectiveness, Efficiency, Terms relating to Characteristics, Quality Characteristics; Terms Relating to Conformity, NonConformity, Defect, Preventive Action, Corrective Action, Correction, Rework, Repair, Scrap, Concession, Deviation Permit, Release; Objective Evidence, Inspection, Test, Metrological Confirmation. Final Inspection and Testing

MODULE V QUALITY MANAGEMENT 10

The development of regulatory requirements for validation, The V model and Life Cycle model approach to validation and documentation, Risk Analysis Techniques: Impact Assessment; Failure Mode and Effects Analysis (FMEA), Validation Master Plans, Contamination Control, Risk Management in the Pharmaceutical Industry, Solid Dose Manufacture Principles and Practices, Liquid and Cream Manufacture Principles and Practices, Good Laboratory Practices (for Non-Clinical Laboratories), Computer Systems Validation Principles and Practices, Good Aseptic Practices and Sterile Products, Clinical Trials Quality Assurance Management, Pharmaceutical Engineering-Facility, Equipment and Process Design, Fundamentals of Process Analytical Technology, Quality and Continuous Improvement in the Biotech Industry

L – 45; Total Hours –45

TEXT BOOKS:

1. Pharmaceutical Process Validation Robert Nash and Alfred Wachter, Marcel Dekker New York : Marcel Dekker, 2003.
2. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control from Manufacturer to Consumer Sidney J. Willig, Marcel Dekker New York : Marcel Dekker, 2001

3. Validation of Pharmaceutical Processes: Sterile Products Frederick J. Carlton and James Agalloco New York : Marcel Dekker, 3rd Edition 2008
4. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries Syed ImtiazHaider Saint Lucie Press 2001

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: demonstrate through presentations and in discussions their understanding of different international policies, regulations and agreements that govern the use of biotechnology and show how these can be used as a framework for developing national biosafety laws.

CO2: demonstrate using specific case-studies an understanding of the effectiveness and reliability of biosafety regulations in governing the use of biotechnology

CO3: understand in written essays their understanding of consumer rights and why labelling of genetically modified foods has become such a controversial issue.

CO4: discuss using presentations and in written essays the influence of politics and science in the regulation of biotechnology.

CO5: explains in written assignments the risks and benefits of genetic modification from a regulatory perspective.

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 100	FOOD SATANDARDS AND QUALITY CONTROL	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To have an idea about various issues related to food safety and quality.

COB2: To understand national and international food safety management system and their role in food quality.

COB3: To be acquainted with various career avenues/options in this area.

COB4: To learn food quality indices

COB5: Gain the deep knowledge in food related laws and regulations

MODULE I MODULE NAMEBASIC CONCEPTS OF FOOD STANDARDS 9

Introduction, early history, industrial revolution in the nineteenth century, standard in food production, principal aspects of standardization, terminology, methods of sampling and analysis, product specifications and grading, implementation of the basic concepts of standardization, types of standard, methods of test and analysis. The uniform structure of ISO standards specifying analytical methods for the determination of food.

MODULE II FOOD SAFETY 9

Introduction, Biological pathogens, emerging pathogens, health effects of food borne diseases, nutritional and physical hazards, prevention and control of food borne diseases, biological and chemical hazards, chemical food safety and international efforts, food allergy and intolerance, economic and social consequences of food contamination.

MODULE III FOOD QUALITY AND ASSURANCE

Analytical methods used for quality determination, chemical and physicalchemical methods, microbiological methods, biochemical methods, methods of sensory analysis, analytical methods for the determination of basic food components, food quality control, trends in quality control and assurance.

MODULE IV FOOD QUALITY INDICES 9

Introduction, factors determining food quality, sensory properties, appearance, color, texture and flavor, physical properties and chemical composition, moisture and fat content, food additives, minerals, vitamins, microbiological characteristics, natural or synthetic components influencing quality and safety.

MODULE V FOOD LAWS AND REGULATIONS 9

Introduction, the structure of food law, food standards, laws and regulation to prevent gross adulteration and contamination, microbial contamination, hygienic practice, chemical and environmental contamination, food additives, labeling.

L – 45; Total Hours –45

TEXT BOOKS:

1. Food Quality and Standards, Edited by RadomirLasztity, Encyclopedia of life support system, Volume 1.
2. Introduction to Food Biotechnology A practical approach. SinashSkariyachanAbhilash M, CBS Publishers Pvt. Ltd.

COURSE OUTCOMES:

CO1: The basic concept of food standards and protein stability by different techniques.

CO2: Understand the importance of food insurance

CO3: The different indices to control the food quality measurement

CO4: Understand the food quality indices

CO5: The general laws governing the control of food quality.

Board of Studies (BoS) :

9thBoS of SLS held on 20.08.2022

Academic Council:

19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to to geneticists that gives knowledge about relation with all the levels of life in the earth.

LTEY 101	QUALITY EVALUATION OF FOODS	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To learn the food quality and its role in Industry

COB2: To learn food quality and Quality Spectra

COB3: To understand the basic principles of viscosity and consistency of fluids

COB4: To learn defects and Entomological defects

COB5: To learn the texture, flavour and odour Classification

MODULE I FOOD QUALITY AND ITS ROLE IN INDUSTRY 8

Food quality and its role in food industry need of quality control, factors affecting quality control.

MODULE II QUALITY ATTRIBUTES, COLOR ROLE IN QUALITY SPECTRA 8

Quality attributes: dominant and hidden attributes, Color-role of colors in quality spectra, different types of colour measuring instruments.

MODULE III VISCOSITY AND CONSISTENCY OF FLUIDS

Viscosity:-types of fluids, different viscometers to measure viscosity, Consistency:- methods used to measure consistency or product difference between viscosity and consistency, Size and shape: - Method to find shape and size of food and food products.

MODULE IV TEXTURE, FLAVOUR AND ODOUR CLASSIFICATION 1 1

Texture: classification, role of firmness, yielding quality, juiciness, chewiness, fibrousness, grittiness, mealiness, stickiness,, measurement of texture/ kinesthetic characteristics.- by compression, mechanical thumb, puncture tester, succulometer, shearing by tenderometer, texturometer, maturometer, fibro meter, moisture content, by barbender moisture tester, alcohol insoluble solids, color, consistency & sound measurement for kinesthetics, Flavour: Definition and its role in food quality, Taste, classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes and interaction of tastes. Odour: definition, Classification, neutral - mechanisms, Olfactory abnormalities, odor testing, techniques, thresholds, odor intensities.

MODULE V FACTORS INFLUENCING THE FOOD QUALITIES 9

Factors influencing the food qualities: Soil, field practices, harvesting practices,procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products, Recording and reporting of quality.

L – 45; Total Hours –45

TEXT BOOKS:

1. Krammer and Twigg. Fundamentals of Quality Control for Food Industry. Avi Publishing Company, 1966.
2. Krammer and Twigg. Quality Control in Food Industry. Avi Publishing Company, 1966
3. Herschdoerfer. Quality Control in Food Industry. Elsevier, 2012
4. Civillie and Carr. Sensory Evaluation Techniques. CRC Press, 2015
5. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw-Hill. 2001.

COURSE OUTCOMES:

CO1: Food quality and its role in Industry

CO2: Food quality and Quality Spectra

CO3: The basic principles of viscosity and consistency of fluids

CO4: learn defects and Entomological defects

CO5: Understand the texture, flavour and odour classification

Board of Studies (BoS) :
9th BoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

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SDG15: Life on Earth

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LTEY 102	FOOD SAFETY ASSESMENT	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: To learn the importance of Food safety and quality management

COB2: To learn to prepare SOP and its importance

COB3: To learn risk analysis and management

COB4: To learn implementation of haccp and conducting audit

COB5: To learn the practices of food safety

MODULE I FOOD SAFETY AND QUALITY MANAGEMENT SYSTEMS 9

Introduction to Food Safety-Food Safety System-Preparing scope, quality policy and quality objectives of food processing, Defining Standard operating procedure – purpose- Format - developing and implementing - Total Quality Management.

MODULE II STANDARD OPERATING PROCEDURES 9

SOP checklist - personal hygiene, food preparation, hot holding, cold holding, refrigerator, freezer and milk cooler, food storage and dry storage, cleaning and sanitizing, utensils and equipment, large equipment, garbage storage and disposal and pest control.

MODULE III RISK ANALYSIS AND PRE-REQUISITE PROGRAM

An Introduction to Risk Analysis- Risk Management- Risk Assessment Risk Communication. Good Manufacturing Practices - Personal hygiene – occupational health and safety specification, Food Plant Sanitation Management - Plant facilities construction and maintenance - exterior of the building- interior of the building- equipment. Storage, transportation, traceability, recalling procedures

MODULE IV IMPLEMENTATION OF HACCP AND CONDUCTING AUDIT 9

History, Background and Structure -Conduct a hazard analysis, CCP identification, establish critical limits for each CCP, establish CCP 97 monitoring procedures, establish corrective actions procedures, and establish procedures for HACCP verification and validation, documenting the HACCP Program.

MODULE V FOOD SAFETY PRACTICES 9

Good Agriculture Practices, Good Animal Husbandry Practices and Good Manufacturing Practices- Good Retail Practices, Good Transport Practices and Nutrition Labeling- Traceability Studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. 1. V RavishankarRai, Jamuna A Bai. First Editon of Food Safety and Protection. CRC press 2017. ISBN 9781498762878.
2. Ronald H. Schmidt, Gary E. Rodrick. Food Safety Handbook. John Wiley & Sons, Inc. (2003).
3. YasmineMotarjemi, HuubLelieveld. Food Safety ManagementA Practical Guide for the Food Industry (A Practical Guide for the Food Industry). Elsevier. ISBN: 9780123815040, (2013).

COURSE OUTCOMES:

CO1: understand importance of Food safety and quality management

CO2: understand the importance of SOP and its preparation method

CO3: understand risk analysis and management

CO4: understand to implement of HACCP and conducting audit

CO5: understand the practices of food safety

Board of Studies (BoS) :
9thBoS of SLS held on 20.08.2022

Academic Council:
19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being

SDG15: Life on Earth

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LTEY 103	GLOBAL FOOD MARKETING AND AID POLICY	L	T	P	C
SDG: 3, 15		3	0	0	3

COURSE OBJECTIVES

COB1: Describe the mechanisms of and factors affecting market demand and supply;

COB2: Identify the trends and socioeconomic mechanisms in global food markets;

COB3: Analyse market opportunities/threats for rising agribusinesses;

COB4: Apply basic economic and financial methods to address food market/marketing issues.

COB5: Apply the basics of food production control in managing food resources

MODULE I FOOD & AGRICULTURALMICROECONOMICS 9

Defination of market; Economic analysis of markets; Economic analysis of markets II; Welfare dynamics; Market structure; Market failure; Market mechanisms - Alignment of demand and supply; Agent behaviour; Price dynamics.

MODULE II FOOD & AGRICULTURAL MACROECONOMICS 9

The demand side: food consumption; The supply side: agricultural production; Overview of the global food markets; International agricultural trade; Economic theories; International agricultural trade practices; Case studies.

MODULE III AGRIBUSINESS

The role of agribusiness; Agribusiness management and organisation; Geography, demography and market locations; Agricultural marketing; Agricultural marketing I; Agricultural marketing II; Case studies.

MODULE IV STRATEGIC MARKET BEHAVIOUR 9

Related markets; Agricultural input markets; Financial markets; Natural resource and environmental markets; Strategic behaviour under risk and uncertainty; Risk and uncertainty I; Risk and uncertainty II; Review + final exercise.

MODULE V FOOD PRODUCTION CONTROL 9

Introduction, forecasting various standards – standard yield, yield testing, standard recipe, standard portion size; Records maintained – stores issued note, indent cum issue note, inter departmental transfers, production sheet, food cost sheet Meat costing. Food & Beverage service & Control: Food sales

– service charge, cash sales, credit sales, credit to residential guests Room service Banquet sales KOT, Bills, ECR, POS & Cashier summary sheet Special concerns for control in beverage sales.

L – 45; Total Hours –45

TEXT BOOKS:

1. Peter Jones with Paul Merricks. The management of foodservice operations, Cassell, 1994
2. David Foskett, Victor Ceserani, Theory of Catering, 11th Edition, Dynamic Learning, 2007.

COURSE OUTCOMES:

CO1: Plan, prepare and present quality food and beverage for a variety of hospitality environments.

CO2: Use marketing concepts, market research, social networks, sales and revenue management strategies, relationship management skills and product knowledge to promote and sell hospitality services, products and guest experiences.

CO3: Apply business and revenue models as well as basic accounting, budgeting, financial and administration skills to support the effective management and operation of a variety of organizations delivering hospitality services and products.

CO4: Comply with relevant organization and workplace systems, processes, policies, standards, legal obligations and regulations.

CO5: Comply with relevant organization in food production control

Board of Studies (BoS) : 9thBoS of SLS held on 20.08.2022

Academic Council: 19th Academic Council meeting held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of techniques taught we can understand the genetic basis of underlying diseases, that will help in good heath and well being.

SDG15: Life on Earth

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OPEN ELECTIVE COURSES

OEEY 701	ANALYTICAL TECHNIQUES	L	T	P	C
SDG: 6, 7		3	0	0	3

COURSE OBJECTIVES:

To make the students to understand the

COB1: basics in data analysis

COB2: basics and principles in volumetric and gravimetric analysis

COB3: types and principles of electro analytical methods

COB4: principles and analysis of spectroscopic techniques

COB5: the principle and methods in chromatography and thermal analysis

MODULE I DATA ANALYSIS 9

Precision and accuracy, Classification of errors, methods of minimization and elimination of errors Mean and standard deviation; absolute and relative errors; students t-test, F-test, linear regression for deriving calibration plots, covariance and correlation coefficient

Statistics for analytical experimentation: Probability, Regression analysis, Data analysis and signal enhancement.

MODULE II VOLUMETRIC METHODS OF ANALYSIS 9

Different methods of expressing concentration terms, Difference between titrimetic and volumetric analysis, Types and roles of indicators - Principle and reactions involved in neutralization, precipitation, complexometric and redox titrations, calculations involving stoichiometry – for all types of systems - Gravimetric analysis (volatilisation and precipitation methods)

MODULE III ELECTROANALYTICAL METHODS 9

Types of electrodes - Conductometric Titrations - Potentiometric titrations - pH-metry and ion-selective electrodes - Amperometric titrations - Coulometric Titrations, DM Electrode - polarography - electrogravimetry - voltammetry, cyclic voltammetry, impedance studies - Electrochemical sensors, ISFETs, CHEMFETs.

MODULE IV SPECTROPHOTOMETRIC TECHNIQUES 9

Quantitative applications of Colorimetric analysis – UV-Visible spectrophotometry – *Atomic absorption spectroscopy* (*AAS*) - atomic emission spectroscopy (AES), *Flame photometry*, ICP-AES - Fluorescence

spectroscopy, Stern Volmer Equation and quantum yield calculation.

