Course Title:	**EMERGING APPLICATIONS OF BIOSENSORS**		
Course Code:	BETCK105G/205G	CIE Marks	50
Course Type (Theory/Practical /Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	3 hrs of Theory
Total Hours of Pedagogy	40 hours	Credits	03

Course objectives

1. To learn the Fundamentals of biosensors.
2. To acquaint the student with design and construction of biosensors.
3. To expose the students to recent advances in application of biosensors in health, environment, agriculture and food industry.

Teaching-Learning Process

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Include traditional teaching learning process such as Chalk and Talk using writing boards.
2. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.
3. Collaborate with students how tools are applied to solve biological problems.
4. Integrate real time case studies in various scientific tools used.
5. Reflective approaches on analysing how and why the tools are used in self-reflected or published data.
6. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-1 (8)

INTRODUCTION TO BIOSENSORS

Introduction to biosensor, General components of biosensor, Biomolecules in biosensors such as enzyme, DNA, antigen antibody, protein, Classification of biosensors based on principle: amperometric, potentiometric biosensors, optical, acoustic, piezoelectric, and calorimetric biosensors, scope of biosensors and its limitations.

Module-2 (8)

BASIC DESIGN AND TRANSDUCER

Design Considerations: calibration, dynamic Range, signal to noise, sensitivity, selectivity, Interference recognition. Transduction membrane protein sensors: ion channels, Types of Transducer, Optical;Fiber Optic, ECL, Surface Plasmon Resonance, Electro chemical; FET, Impedance, Piezoelectric;Cantileaver,

Module-3(8)

APPLICATIONS OF BIOSENSORS IN HEALTH AND ENVIRONMENT

Biosensors and diabetes management, Microfabricated biosensors and point-of-care diagnosticssystems, Noninvasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Biosensor in cancer and HIV early diagnosis.

Module-4(8)

APPLICATIONS OF BIOSENSORS IN FOOD AND AGRICULTURE INDUSTRY

Detection of product content, allergic components, pathogens, pesticide residues. Monitoring of raw material conversions. Detection of crop diseases, pathogens in plants, Detection of soil nutrients, pesticide and its residual detection.

Module-5 (8)

APPLICATIONS OF NANOMATERIALS IN BIOSENSORS

Nano Materials in biosensors; Carbon based Nano Material, Metal oxide and nano particle, Quantumdots, Role of nano material in Signal Amplifications, Detection and Transducer Fabrication

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Classify types of biosensors based on principle
CO2	Able to differentiate different types of transducers based on theirphysicochemical characteristics
CO3	Apply bio sensing techniques in health, environment, agriculture and food industry.
CO4	Use biomaterial and nanomaterials in biosensors for signal amplification, Detection and Transducer Fabrication

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

Three Tests each of 20 Marks**;**

- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 40 Marks.

  If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill development activities etc then the evaluation method shall be one.

Total CIE marks (out of 100 marks) shall be scaled down to 50 marks**Semester End Examination(SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks.
- Students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

Text Books:

1. Jeong-Yeol Yoon,Introduction to Biosensors, Springer-Verlag New York Ed. 2016
2. Mohammed Zourob,Recognition Receptors in Biosens; Publisher: Springer-Verlag New York Ed. 2010

Reference Books:

1. Zvi Liron,Novel Approaches in Biosensors and Rapid Diagnostic Assays; Publisher: Springer US Ed..2001
2. Pierre R. C, and Loïc J.B,Biosensor Principles and Applications, , CRC Press, 2019

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=kQ6CY1qpGjY
- https://nptel.ac.in/courses/102101054
- https://onlinecourses.nptel.ac.in/noc20_ph13/preview
- https://onlinecourses.nptel.ac.in/noc22_ph01/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- AV presentation by students (on specific topics).
- Discussion of case studies based on research findings.
- Model making and Poster presentations

COs and POs Mapping (Individual teacher has to fill up)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	2			2		2					
CO2	2	2			2		2					
CO3	3	2			2		2					
CO4	3	2			2		2					

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped