

2024-25 1st Semester

BT 637 Genome Editing and Engineering (C1 slot)

Lecture room: 1005

Introductory Lecture



Dr. Kusum K. Singh

Office-303, O-Block, kusumsingh@iitg.ac.in

Department of Biosciences and Bioengineering

Indian Institute of Technology Guwahati

Guwahati Assam 781 039

1. Introduction
2. Why BT 637 ?
3. Prerequisites for the Course
4. Course Content
5. Class Schedule
6. Interaction Sessions
7. Course Evaluation Process
8. Course Grading Scheme
9. Important Points to Remember

1. Introduction

1. Safe at respective hostels and academic places (stay healthy and stay safe).
2. Genome Editing and Engineering (Departmental elective course) (3-0-0=6)
3. Advanced Genetic Engineering Course (various vectors..)
4. About Myself
5. Area of Research (RNA-binding Proteins / Gene expression & regulation)
6. EJC; Splicing and alternative splicing pathways
7. Isoform switching (CRISPR/Cas9 KO, RNA Sequencing, NGS analysis, PTC features)
8. Relevance in human diseases (Model system : cell cultures like HeLa, MCF7, HCT116, HEK293)

2. Why BT 637?

1. Genome Editing = method to edit endogenous DNA (organisms, plants, humans)
2. Editing = Change into physical traits
3. Physical traits = eye color, leaf pattern / visible pattern, hair color
4. Natural sources = Edit DNA = understand working mechanism
5. Natural sources = Engineered = Different technologies = Edit DNA
6. Editing Genome = Human benefits
7. Human benefits = Genetic Diseases (replace, remove, add)
8. Gene Therapies = cystic fibrosis or somatic therapy
9. Ethical concerns = embryo treatment

∴ Genome Editing & Applications

3. Prerequisites for the Course

1. BT 205: Cell and Molecular Biology

Syllabus

Cell organization and subcellular structures; structure and properties of nucleic acids; organization of prokaryotic and eukaryotic genomes; mechanisms of DNA replication; mechanism of DNA recombination; transcription, eukaryotic RNA splicing and processing; translation; regulation of gene expression; cell signaling; programmed cell death; oncogenes; genes in differentiation and development.

3. Prerequisites for the Course

2. BT 503 : Genetic Engineering

Syllabus

Principles of recombinant DNA technology and its applications: identification, isolation, amplification and cloning of genes; High throughput analysis of genome and proteome; Recombinant protein expression systems: design of different expression systems in E.coli, yeast, fungi, plant and mammalian cells; Transgenic plants, animals and their applications; Molecular therapeutics: Gene probes and DNA fingerprinting for diagnosis, identification of biomarkers, gene silencing using antisense and siRNA technology, gene therapy systems, application of stem cells in therapy, recombinant vaccines and antibodies.

4. Course Content

1. Genome Editing and Engineering (3-0-0=6)

Course contents:

Introduction to genetics and genetic engineering; limitations of genetic engineering; double stranded DNA breaks and repair; homologous and non-homologous recombination; knock-ins and knock-outs; Genome engineering using Zinc Finger Nuclease (ZFN) Technology; Transcription activator-like effector nuclease (TALEN) Technology; Clustered regularly interspaced short palindromic repeats (CRISPR)/Cas9 technology: target identification, gRNA design, donor design, screening and validation; Applications in treating human diseases: Human cell engineering-Thalassemia, SCID, Hemophilia, etc; Disease modeling-Cancer, iPSc and animal models; Engineered immune cells for cancer therapy; Personalized therapy; Challenges: safety and specificity; Ethical concerns: Germ line gene editing.

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2. Flow of teaching : Introduction to RE, FokI, ZFN, TALEN, CRISPR/CAS, DSB

4. Course Content

1. Genome Editing and Engineering (3-0-0=6)

Texts:

1. Harber , J. E., Genome Stability: DNA Repair and Recombination , Garland Science, 2013.
2. Yamamoto, T. , Targeted Genome Editing Using Site-Specific Nucleases, Springer, 2015.
3. Zlatanova, J. and Holde, K. van, Molecular Biology: Structure and Dynamics of Genomes and Proteomes. Garland Science, 2015.
4. Yamamoto, T.(Ed.), Targeted Genome Editing Using Site-Specific Nucleases: ZFNs, TALENs, and the CRISPR/Cas9 System , Springer 2015.

References:

1. Barrangou , R. and Oost, J. van der, CRISPR-Cas Systems: RNA-mediated Adaptive Immunity in Bacteria and Archaea , Springer, 2013.
2. Addgene, CRISPR 101:A Desktop Resource , January 2016
3. Alberts , B. , Johnson , A., Lewis , J., Morgan, D., Raff, M., Roberts, K.and Walter, P., Molecular Biology of the Cell, 6th Edn., Garland Science, 2014.

4. Course Content

1. Genome Editing and Engineering (3-0-0=6)
2. Flow of teaching : Introduction to RE, FokI, ZFN, TALEN, CRISPR/CAS, DSB
3. Teaching procedure :
 - a) Power-point Presentation
 - b) Original articles (as the field originated.....)
 - c) Review articles (~ 20-25 manuscripts)
4. Teaching materials :
 - a) Make notes
 - b) Read Research articles

5. Class Schedule

- Class schedule is as follows
 - **MONDAY → 8 to 9 PM**
 - **TUESDAY → 8 to 9 PM**
 - **WEDNESDAY → 8 to 9 PM**
- **EXTRA CLASS ON 10TH AUGUST (Saturday) 9 TO 11 AM.**

5. Class Schedule

Time Table for July - November, 2024

Department of Biosciences and Bioengineering IIT Guwahati

DAY	SEM		8:00- 8:55 AM	9:00 - 9:55 AM	10:00 - 10:55 AM	11:00 - 11:55 AM	12:00 - 12:55 PM	1:00- 1:55 PM	2:00 - 2:55 PM	3:00 - 3:55 PM	4:00 - 4:55 PM	5:00 - 5:55 PM
MON	BTech	III		BT202	BT203	MA201	BT204					HS200
		V		BT 311					BT303	BT302	BT304	BT301
		VII		BT612		BT645/ BT623/ BT610/ BT651	BT641		BT618/ BT620/ BT634/ BT636	BT637/ BT640/ BT643/ BT644	BT604/ BT605/ BT615/ BT621	
	MTech (BT)	I		BT612	BT501	BT610/ BT651	BT641		BT618/ BT620/ BT634/ BT636	BT637/ BT640/ BT643/ BT644	BT604/ BT605/ BT615/ BT621	
	MTech (BE)	I		BT612	BT501	BT645/ BT610/ BT651	BT641		BT618/ BT620/ BT634/ BT636	BT637/ BT640/ BT643/ BT644	BT604/ BT605/ BT615/ BT621	
		III				BT623						
	PhD			BT612		BT645/ BT623/ BT610/ BT651	BT641		BT618/ BT620/ BT634/ BT636	BT637/ BT640/ BT643/ BT644	BT604/ BT605/ BT615/ BT621	

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T H U	BTech	III		MA201	BT205	BT201	BT201M					HS200
		V		BT 312				HS1xx	BT301	BT301M	BT303	BT304
		VII		BT645/ BT623/ BT610/ BT651		BT401M	HS2xx					BT637/ BT640/ BT643/ BT644
	MTech (BT)	I		BT610/ BT651		BT503			BT 510			BT637/ BT640/ BT643/ BT644
	MTech (BE)	I		BT645/ BT610/ BT651		BT521			BT 530			BT637/ BT640/ BT643/ BT644
		III		BT623								
	PhD			BT645/ BT623/ BT610/ BT651								BT637/ BT640/ BT643/ BT644

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6. Interaction Session

- Every lecture schedule will be an interactive session.
- Try to ask your doubts.
- During the interaction session all the relevant and genuine doubts will be clubbed and addressed.
- All the doubts should be mentioned in clearly.
- It is understood that you have gone through the lecture material and tried reading the articles.

7. Course Evaluation Process

- A continuous evaluation procedure
- 4th September- First Quiz (10%)
- 3rd November- Second Quiz (10%)
- Mid semester examination (20%)
- End semester examination (30%)
- A Research project (Term- project 20%)
- Attendance and interactions (10%)

8. Course Grading Scheme

- There will be **Mid** and **End** semester examinations
 - The **Quiz-1** will have a weightage of **10%**. (4th September 2024)
 - The **Quiz-2** will have a weightage of **10%**. (3rd November 2024)
 - The **Mid-semester** examination will be as per C1 slot. (18th September 2024)
 - The Mid-semester examination will have a weightage of **20%**.
 - The **End-semester** examination will have a weightage of **30%**. (19th November 2024)
 - The **term project** (research proposal) using nuclease will have **20%**. (01st November 2024)
 - The **attendance and interaction** will have a weightage of **10%**.
 - So total percentage of 100% course grading will be done by end-semester.

8. Course Grading Scheme

- There will be **Mid** or **End** semester examinations

<u>Grade</u>	<u>Grade Point</u>	<u>Grade Point</u>
AS	-	10 (Outstanding)
AA	10	10(Excellent)
AB	9	9
BB	8	8
BC	7	7
CC	6	6
CD	5	5
DD	4	4
F	0	0
In addition, there shall be two transitional grades I and X used by the instructors.		

9. Important Points to Remember

- **Lectures**, it's scheduled according to the time table.
- There will **NOT be any re-quizzes** or **re-mid-semester** examination.
- **Don't copy or cheat** in quizzes or mid- & end-sem. If caught you will be penalised appropriately.
- Do not ask vague questions without going through the course material. It will count as negative interaction. Ask well meaning doubts and questions. This will save time and lead to more constructive course.

Thank You !

Questions?