MODULE V CHROMATOGRAPHIC TECHNIQUES AND THERMAL METHODS 9

Chromatography**:** Paper, TLC and column Chromatography – Detectors in Chromatography - GC, HPLC, (hyphenated techniques GC/MS, LC/MS) and GPC -– ion exchange chromatography – Electrochromatography**:** Capillary electrophoresis and gel electrophoresis

Thermal analytical techniques: TGA, DTA, DSC, DMA – Chemisorption Techniques – TPD, TPO, TPR, TPS.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. Skoog D.A., Holler F.J. and Nieman T.A., Principles of Instrumental Analysis, 5th Edition, Harcourt College Publication., Singapore, 1998.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the numerical data without error

CO2: perform the volumetric and gravimetric analysis of chemical compounds and interpret the result

CO3: perform the electro analytical titrations and analyse the result

CO4: identify the appropriate spectral technique and do the spectral analysis and interpret the data

CO5: perform the chromatographic techniques and separate the compounds

Board of Studies (BoS):
12th BoS of Chemistry held on 22.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M		M											
CO2	H	M		M											
CO3	H	M		M		H									
CO4	H	M		M	M	H									
CO5	H	M		M	M	H									

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 6: Clean Water & Sanitation
SDG 7: Affordable and Clean Energy

Statement: Through various analytical methods, innovative, cheap and affordable materials can be developed and can be employed in the area of clean water, sanitation and energy

OEEY 702 ARTIFICIAL INTELLIGENCE AND IOT L T P C

SDG: 8 3 0 0 3

COURSE OBJECTIVES:

COB1: To learn the working of intelligent agents.

COB2: To study the various search techniques and optimization of search.

COB3: To represent knowledge in first order logic**.**

COB4: To know the fundamentals of IoT.

COB5: To learn the IoT architecture and protocol stack.

MODULE I ARTIFICIAL INTELLIGENCE INTRODUCTION 9

Artificial Intelligence Foundations - Artificial Intelligence History - Agents and Environments - Structure of Agents - Problem-Solving Agents - Search Algorithms - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Heuristic Functions.

MODULE II SEARCH OPTIMIZATIONS 9

Local Search and Optimization Problem - Continuous Spaces - Nondeterministic Actions - Partially Observable Environments - Online Search Agents and Unknown Environments - Constraint Satisfaction Problems – Backtracking Search – Adversarial Search and Games - Alpha Beta Search.

MODULE III KNOWLEDGE REPRESENTATION 9

Knowledge Based Agents – Propositional Logic – First Order Logic – Inference in First Order Logic – Forward Chaining – Backward Chaining.

MODULE IV IOT FUNDAMENTALS 9

Fundamentals of IoT – Characteristics of IoT – IoT architecture and Components – Logical Design of IoT – Communication Models – IoT Communication APIs.

MODULE V IOT ARCHITECTURE AND PROTOCOLS 9

Structure – Objectives – Three layer and Five Layer Architecture – Cloud and Fog based Architecture – IoT Network Protocol Stack - IoT Technology Stack – Case Study – Applications of AI in IoT.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2020. ISBN: 978-0134610993.

2. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey, Joseph Kofi Wireko, Kamal Kant Hiran, Internet of Things (IoT): Principles, Paradigms and Applications of IoT, BPB Publications, First Edition, 2020, ISBN: ISBN: 978-9389423365.

REFERENCES:

1. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, Artificial Intelligence (AI): Recent Trends and Applications, CRC Press, 2021, ISBN: 978-0-367-43136-5.
2. Vlasios Tsiatsis, Stamatis Karnouskos, Jan, Internet of Things: Technologies and Applications for a New Age of Intelligence, 2nd Edition, Academic Press, 2019, ISBN: 978-0-12-814435-0

COURSE OUTCOMES: The student will be able to

- Identify the suitable search algorithms for solving problems.
- Employ AI adversarial game search techniques while evaluating the application of more real world problems.
- Use first order logic for wide variety of applications, from planning and diagnosis to knowledge representation and reasoning.
- Apply the technologies, standards, and protocols that are best suited for low-level sensor nodes.
- Determine the most appropriate IoT Devices and Sensors based on case Studies.

Board of Studies (BoS) :
21st BoS of CSE held on 27.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	H	M	H	L	M	-	L	-	-	L	-	M	H	M
CO2	H	H	H	L	M	-	L	-	-	L	-	H	M	H
CO3	H	H	H	L	L	-	-	-	-	L	-	L	M	H
CO4	H	M	H	L	L	-	-	-	-	-	-	M	M	H
CO5	H	H	H	L	L	-	-	-	M	-	M	M	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Statement: The objective of AIoT is to improve human-machine interactions, IoT operations and data management and analytics.

OEEY 703	BIOMATERIALS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To enable the students understand importance of and properties of Biomaterials

COB2: To familiarize the students with different orthopaedic materials.

COB3: To understand different cardiovascular materials.

COB4: To help students study about materials in opthalmology

COB5: To make the students understand applications of various biomaterials

MODULE I BIOLOGICAL PERFORMANCE OF MATERIALS 9

Biocompatibility- Introduction to the biological environment – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – Host response: the inflammatory process - coagulation and hemolysis- approaches to thrombo- resistant materials development.

MODULE II ORTHOPAEDIC MATERIALS 9

Bone composition and properties - temporary fixation devices - joint replacement – Biomaterials used in bone and joint replacement: metals and alloys – Stainless steel, cobalt based alloys, titanium based materials – Ceramics: carbon, alumina, zirconia, bioactive calcium phosphates, bioglass and glass ceramics – polymers: PMMA, UHMWPE/HDPE, PTFE – Bone cement – Composites.

MODULE III CARDIOVASCULAR MATERIALS 9

Blood clotting – Blood rheology – Blood vessels – The heart – Aorta and valves – Geometry of blood circulation – The lungs - Vascular implants: vascular graft, cardiac valve prostheses, cardiac pacemakers – Blood substitutes – Extracorporeal blood circulation devices.

probability-internal conversion- nuclear isomerism.

MODULE IV DENTAL MATERIALS 9

Teeth composition and mechanical properties – Impression materials – Bases, liners and varnishes for cavities – Fillings and restoration materials – Materials for oral and maxillofacial surgery – Dental cements and dental amalgams – Dental adhesives.

MODULE V MATERIALS IN OPTHALMOLOGY 9

Biomaterials in ophthalmology – Viscoelastic solutions, contact lenses, intraocular lens materials – Tissue grafts – Skin grafts – Connective tissue grafts – Suture materials – Tissue adhesives – Drug delivery: methods and materials – Selection, performance and adhesion of polymeric encapsulants for implantable sensors-biomemtic materials-Technology from nature.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Sujata V. Bhat. Biomaterials, Narosa Publication House, New Delhi, 2002.
2. Jonathn Black. Biological Performance of Materials: Fundamentals of biocompatibility, Marcel Dekker Inc, New York, 1992.
3. D.F.Williams (editor). Materials Science and Technology: A comprehensive treatment, Volume 14. Medical and Dental Materials, VCH Publishers Inc, New York, 1992.
4. F.Silver and C.Doillon. Biocompatibility: Interactions of Biological and implantable materials. Volume I Polymers, VCH Publishers Inc, New York, 1989.
5. L.L.Hench and E.C.Ethridge. Biomaterials: An Interfacial Approach, Academic Press, 1982.
6. Joon Park, R. S. Lakes, Biomaterials. An Introduction, Springer, third edition, 2010. Springer

COURSE OUTCOMES:

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

CO1: importance and properties of biomaterial..

CO2: different classes of orthopaedic materials

CO3: different types of cardiovascular materials.

CO4: various types of materials used in ophthalmology.

CO5: applications of various biomaterials

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 30.6.22	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 704	BIOMEDICAL INSTRUMENTATION	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the human physiological systems.

COB2: To know the different aspects of biosignal acquisition.

