COURSE TITLE	**TRANSCRIPTOMICS**
COURSE CODE	**01CB0505**
COURSE CREDITS	**3**

Objective:

1 The course aims to foster an appreciation for the role of transcriptomics in advancing research and innovations in fields such as biotechnology, medicine, and agriculture, preparing students for careers that require expertise in genomic technologies.

Course Outcomes: After completion of this course, student will be able to:

1 Apply core principles of transcriptomics to interpret gene expression mechanisms.
2 Develop practical skills in using transcriptomics technologies such as RNA-Seq and microarrays.
3 Design transcriptomics experiments to address relevant biological questions.
4 Analyze sequencing datasets using insilico approaches.
5 Evaluate RNA seq datsets to infer biological insights.

Pre-requisite of course: Basic knowledge of Bioinformatics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**TRANSCRIPTOMICS OVERVIEW** Overview of Transcriptomics, Microarray Technology and Gene Expression, Serial Analysis of Gene Expression (SAGE), Applications of Microarrays in Medicine, Databases: Gene Expression Omnibus (GEO), ArrayExpress, RNA Dynamics	7
2	**RNA ISOLATION** RNA Isolation and Purification, RNA Integrity Number (RIN), Bulk RNA Sequencing, Single-Cell RNA Sequencing, Small RNA Sequencing Importance of Gene Silencing, microRNA (miRNA), small interfering RNA (siRNA), long non-coding RNA (lncRNA), Competing endogenous RNA (ceRNA)	7
3	**DATA ANALYSIS TRANSCRIPTOMICS** Data Analysis in Transcriptomics, Quality Check: FastQC, Multi FastQC Trimming of Adapters: Trimmomatic, Cutadapt, Tools: Samtools, Bowtie Assembly using Genome Assemblers, Alignment of Sequences, Generation of Contigs and Scaffolds	7

Contents : Unit	Topics	Contact Hours
4	**NETWORKS** Competing endogenous RNA (ceRNA) Networks, Predicting Differentially Expressed Genes (DEGs), Ontology Analysis, Statistics behind DGE Analysis, Gene Annotations, Protein Interaction Network Prediction	7
Total Hours		**28**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Module 1 :** To analyze the transcriptomic data from NCBI database	2
2	**Module 1 :** To analyze the SRA data using online methods for a particular experiment	2
3	**Module 2 :** To analyze the SRA data using coding methods for a particular experiment	2
4	**Module 2 :** To analyze the Microarray data for gene expression	2
5	**Module 2 :** To perfom Primer designing using online tools	2
6	**Module 3 :** To perform Quality check of the transcriptome dataset	2
7	**Module 3 :** To analyze the quality of the transcriptome data using the FastQC tool	2
8	**Module 3 :** To perform the Trimming of the adapters of the selected dataset	2
9	**Module 4 :** To perform the assembly of the transcriptome using bowtie tool	2
10	**Module 4 :** To annotate the assembled transcripts	2
11	**Module 4 :** To analyze the offline blast result	2
12	**Module 4 :** To identify the genes from the transcripts	2
13	**Module 4 :** To compare GO analysis in control and treated datasets	2
14	**Module 4 :** To perform the differential gene expression/ and visualize the data	2
Total Hours		**28**

Textbook :

1 Next Generation Sequencing Methods and Protocols, Head, Steven R., Ordoukhanian, Phillip, Salomon, Daniel R, Springer, 2018

References:

1 RNA-seq Data Analysis: A Practical Approach, RNA-seq Data Analysis: A Practical Approach, Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, Garry Wong, Taylor and Francis publishers, 2017

2 Exploring the new world of the genome with DNA microarrays, Exploring the new world of the genome with DNA microarrays, Brown P. O and Botstein D, USA: Nat. Genet, 1999

3 Gene Regulation and Metabolism – Post Genomic Computational Approaches, Gene Regulation and Metabolism – Post Genomic Computational Approaches, Collado Vides Julio and Ralf Hofstadter, India: Ane Books, 2004

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
20.00	30.00	20.00	10.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Supplementary Resources:

1 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

2 https://www.ebi.ac.uk/training/

3 https://omicstutorials.com/