

## **CERTIFICATE COURSE ON GENE SILENCING**

**(Non-Semester)**

**(With effect from the academic year 2013-14)**

### **Eligibility for the Course**

Candidates for admission to Certificate course on Gene Silencing could possess a Higher Secondary school Education in Science subjects with Biology

### **Duration of the Course**

One year Certificate course on Gene Silencing course non-semester for One Year duration

### **Examination**

All the theory papers are of 3 hours duration each for a maximum of 100 marks with passing minimum of 35 marks. Practical examinations are also for 3 hours duration for a maximum of 100 marks and passing minimum of 35 marks.

Question Paper Pattern

Maximum marks: 100

Time: 3 hours

Part A (5 x 3 = 15)

Five short answer questions (One question from each unit)

Part B (5 x 8 = 40)

Paragraph questions (Total questions 8, out of which answers are to be given for any five questions;

Part C (3 x 15 = 45)

Total questions 5, out of which answers are to be given for any Three questions;

S.No	Theory & Practicals	Maximum Marks	Minimum Marks
1.	Gene silencing - basics	100	35
2.	Application of Gene silencing	100	35

### Paper 1 : Gene silencing - Basics

#### Unit: 1

Epigenetics-overview, Chromatin structure, Nucleosomes; Histones, Histone modifications: Histone Acetyl Transferases, Histone Deacetylases, Histone methyltransferase, Gene silencing by histone modification; DNA methylation: DNMT1, DNMT3a and DNMT3b, gene silencing by DNA methylation.

#### Unit: 2

Transcriptional gene silencing: DNA structure, eukaryotic gene structure, eukaryotic transcription, genomic imprinting, para-mutation, position effect, RNA directed DNA methylation, transposons, retroposons, transposon silencing; transgenes, transgene silencing, transcriptional gene silencing.

#### Unit: 3

Post-transcriptional gene silencing: RNA interference: mechanism, Dicer, Drosha, argonautes, miRNA, siRNA, shRNA, piRNA, rasiRNA, tasiRNA, nonsense mediated decay; meiotic gene silencing: Transvection.

#### Unit: 4

Gene silencing : RNAi for crop improvement: enhanced nutrient contents, reduced alkaloid production, reduced allergenicity, reduced polyphenol production, heavy metal accumulation; Insect control: RNAi pesticides ; RNAi therapeutics: cancer, age-related macular degeneration (AMD), RNAi delivery: nanocarriers, nanocarrier mediated delivery.

#### Unit: 5

Techniques: in vitro synthesis of siRNA, shRNA, vector mediated synthesis of shRNA, gene silencing in cells, systemic gene silencing in animals, Models: *C. elegans*, plants, mice tumors and xenograft tumors.

## **Paper 2: Application of Gene silencing**

### **Unit: 1**

siRNA Immunity : Immune system, monocytes, macrophages, dendritic cells; toll like receptors: types, structure and function. TLR7/ 8 pathways, interferon, activation of the host immune system. Off target effects; 2'-O-methyl- modified RNAs. siRNA designs to minimize immune response.

### **Unit: 2**

siRNA delivery to mammalian cells : lipid based transfection agents; receptor mediated delivery; bioluminescence imaging; atelocollagen; molecular imaging: contrast agents, optical imaging, magnetic resonance imaging; siRNA delivery *in vitro*, magnetic nanoparticles, magnetic transfection vectors.

### **Unit: 3**

Bacterial delivery of siRNA: Bacterial delivery vectors, *Salmonella*, plasmids carrying shRNA coding sequence, solid tumor targeting, Use of gene knockdown plasmid containing bacteria : control of nematodes, insects, mosquitoes.

### **Unit: 4**

Oncogene targeting: Oncogenes, oncogenic transcription factors, *in silico* tools to select oncogene target sequences, design of shRNA , *in vitro* testing, silencing telomerase coding gene, survivin, tubulin B1 and G protein coding genes.

### **Unit: 5**

Anti-viral siRNAs: Respiratory syncytial virus (RSV), parainfluenza virus (PIV), Influenza virus; chemically modified siRNA: 2'-O-methyl (2'-O-Me) and 2'-deoxy-2-fluoro(2'F); use of RNAi to control plant viruses,

RNA dependent RNA polymerases, breeding viral resistant plants.

### **Text Books:**

Si RNA and miRNA gene silencing, 2009, Sioud, Mouldy(ed), Humana Press.

### **Reference Books :**

1. Gene Silencing by RNA interference: Technology and application,2004, Muhammad Sohail. CRC Press.
2. siRNA and miRNA Gene Silencing, 2008, MouldySioud, Humana Press.
3. Gene Silencing, 2006, Grace W. Redbery. Nova Science Publishers, Inc.
4. Plant Gene Silencing , 2000, M.A. Matzke and A.J.M. Matzke. Kluwer Academic Publishers.
5. Theory, Techniques and Applications of Nanotechnology in Gene Silencing ,2011, Surendra Nimesh and Ramesh Chandra, River Publishers.