COB3: To understand the basics in biopotential recorders.

COB4: To know the importance methods, instruments available for biomedical field.

COB5: To analyze the special biomedical instrumentation systems.

MODULE I HUMAN PHYSIOLOGICAL SYSTEMS 9

Cells and their structure – Nature of Cancer cells – Transport of ions through the cell membrane – Resting and action potentials – Bio-electric potentials – Nerve tissues and organs – Different systems of human body. Biopotential Electrodes and Transducers Design of Medical instruments – components of the biomedical instrument system – Electrodes – Transducers.

MODULE II BIOSIGNAL ACQUISITION 9

Physiological signal amplifiers – Isolation amplifiers – Medical preamplifier design – Bridge amplifiers – Line driving amplifier – Current amplifier – Chopper amplifier – Biosignal analysis – Signal recovery and data acquisition – Drift Compensation in operational amplifier – Pattern recognition – Physiological Assist Devices. Pacemakers – Pacemakers batteries – Artificial heart valves – Defibrillators – nerve and muscle stimulators Heart – Lung machine – Kidney machine.

MODULE III BIOPOTENTIAL RECORDERS 9

Characteristics of the recording system – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electroethinogrphy (ERG) and Electroculography (EOG) – Recorders with high accuracy – recorders for OFF line analysis.

MODULE IV OPERATION THEATRE EQUIPMENT 9

urgical diathermy- shortwave diathermy – Microwave diathermy – Ultrasonic disathermy – Therapeutic effect of heat – Range and area of irritation of different techniques – Ventilators – Anesthesia machine – Blood flowmeter – Cardiac

Output measurements – Pulmonary function analyzers – Gas analyzers – Blood gas analyzers – Oximeters – Elements of intensive care monitoring.

MODULE V SPECIALISED MEDICAL EQUIPMENTS 9

Blood Cell counter – Electron microscope – Radiation detectors – Photometers and colorimeters – digital thermometer – audiometers – X-rays tube – X-ray machine – image intensifiers – Angiography – Application of X-ray examination. Safety instrumentation: Radiation safety instrumentation – Physiological effects due to 50Hz current passage – Microshock and macroshock – electrical accident Hospitals – Devices to protect against electrical hazards – Hospitals architecture.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Arumugam M., Biomedical Instrumentation, Anurada Agencies Publishers, 1992.
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Third Edition, Tata McGraw-Hill Education, 2014.
3. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Cengage Learning Publisher, 2010.
4. Gromwell L., Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second Edition, Prentice Hall, 1980.

COURSE OUTCOMES:

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

CO1: the human physiological systems.

CO2: the different aspects of biosignal acquisition.

CO3: different biopotential recorders such as EEG, ECG, EMG, EOG

CO4: biomedical instruments involved in advanced operation theatres

CO5: the application of biomaterials towards specialized medical equipment such as electron microscope and radiation detectors

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 30.6.22	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 705	BIOPHOTONICS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To know the role of light and its interaction in the cells and tissues.

COB2: To understand the different imaging techniques for the biological systems.

COB3: To know the concepts of spectroscopy in biological applications.

COB4: To understand the optical force spectroscopy.

COB5: To understand the role of Biophotonic materials in applications.

MODULE I INTERACTION OF LIGHT WITH BIOLOGICAL SYSTEMS 9

Interaction of light with cells, tissues, nonlinear optical processes with intense laser beams, photo-induced effects in biological systems.

MODULE II IMAGING TECHNIQUES 9

Imaging techniques: Light microscopy, wide-field, laser scanning - confocal, multiphoton, fluorescence lifetime imaging, FRET imaging - Frequency-Domain lifetime imaging. Cellular Imaging - Imaging of soft and hard tissues and other biological structures.

MODULE III SINGLE MOLECULE SPECTROSCOPY 9

Single molecule spectroscopy: UV-VIS spectroscopy of biological systems, single molecule spectra and characteristics – IR and Raman spectroscopy and Surface Enhanced Raman Spectroscopy for single molecule applications.

MODULE IV OPTICAL FORCE SPECTROSCOPY 9

Optical Force Spectroscopy: Generation optical forces – Optical trapping and manipulation of single molecules and cells in optical confinement - Laser trapping and dissection for biological systems - single molecule biophysics, DNA protein interactions.

MODULE V BIOSENSORS 9

Biosensors, Principles- DNA based biosensors – Protein based biosensors– materials for biosensor applications- fabrication of biosensors.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Prasad. P.N., Introduction to Biophotonics, John Wiley & Sons, 2003
2. Michael P. Sheetz, Laser Tweezers in Cell Biology (Methods in Cell Biology), Vol.55, Academic Press Publishers, 1997.
3. Ranier .W, Nanoelectronics and Information Technology, Wiley Publishers, 2012.
4. Drexler. K.E., Nanosystems: Molecular Machinery, Manufacturing and Computation, Wiley Publishers, 1992.

COURSE OUTCOMES:

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

CO1: Make clear insights into the applications of light interaction with biological systems.

CO2: Compare different imaging techniques

CO3: Understand and analyse the various spectroscopic techniques used in biological system.

CO4: Effectively grasp the usage of the optical force spectroscopy.

CO5: Get clear ideas and communicate about the importance of use of spectroscopy in design of bio-photonic devices.

Board of Studies (BoS) : BOS of Physics was held on 30.6.22

Academic Council: 19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 706	DATA SCIENCE AND MACHINE LEARNING	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

CO1: To understand the needs of machine learning in Real Time.

CO2: To acquire knowledge about the data science in machine learning.

CO3: To study the Monte Carlo Sampling and processing.

CO4: To explore knowledge about real-time data analysis using various models.

CO5: To understand the deep learning.

MODULE I INTRODUCTION 9

Introduction to Artificial Intelligence - Machine Learning – Types of Machine Learning - Data preprocessing - Noise Removal - Data Transformation - Normalization - Importing, Summarizingand Visualizing Data – Statistics-Visualizing Data-Plotting Qualitative Variables and Quantitative Variables- Data Visualization in a Bivariate Setting

MODULE II MACHINE LEARNING ALGORITHMS 9

Introduction to Supervised and Unsupervised Learning-Linear Regression - Single Variable – Multivariate –Logistic - Naive Bayes - Decision Tree - Neural Network -Single Layer Perceptron - Multilayer BPN- Training and Test Loss-Statistical Learning-Estimating Risk-Modeling Data-Multivariate Normal Models-Bayesian Learning

MODULE III SAMPLING AND UNSUPERVISED LEARNING 9

Unsupervised Learning Algorithm -Clustering - Monte Carlo Sampling-Resampling-Markov Chain Monte Carlo-Monte Carlo Estimation-Monte Carlo for Optimization-Simulated Annealing – Cross-Entropy Method-Splitting for Optimization -Noisy Optimization-Risk and Loss in Unsupervised Learning – Expectation-Maximization (EM) Algorithm-EM Algorithm for Mixture Models-K-Means – KNN - Hierarchical

MODULE IV REGRESSION ANALYSIS AND REGULARIZATION 9

Linear Regression-Analysis via Linear Models-Model Selection and Prediction – Cross-Validation and Predictive Residual Sum of Squares-In-Sample Risk and Akaike Information Criterion-Inference for Normal Linear Models -Nonlinear Regression Models-Modeling Regularization-Reproducing Kernel Hilbert Spaces- Smoothing Cubic Splines- Gaussian Process Regression - Graphical Models - Bayesian Networks

MODULE V ADVANCED LEARNING 9

Semi-supervisory Learning - Reinforcement Learning Algorithm – Feed-Forward Neural Networks -Back-Propagation – QLearning-Methods for Training- Steepest

Descent- Levenberg–Marquardt Method - Limited-Memory BFGS Method- Adaptive Gradient Methods-Simple Polynomial Regression -Image Classification

L – 45 ; TOTAL HOURS – 45

REFERENCES:

1. Alex Smola, S.V.N. Vishwanathan, Introduction to Machine Learning, Cambridge University Press, 2008.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Second Edition, Chapman & Hall/CRC, 2014.
3. Kroese, Dirk P., et al. Data science and machine learning: mathematical and statistical methods. Chapman and Hall/CRC, 2019.

COURSE OUTCOMES:

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

CO1: pre process the data

CO2: identify the suitable machine learning algorithm and apply the same to solve the given problem.

CO3: explain risk analysis and optimization algorithms.

CO4: apply the suitable regression method and regularization of data.

CO5: explore the applications of advanced learning.

Board of Studies (BoS): 17th BoS of IT held on 28.02.2023

Academic Council: 20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5
CO1	M	L			L
CO2	M	L		M	
CO3	L	L	L		L
CO4	M	L	L	H	
CO5	L	H	L		H

Note: L - Low Correlation M -Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work.

Statement: The Learning algorithms helps to design and develop solutions for solving real world application in any engineering domain.

OEEY 707	ELECTRIC VEHICLE AND BATTERY STORAGE TECHNOLOGY	L	T	P	C
SDG:8,9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To study the concept of electric vehicles

COB2: To get familiarized with EV and PHEV Energy Storage Systems

COB3: To learn the basics of various electric drive trains

COB4: To study about sensors and electric vehicle control

COB5: To study about electric vehicle and its environmental impact.

MODULE I INTRODUCTION TO ELECTRIC VEHICLE (EV) 9

A Brief History -Technology, benefits and challenges in comparison with IC engine - EV classification and electrification levels - degree of hybridization - Concept of Hybrid Electric Vehicle (HEV) – Working Principle of an HEV drive train - concept of electric, hybrid electric and plug-in hybrid electric vehicles – HEV drive train topologies - plug-in HEV drive train topologies.

MODULE II EV AND PHEV ENERGY STORAGE SYSTEMS 8

Battery parameters - Types of Battery : Lithium – Nickel – Sodium – Zinc – Lead Acid - Coin cell - Rechargeable Battery sealing – Ideal model, Linear model, Thevenin model – Battery Cell Voltage Equalization – Onboard power electronics battery management – Equalizer chaining method. Electrical Modeling of Ultra capacitors, Flywheel Energy Storage Systems and Renewable Fuel Cell Power Sources.

MODULE III FUEL CELL AND HYBRID ELECTRIC VEHICLE DRIVE TRAIN 10

Component Stage Based Efficiency Analysis of Series and Parallel HEV Drive Trains - Varied Driving Patterns and Regenerative Braking Efficiency Analysis - Overall Electric Drive Train Efficiency Analysis - Fuel Cell HEV: Modeling and Control - Power Electronics Interface of Fuel Cell and Traction System - Concept of Fuel Cell Plug-in HEV (FC-PHEV).

MODULE IV SENSORS AND VEHICLE CONTROL 11

Introduction, Basic Sensor Arrangement, Types of Sensors, Oxygen Sensor, Cranking Sensor, Position Sensor, Engine Oil Pressure Sensor, Linear and Angle Sensor, Flow Sensor, Temperature and Humidity Sensor, Gas Sensor, Speed and Acceleration Sensor, Knock Sensor, Torque Sensor, Yaw Rate Sensors, Tire Pressure Sensor, Actuators.

Protocols: In vehicle Networking (IVN) - Local Interconnect Network(LIN) – Control Area Network (CAN) – Media Oriented System Transport (MOST) and FlexRay - Wireless Access in Vehicular Environment (WAVE).

MODULE V ENVIRONMENTAL IMPACT AND ENERGY MANAGEMENT 6

Vehicle pollution in context - alternative and sustainable energy used via the grid hybridization - V2G, G2V, V2B, V2H - energy consumption in braking and regeneration - brake system of EVs and HEVs.

L – 45; TOTAL HOURS:45

TEXT BOOKS:

1. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
2. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2nd edition, 2015.
3. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 3rd Edition,2018.

REFERENCES:

1. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
3. Tom Denton, “Electric and Hybrid Vehicles” Routledge Publishers, 1st edition, March 2016.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: identify the opportunities and challenges of advances in electric vehicles

CO2 : model battery system for any EV

CO3: model and choose a suitable drive scheme suitable for developing an EV

CO4: compute the performance parameter of sensors, actuators and to apply suitable technique for automotive communication

CO5: choose proper energy consumption method to integrate with grid

Board of Studies (BoS) : 18th BoS of EEE held on 10.02.2023

Academic Council: 20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L	H	L	L	M	L	L	H	L	M	M	L	H	L
CO2	H	L	L	L	L	L	H	L	L	L	L	L	L	H
CO3	L	H	M	L	M	L	L	L	M	L	M	L	M	M
CO4	M	L	H	L	L	L	M	L	H	L	L	H	L	L
CO5	L	L	L	L	H	L	L	L	L	L	H	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas to promote economic growth.

SDG No. 9 Industry, innovation and infrastructure

Statement:

The development of zero emission electric vehicles will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

OEEY 708	GREEN BUILDING AND ENERGY	L	T	P	C
SDG: 11	MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to impart knowledge on

COB1: the concept of green design

COB2: the basics of green design strategies

COB3: the elements of green building

COB4: the concept of green building materials

COB5: the concept of energy management.

MODULE I BASIC CONCEPTS 8

Green Design concepts and definitions - sustainability begins with climate - recent upsurge in the green building movement -incentives for building green - incentives and tax deductions-green building programs -defining sustainable communities-emerging directions- liability - spectacular landmarks

MODULE II DESIGN STRATEGIES 9

Conventional versus Green Delivery Systems- green design strategies- The Integrated Design Process (IDP) -the green-building project delivery process- the integrated multidisciplinary project team - design process for high-performance buildings -sustainable site selection-general considerations- site selection - development density and community connectivity –brown field redevelopment - alternative transportation -site development storm water design-heat-island effect - light-pollution reduction

MODULE III ELEMENTS OF GREEN BUILDING 9

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency- Commissioning process – fundamental commissioning –retro commissioning -enhanced commissioning

MODULE IV GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites-low-emitting materials -adhesives, finishes, and sealants -paints and coatings- flooring systems- earthen building materials- building reuse -materials reuse- construction waste management-recycled materials regional materials- rapidly renewable materials- bamboo-cork - insulation- linoleum straw-

bale construction-wheat board - use and selection of green office equipment - certified wood- life-cycle assessment of building materials and products

MODULE V ENERGY MANAGEMENT 10

Energy Management – Definitions and significance – objectives – Characterising of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems- Low Energy Approaches to Water Management. Management of Solid Wastes.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Osman Attmann., “Green Architecture Advanced Technologies and Materials”, McGraw Hill, 2010.
2. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.
3. Moncef Krarti, “Energy Audit of Building Systems: an Engineering approach” CRC Press, LLC, Florida 2000.
4. “Alternative Building Materials and Technologies”. K.S.Jagadish, B.U. Venkataramareddy and K. S. Nanjundarao New Age International, 2007.

REFERENCES:

1. Doty S. and W. C. Turner, “Energy Management Hand book”, Fairmont Press, 2009.
2. LEED - Practices, Certification and Accreditation Handbook”. Sam Kubba, Butterworth-Heinemann, 2009.

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: describe the basics of green design concept.

CO2: explain the concepts of green design strategies.

CO3: illustrate the elements of green building.

CO4: summarize the different green building materials.

CO5: describe the concept of energy management.

Board of Studies (BoS) : Academic Council:

17th BOS of CE held on 10.08.2022 20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	L	-	-	L	H	-	-	-	-	-	L	-	M
CO2	-	-	L	-	-	L	H	-	-	-	-	L	L	-	M
CO3	-	-	L	-	-	L	H	-	-	-	-	-	L	-	M
CO4	-	-	M	-	-	L	H	-	-	-	-	L	L	-	M
CO5	-	-	L	-	-	M	H	-	-	-	-	-	L	-	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The understanding of basics of green concepts, materials, energy management and leads to the development of sustainable building

OEEY 709	INDUSTRY 4.0 AND APPLICATIONS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To describe the concepts, trends and the paradigm of Industry 4.0

COB2:To analyze the IoT technologies for practical IoT applications

COB3: To develop the ability to use Internet of Things related protocols and connectivity methods

COB4:. To elaborate the business issues in Industry 4.0.

COB5: To select the appropriate design concepts of Industrial IoT systems for various application

PREREQUISITES: Basic concepts in automation

MODULE I INTRODUCTION TO INDUSTRY 4.0 9

The Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

MODULE II ROAD TO INDUSTRY 4.0 & RELATED DISCIPLINES 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics, Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Support System for Industry 4.0, Cyber Security.

MODULE III DATA INFORMATION AND COLLABORATION 9

Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0

MODULE IV BUSINESS ISSUES IN INDUSTRY 4.0 9

Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

MODULE V INDUSTRY 4.0 APPLICATIONS 9

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer, 2017.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" A press, 2017.
3. Deepak Gupta, Victor Hugo C. de Albuquerque, Ashish Khanna, Purnima Lala Mehta, "Smart Sensors for Industrial Internet of Things: Challenges, Solutions and Applications", Springer, 1st Edition, 2021.
4. Francis daCosta, “Rethinking the Internet of things: A Scalable Approach to Connecting Everything”, Apress, 2014.

REFERENCES:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2016.
2. Gary Smart, "Practical Python Programming for IoT: Build advanced IoT projects using a Raspberry Pi 4, MQTT, RESTful APIs, Web Sockets, and Python 3", Pckt Publishing, 2020

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: apply the basic concepts and principles of Industry 4.0

CO2:identify, formulate and solve engineering problems using Industrial IoT

CO3:describe basics of cloud computing with IoT capability

CO4:discuss the challenges of the industry through IoT techniques

CO5:develop a domain specific IoT system

Board of Studies (BoS) :	**Academic Council:**
24th BOS of ECE held on 08.02.2023.	20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO2	M	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO3	M	M	L	M	L	L	L	L	L	L	L	L	H	H	H
CO4	H	M	M	M	L	L	L	L	L	L	L	L	H	H	H
CO5	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation,

Statement: Able to apply the theoretical concepts for the various application in Industry 4.0

OEEY 710	NANOTECHNOLOGY AND	L	T	P	C
SDG: 6,7,9,15	CATALYSIS	3	0	0	3

COURSE OBJECTIVES:

To make the student conversant with

COB1: basic knowledge on nanoscience and nanotechnology which includes the exotic properties of materials at nanoscale including various techniques for the processing of nanomaterials

COB2: various techniques available for the characterization of nanostructured materials

COB3: applications in selected fields and impacts of nanotechnology in ecosystem

COB4: Impart the basic concepts involved in catalytic processes.

COB5: Understand the importance of heterogeneous catalysis.

MODULE I INTRODUCTION AND PREPARATION OF NANOMATERIALS **9**

Introduction to nanomaterials, Properties of nanomaterials, Nanostructures: Zero-, One-, Two- and Three-dimensional structures, Surface Plasmon Resonance, Change of bandgap; Methods of preparation of nanomaterials, top-down approach and bottom-up: Chemical precipitation and coprecipitation; Sol-gel synthesis; Ball milling synthesis; lithography, Plasma Laser deposition (PLD) techniques, Thermolysis routes (Solvothermal, Hydrothermal and pyrolysis), Microwave assisted synthesis; Sonochemical synthesis; Electrochemical synthesis.

MODULE II CHARACTERIZATION TECHNIQUES **9**

Structural Characterization: X-ray diffraction, Scanning Electron Microscopy (SEM/HR-SEM/FE-SEM) with EDS, TEM (HR-TEM) and SAED analysis, Atomic force Microscopy (AFM). X-ray Photoelectron spectroscopy (XPS), Raman analysis. Introduction to advanced Scanning Probe Microscopy Techniques Scanning Tunnelling Mode (STM), Piezoelectric force microscopy (PFM). DLS and zeta potential analysis. BET surface area analysis, CHNSO micro analysis.

MODULE III APPLICATIONS AND ENVIRONMENTAL IMPACTS **9**

Current applications - Short-term Applications - Long - term Applications – Energy filed - solar cells, military battle suits. Biomedical applications – Photodynamic therapy in targeted drugs - quantum dot technology in cancer

treatment, MRI applications. Nanosensors: pH, heat, humidity, gas, toxic chemicals sensors and sensors for aerospace and defence – biosensors – water remediation - Environmental Impacts: toxicological health effects, relevant parameters in nanoparticles toxicology, integrated concept of risk assessment of nanoparticles.

MODULE IV CONCEPTS OF CATALYSIS 9

Acid-base catalysis – catalysis by transition metal ions and their complexes – supported transition metal complexes as catalysts – catalysis by enzymes – phase transfer catalysis - photocatalysis – adsorption – chemisorption on metals, metal oxides and semiconductors - kinetics of unimolecular and bimolecular surface reactions - Contact time - WHSV - time on stream - Catalyst deactivation and regeneration, TOF, TON.

MODULE V HETEROGENEOUS CATALYSTS 9

Metals, metal oxides, mixed metal oxides, supported metals, spinels, perovskites, super acids, hydrotalcites, zeolites and zeotypes (small, medium, large), shape selective catalysts, mesoporous materials (SBA, MCM, KIT, AlPOs, MOFs, COFs) Hydrothermal synthesis, sol-gel process, impregnation method, ion-exchange method - Operations in catalyst manufacture - drying, calcination, spray drying, Reactors- fixed bed and flow reactors.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.
2. G. Cao, Nanostructures and Nanomaterials –Synthesis, Properties and Applications, Imperial College Press, London, 2004.
3. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume 1, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004.
4. G. A. Ozin, A. C. Aresnault, L. Cadematriri, Nanochemistry: A chemical approach to nanomaterials, RSC Publishing, 2008
5. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanisms of Chemical Transformations, Macmillan Publishers India Limited, 2000.
6. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis

COURSE OUTCOMES:

The students will be able to

CO1: differentiate the nanomaterials based on their dimensions and acquire knowledge of various synthetic methods

CO2: understand the components of instrumental techniques of and characterization techniques for structural and properties of nanomaterials

CO3: select the appropriate nanomaterials for specific applications in the interested arena

CO4: Find the fundamentals of catalysis

CO5: Evaluate significance of heterogeneous catalysts.

Board of Studies (BoS):
12th BoS of Chemistry held on 22.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		L		M	H	H									
CO2	M			H	M	H									
CO3					H	M									
CO4															
CO5															

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 6: Clean Water and Sanitation
SDG 7: Affordable & Clean Energy
SDG 9 : Industry and Innovation
SDG 15 : Life on Land
Statement:
SDG 6, 7 & 9: Foundation to work in R&D of renewable energy and sensors sector and for teaching career.
SDG 15: R&D labs in API labs in the production novel materials for various applications

OEEY 711	PROJECT MANAGEMENT	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the concepts of organizational project management.

COB2: To acquire knowledge on leadership in project management.

COB3: To gain knowledge in stakeholder management and program management

COB4: To familiarize with the project scope and time management

COB5: To be conversant with project execution, monitoring and closing.

MODULE I INTRODUCTION – ORGANIZATIONAL PROJECT MANAGEMENT L:9

Introduction to Organizational Project Management- Organizational Project Management Framework- Project Linkages to Strategic Management - Relationships between Portfolio, Program, and Project Management - Organizational Issues and Project Management.

MODULE II PROJECT MANAGEMENT - LEADERSHIP L:9

Importance of Leadership in Project Management-Roles and Responsibilities of a Project Manager-Leadership vs. Management-Project Management Leader's Portfolio-Technical Management skills -Project Entrepreneurship skills- Project Leadership skills

MODULE III PROJECT STAKE HOLDER MANAGEMENT AND PROGRAM MANAGEMENT L:9

Project Stakeholder Management-Stakeholders Identification and Assessment - Stakeholders vs. Project Lifecycle - Stakeholders and Interested Parties- Program Management - Program Characteristics - Programs vs Projects - Programs vs Portfolios

MODULE IV PROJECT SCOPEAND TIME MANAGEMENT L:9

Project Scope: Planning, Defining, Verification and Change control -Project Activity sequencing -Precedence diagram method- Arrow diagram method – Project Activity Time Estimation -Tools for Activity Time Estimation -Schedule development – Resource levelling heuristics

MODULE V PROJECT EXECUTION,MONITORING AND CLOSING L:9

Execution phase overview-Delegating tasks -Assessing project status - Foreseeing future challenges - Managing progress and timeline adjustments Project execution guidelines - Monitoring phase overview - Key Performance Indicators -Evaluating progress-Assessing work quality -Setting quality assurance procedures -Monitoring risks -Closing phase overview -Obstacles in the closing phase -Evaluating project performance-Final reports and managing records -Project closing guidelines

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Projects: Planning, Analysis, Financing, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015

REFERENCES:

1. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009
3. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition, Author& publisher - Project Management Institute 2017
4. Lean Project Management: Philip Small, Arkham Publishing Limited, March 2020

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1:Explain the concepts of organizational project management

CO2: Discuss the leadership in project management.

CO3: Elucidate the stakeholder management and program management

CO4: Explain project scope and time management

CO5: Describe project execution, monitoring and closing

Board of Studies (BoS) :
21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		L	M		H							M	L
CO2	L		M	L		L							L	H
CO3	M		M	H		L							H	M
CO4	L		L	L		M							L	M
CO5	L		M	L		L							H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The comprehensive understanding of Project management principles and techniques brings prosperity, create jobs, and build prosperous equitable societies across the country

OEEY 712	REAL TIME EMBEDDED SYSTEMS	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the fundamental concepts of real time systems

COB2: To analyze the various uniprocessor and multiprocessor scheduling mechanisms

COB3: To develop knowledge on programming languages and tools for real time systems.

COB4: To discuss the overview of real time data bases

COB5: To classify the fault tolerance and evaluation techniques in real time systems.

PREREQUISITES: Embedded Systems, Operating Systems

MODULE I INTRODUCTION : EMBEDDED SYSTEMS & REAL TIME SYSTEMS **9**

Introduction –Embedded system - characterizing real time system -Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling.

MODULE II PROGRAMMING LANGUAGES AND TOOLS **9**

Desired language characteristics – ADA language - Data typing – Control structures – Facilitating Hierarchical Decomposition- Packages- Run time Error handling – Overloading and Generics – Multitasking – Timing Specifications – Programming Environments – Run time support.

MODULE III REAL TIME DATABASES **9**

Basic Definition, Real time Vs General Purpose Databases- Main Memory Databases- Transaction priorities-Transaction Aborts-Concurrency control issues-Disk Scheduling Algorithms-Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

MODULE IV REAL TIME COMMUNICATION **9**

Communications media, Network Topologies, Protocols- contention based, Token based, Stop-and-Go multihop, Polled Bus, Hierarchical Round Robin Protocol, Deadline-Based Protocols, Fault Tolerant Routing.

MODULE V FAULT TOLERANT AND EVALUATION TECHNIQUES 9

Fault Tolerance Techniques – Fault Types – Fault Detection-Fault and Error containment- Redundancy- Reliability Evaluation Techniques – Software error models.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 2010.
2. Rajib Mall,”Real-time systems: theory and practice”, Pearson Education, 2007.

REFERENCES:

1. Xiaocong Fan, “Real-Time Embedded Systems: Design Principles and Engineering Practices”, Elsevier, 2015.
2. Albert M. K. Cheng, “Real-Time Systems: Scheduling, Analysis, and Verification“, Wiley publishers, 2003.
3. P. A. Laplante," Real-Time Systems Design & Analysis", Willey, 2011.
4. Qing Li, "Real Time Concepts for Embedded Systems", Elsevier, 2011.

COURSE OUTCOMES:

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

CO1: describe the characteristics of real time system.

CO2: apply scheduling algorithms based on the application.

CO3: discuss about the programming language characteristics and tools of real time systems.

CO4: choose the appropriate real time communication protocols.

CO5: analyze the fault tolerance and evaluation techniques in real time systems.

Board of Studies (BoS) : 24th BOS of ECE held on 08.02.2023.

Academic Council: 20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO2	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO3	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO4	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO5	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Statement: Understanding of the real time systems will bring practical knowledge on quality education.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: capable of promoting industrialization through the application of real-time system design principles.

OEEY 713 **ROBOTIC TECHNOLOGY** **L T P C**

SDG: 9 **3 0 0 3**

OBJECTIVES:

COB1: To study the basics of robotics technology.

COB2: To acquire knowledge about robot operating system.

COB3: To familiarize with robot assembly and aerial robots.

COB4: To learn about futuristic robots.

COB5: To know about the application of robots in various fields.

MODULE I INTRODUCTION L:6

Robot – Definition – Robot Anatomy – Co-ordinate Systems - Work envelope: Types and classification – Specifications – Pitch, Yaw, Roll, and Joint notations - Speed of motion - Pay load – Robot Parts and their functions – Need for robots.

MODULE II ROBOT OPERATING SYSTEM L:10

Master – Node – Topic – Messages – Subscriber – Publisher – Robot Operating System (ROS) packages – ROS file system – Services and actions – Custom publisher – Custom subscriber – ROS topic list and ROS topic information -ROS topic echo – ROS topic pub – Custom messages.

MODULE III ROBOT ASSEMBLY AND AERIAL ROBOTS L:12

Robotic assembly automation - Parts presentation methods - Assembly operations - Assembly system configurations - Design for robot assembly - Basics of aerial robots - Modelling and control of small Unmanned Aerial vehicles - Guidance and navigation of small range aerial robots.

MODULE IV FUTURE TECHNOLOGY L:9

Wheeled and legged Robot – Legged locomotion and balance – Arm movement, Gaze and auditory orientation control – Facial expression – Hands and manipulation – Sound and speech generation – Motion capture/Learning from demonstration.

MODULE V APPLICATIONS L:8

Implementation of Robots in Industries - Industrial application for material handling: machine loading and unloading, assembly, and inspection–Applications of robot in Arc welding, Spot welding, and Spray painting - Robots in Assembly operation, Cleaning and underwater applications –Applications of Robots in Agriculture, Mining, Defense, Nuclear, Medical, and Space.

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, PHI Learning.,2009.
2. Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, Phi Learning.,2009
3. YoonSeokPyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim, ROS Robot Programming.
4. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw Hill, 2001.

REFERENCES:

1. Bernard Hodges, “Industrial Robotics”, Second Edition, Jaico Publishing house, 1993.
2. Tsuneo Yohikwa, “Foundations of Robotics Analysis and Control”, MIT Press., 2003.
3. John J. Craig, “Introduction to Robotics Mechanics and Control”, Third Edition, Pearson,2008.
4. Craig.J. J, “Introduction to Robotics Mechanics and Control”, Addison-Wesley, 1999.Robotics Lab manual, 2007.

COURSEOUTCOMES:

After completion of the course, students should be able to

CO1: Explain the basics of robots.

CO2: Elucidate robot operating system.

CO3: Discuss about robot assembly and aerial robots.

CO4: Describe the future robot technology.

CO5: Explain the applications of robots.

Board of Studies (BoS) :
21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	M		M			M					L	L	H	M
CO2	M		M			M					L	L	H	M
CO3	M		M			M					L	L	H	M
CO4	M		M			M					L	L	H	M
CO5	M		M			M					L	L	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic knowledge of robot technology, its operating system, and future robot helps in developing robots for various applications.

OEEY 714 SOFT COMPUTING TECHNIQUES L T P C
SDG:8,9 3 0 0 3

COURSE OBJECTIVES:

COB 1: To enumerate the strengths and weakness of soft computing
COB2 To focus on the basics of neural networks
COB3: To learn the basics of fuzzy systems and hybrid Neurofuzzy systems
COB4: To emphasize the role of evolutionary computing algorithms
COB5: To learn the ANN, FIS and GA tool boxes for various soft computing applications.

MODULE I BASICS OF SOFT COMPUTING 8

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches- Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research.

MODULE II ARTIFICIAL NEURAL NETWORK 10

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications.

MODULE III FUZZY SYSTEMS 10

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications.

MODULE IV EVOLUTIONARY COMPUTING & ALGORITHMS 7

Overview of evolutionary computing – Genetic Algorithms and optimization – Genetic Algorithm operators – Genetic algorithms with Neural/Fuzzy systems – Variants of Genetic Algorithms– Population based incremental learning – Meta heuristic algorithms - Evolutionary strategies and applications.

MODULE V MATLAB TOOL BOX FOR SOFT COMPUTING 10

Artificial Neural Network (ANN) Toolbox - training and testing with different activation functions- controller design using ANN toolbox Fuzzy Inference System (FIS) Editor

and tool box- fuzzy controller design - Genetic Algorithm Toolbox - Application of ANN, FIS and GA tool box to various power system and control applications.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013

REFERENCES:

1. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
2. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009
3. Matlab Simulink Manual

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: enumerate the theoretical basis of soft computing

CO2 : explain the Neural network architecture and different learning rules

CO3: apply the fuzzy systems and hybrid Neurofuzzy systems

CO4: demonstrate the different evolutionary and metaheuristic algorithms

CO5: demonstrate the most appropriate soft computing technique for a given situation using MATLAB tool box.

Board of Studies (BoS) :
18th BoS of EEE held on 10.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L	H	L	L	M	L	L	H	L	M	M	L	H	L
CO2	H	L	L	L	L	L	H	L	L	L	L	L	L	H
CO3	L	H	M	L	M	L	L	L	M	L	M	L	M	M
CO4	M	L	H	L	L	L	M	L	H	L	L	H	L	L
CO5	L	L	L	L	H	L	L	L	L	L	H	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas to promote economic growth.

SDG No. 9 Industry, innovation and infrastructure

Statement:

The development of soft computing techniques will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

OEEY 715	STRUCTURAL INTERPRETATION OF	L	T	P	C
SDG: 4, 9	MATERIALS	3	0	0	3

COURSE OBJECTIVES:

To use the concepts (basic and advanced level) of analytical methods for structure elucidation of materials and the students will be trained for the

COB1: Interpretation of electronic spectral data of materials

COB2: Interpretation of magnetic spectral data of materials

COB3: Interpretation of structural and morphological data of materials

COB4: Interpretation of thermoanalytical data of materials

COB5: Interpretation of electrochemical and XPS data of materials

MODULE I ELECTRONIC DATA 9

UV-visible, fluorescence and phosphorescence: Characteristic absorption of simple chromophoric groups, conjugated/ aromatic/ ligand systems, metal complexes and materials. FT-IR and Raman: Characteristic group frequencies of organic, inorganic molecules and various materials (polymer, nano, semiconducting) Interpretation of organic and inorganic and hybrid materials using combination of the spectral data.

MODULE II MAGNETIC AND MASS DATA 9

Solid-state nuclear magnetic resonance spectroscopy: Compounds containing ^{1}H, ^{13}C, ^{19}F,^{27}Al, ^{29}Si, and ^{31}P nuclei. Electron spin resonance (ESR): Simulation of ESR spectra of paramagnetic species, spin dynamics in solid and liquid. Mass spectrometry: The production and analysis of positive ions, molecular ions, application of isotopic abundance measurements, fragmentation modes and rearrangement of ions. Interpretation of organic, inorganic compounds and materials using combination of the spectral data.

MODULE III STRUCTURAL AND MORPHOLOGICAL DATA 9

Fundamental theoretical framework for diffraction (XRD) and imaging methods (SEM, TEM and AFM) used in structural and compositional characterization of materials in solid, film state etc.

MODULE IV THERMOANALYTICAL DATA AND SURFACE AREA 9

Interpretation of Differential Thermal Analysis (DTA), Thermo-gravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC) data of various materials including inorganic complex, organic polymeric materials, composite, nano-composites etc; Surface area analysis; isotherms, types, BET surface area, pore dimensions, pore volume, etc.

MODULE V ELECTROCHEMICAL AND XPS DATA 9

Cyclic voltammetry for oxidation and reduction potentials, TAFEL polarization and Impedance spectroscopy for corrosion inhibitor behavior, chronoamperometry for charge or discharge of battery. X-ray photoelectron spectroscopy: Study the chemical composition and oxidation state of elements at the surface and interface. Applications of XPS in various arenas.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. R. S. Drago, Physical Methods for Chemists, W. B. Saunders,1992.
2. R. M. Silverstein, C. G. Bassler and T. C. Morril, Spectrophotometric Identification of Organic Compounds, 5th edition, Wiley, 1991.
3. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 3rd edition, McGraw Hill, 1980.
4. W. Kemp, Organic Spectroscopy, ELBS, 1979.
5. W. L. Jolly, The synthesis and characterization of inorganic compounds, Prentice-Hall, 1970.
6. John Wertz, Electron Spin Resonance: Elementary Theory and Practical Applications, Springer Science & Business Media, 2012.
7. R. F. Speyer, Thermal Analysis of Materials, CRC Press, 1994.
8. P.J. Goodhew, J. Humphreys and R. Beanland, Electron Microscopy and Analysis, Taylor & Francis, 2001.
9. John F Watts, John Woistenhoime, An introduction to surface analysis by XPS and AES, John Wiley and Sons, 2nd edition, 2003.
10. James, B. Condon, Surface Area and Porosity Determinations by Physisorption Measurement and Theory, Elsevier, 1st edition, 2006.

COURSE OUTCOMES:

The students will be able to

CO1: Interpret electronic spectral data of materials

CO2: Interpret magnetic spectral data of materials

CO3: Interpret structural and morphological data of materials

CO4: Interpret thermo analytical data and porous nature of materials

CO5: Interpret electrochemical and XPS data of materials

Board of Studies (BoS):

12th BoS of Chemistry held on 2207.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		H	M	H									
CO2	H	M		H	M	L									
CO3	H	L		H	M	M									
CO4	H	L		H	M	H									
CO5	H	L		H	M	L									

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Quality Education
SDG 9: Industry and Innovation

Statement:
SDG9: Foundation to work in R&D laboratory, chemical industry, independent researcher and for teaching career.
SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities.