

## UNIT – IX : BIOTECHNOLOGY AND ITS APPLICATIONS

Term-II

# BIOTECHNOLOGY AND ITS APPLICATIONS

### Syllabus

- Genetically modified organisms–Bt crops; RNA interference, Human insulin, gene therapy; molecular diagnosis transgenic animals; Biosafety issues, biopiracy and patents.



### STAND ALONE MCQs

(1 Mark each)

Q. 1. What triggers activation of protoxin to active Bt toxin of *Bacillus thuringiensis* in bollworm ?

- (A) Body temperature
- (B) Moist surface of midgut
- (C) Alkaline pH of gut
- (D) Acidic pH of stomach

R

Ans. Option (C) is correct.

**Explanation :** Bt toxin protein exists as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form due to the alkaline pH of the gut which solubilise the crystals.

Q. 2. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes ?

- (A) Retrovirus
- (B) pBR 322
- (C) λ Phage
- (D) Ti plasmid

R

Ans. Option (A) is correct.

**Explanation :** Retrovirus is commonly used as a vector for introducing a DNA fragment in human lymphocytes.

Q. 3. The first human hormone produced by recombinant DNA technology is :

- (A) Insulin
- (B) Estrogen
- (C) Thyroxine
- (D) Progesterone

R

Ans. Option (A) is correct.

**Explanation :** In 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. The chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin.

Q. 4. Bt cotton is not

- (A) a genetically modified (GM) plant.
- (B) insect resistant.
- (C) a bacterial gene expressing system.
- (D) resistant to all pesticides.

R

Ans. Option (D) is correct.

**Explanation :** Bt cotton is a genetically modified (GM) plant which is resistant to insects. These plants are produced by the insertion of one or more genes from a common soil bacterium, *Bacillus thuringiensis*. These genes encode for the production of insecticidal proteins, and thus, genetically transformed plants produce one or more toxins as they grow.





Q. 5. C-peptide of human insulin is

- (A) a part of mature insulin molecule.
- (B) responsible for formation of disulphide bridges.
- (C) removed during maturation of pro-insulin to insulin.
- (D) responsible for its biological activity. R

Ans. Option (C) is correct.

**Explanation :** Insulin and C-peptide are linked when first made by the pancreas. C-peptide is removed from the pancreatic beta-cells during cleavage of insulin from pro-insulin.

Q. 6. A pro-toxin is

- (A) a primitive toxin
- (B) a denatured toxin
- (C) toxin produced by protozoa
- (D) inactive toxin R

Ans. Option (D) is correct.

**Explanation :** Bt toxin protein exist as inactive protoxins but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals.

Q. 7. Golden rice is

- (A) a variety of rice grown along the yellow river in China.
- (B) long stored rice having yellow colour tint.
- (C) a transgenic rice having gene for  $\beta$ -carotene .
- (D) wild variety of rice with yellow coloured grains. R

Ans. Option (C) is correct.

**Explanation :** Golden Rice is a new type of rice that contains beta-carotene (provitamin A), which is converted into vitamin A as needed by the body and gives the grain its golden colour. It is developed through genetic engineering and produces two new enzymes that complete the beta-carotene expression in the rice grain.

Q. 8. Crystals of Bt toxin produced by some bacteria do not kill the bacteria themselves because

- (A) bacteria are resistant to the toxin.
- (B) toxin is immature.
- (C) toxin is inactive.
- (D) bacteria enclose toxin in a special sac. U

Ans. Option (C) is correct.

**Explanation :** Crystals of Bt toxin produced by some bacteria do not kill the bacteria themselves because toxin is inactive.

Q. 9. A probe which is a molecule used to locate specific sequences in a mixture of DNA or RNA molecules could be

- (A) a single stranded RNA
- (B) a single stranded DNA
- (C) either RNA or DNA
- (D) can be ss-DNA but not ss RNA R

Ans. Option (C) is correct.

**Explanation :** A single stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells followed by detection using autoradiography.

Q. 10. The site of production of ADA in the body is

- (A) bone marrow
- (B) lymphocytes
- (C) blood plasma
- (D) monocytes R

Ans. Option (B) is correct.

**Explanation :** The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. This enzyme is crucial for the immune system to function. The disorder is caused due to the deletion of the gene for adenosine deaminase. In some children ADA deficiency can be cured by bone marrow transplantation.

Q. 11. Use of bio-resources by multinational companies and organisations without authorisation from the concerned country and its people is called

- (A) Bio-infringement
- (B) Bioexploitation
- (C) Biodegradation
- (D) Biopiracy R

Ans. Option (D) is correct.

**Explanation :** Some organisations and multinational companies exploit or get patent for the biological resources of other nations without proper authorization from the concerned countries and this is called biopiracy.

Q. 12. Maximum number of existing transgenic animals is of

- (A) Mice
- (B) Cow
- (C) Pig
- (D) Fish R

Ans. Option (A) is correct.

**Explanation :** Over 95% of all existing transgenic animals are mice.

Q. 13. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services.

- (A) Bio-safety committee
- (B) Indian council of Agricultural Research
- (C) Genetic Engineering Approval committee
- (D) Research Committee on Genetic Manipulation. —



Ans. Option (C) is correct.

**Explanation :** Indian government has set up an organisation. Genetic engineering approval committee (GEAC) which makes decisions regarding validity of GM research and its use for public utility.

Q. 14.  $\alpha$ -1 antitrypsin is

- (A) an antacid.
- (B) an enzyme
- (C) used to treat arthritis
- (D) used to treat emphysema

R

Ans. Option (D) is correct.

**Explanation :** Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product such as human protein ( $\alpha$ -1-antitrypsin) used to treat emphysema.

Q. 15. Choose the correct option regarding Retrovirus

- (A) an RNA virus that can synthesise DNA during infection.
- (B) a DNA virus that can synthesise RNA during infection.
- (C) a ss DNA virus.
- (D) a dsRNA virus.

R

Ans. Option (A) is correct.

**Explanation :** A retrovirus is RNA virus which is capable to synthesise DNA during infection.

Q. 16. .... is a first transgenic cow.

- (A) Dolly
- (B) Molly
- (C) Shelly
- (D) Rosie

Ans. Option (D) is correct.

**Explanation :** In 1997, Rosie, the first transgenic cow produced human protein-enriched milk (2.4 gm per litre).

Q. 17. GEAC stands for

- (A) Genome Engineering Action Committee.
- (B) Ground Environment Action Committee.

(C) Genetic Engineering Approval Committee.

(D) Genetic and Environment Approval committee.

R

Ans. Option (D) is correct.

**Explanation :** The Indian Government has set up organisations such as GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

Q. 18. The polio vaccine was tested on :

- (A) Mice
- (B) Monkey
- (C) Rabbit
- (D) Dog

R

Ans. Option (A) is correct.

**Explanation :** Transgenic mice are being developed and used in testing the safety of vaccines before they are used for humans. The polio vaccine was tested in mice.

Q. 19. Transgenic animals are

- (A) Animals whose DNA is manipulated to possess and express an extra (foreign) gene
- (B) Animals whose RNA is manipulated to possess and express an extra (foreign) gene
- (C) Animals whose both DNA and RNA are manipulated to possess and express an extra (foreign) gene.
- (D) None of the above

R

Ans. Option (A) is correct.

**Explanation :** Transgenic animals are animals whose DNA is manipulated to possess and express an extra (foreign) gene e.g. Rosie - transgenic cow.

Q. 20. India has..... varieties of Basmati rice.

- (A) 30
- (B) 29
- (C) 12
- (D) 27

R

Ans. Option (D) is correct.

**Explanation :** India has 27 varieties of Basmati rice.



## ASSERTION AND REASON BASED MCQs (1 Mark each)

**Directions :** In the following questions a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

- (A) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

(B) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

(C) Assertion (A) is true but reason (R) is false.

(D) Assertion (A) is false but reason (R) is true.





**Q. 1. Assertion (A) :** Norman E. Borlaug was the father of "Green revolution".

**Reason (R) :** Green revolution is the period when there is significant increase in agricultural productivity of grains (specially wheat and rice).

**Ans. Option (A) is correct.**

**AIQ. 2. Assertion (A) :** 'Bt' in Bt toxin represent *Bacillus thuringiensis*.

**Reason (R) :** 'Bt' toxin is produced by a virus.

**Ans. Option (A) is correct.**

**Explanation :** Assertion (A) is true, but reason (R) is wrong as Bt toxin is produced by a bacterium called *Bacillus thuringiensis*.

**AIQ. 3. Assertion (A) :** Genetically modification make crops more tolerant to abiotic stress (cold, drought etc.)

**Reason (R) :** Genetically Modified Organisms (GMO) genes have been altered by manipulation.

**Ans. Option (A) is correct.**

**Q. 4. Assertion (A) :** Ti plasmid (tumour-inducing plasmid) of *Agrobacterium tumefaciens* is used as a cloning vector.

**Reason (R) :** Ti plasmid integrates a segment of its DNA, termed T-DNA into the chromosomal DNA of its host plant cells.

**Ans. Option (C) is correct.**

**Explanation :** The Ti plasmid (tumour-inducing plasmid) of *Agrobacterium tumefaciens* has been modified (does not cause tumour) and used as a cloning vector. The Ti plasmid integrates a segment of its DNA, termed T-DNA into the chromosomal DNA of its host plant cells.

**Q. 5. Assertion (A) :** The inactive form of toxic proteins are advantageous to the bacteria producing it.

**Reason (R) :** Low concentration of a bacteria or virus, even at a time when the symptoms of the disease are not visible, can be detected.

**Ans. Option (B) is correct.**

**Explanation :** Many proteins including certain toxins are secreted in their inactive form. They get activated, only when exposed to a specific trigger (pH, temperature, etc.). It is advantageous to the bacteria producing it because the bacterium does not get killed due to the action of protein.

Low concentration of a bacteria or virus, even at a time when the symptoms of the disease are not visible, can be detected by amplification of their nucleic acid by PCR methods.

**Q. 6. Assertion (A) :** Transgenic animals had their DNA manipulated.

**Reason (R) :** 95% of all existing transgenic animals are mice.

**Ans. Option (B) is correct.**

**Explanation :** Transgenic animals originates from recombinant DNA.

**AIQ. 7. Assertion (A) :** GEAC will decide the safety of introducing GM organism for public use.

**Reason (R) :** Genetic modifications of organisms may have opposite results when introduced into the ecosystem.

**Ans. Option (A) is correct.**

**AIQ. 8. Assertion (A) :** Transgenic mice are being used to test the safety of the polio vaccine.

**Reason (R) :** It could replace the use of monkeys to test the safety of batches of the vaccine.

**Ans. Option (A) is correct.**

**Q. 9. Assertion (A) :** Rosie was the first transgenic cow.

**Reason (R) :** It contained human alpha lactalbumin.

**Ans. Option (B) is correct.**

**Explanation :** Transgenic animals are animals whose genes are altered by manipulation (recombinant DNA technology). Rosie was the first transgenic cow. The milk produced by it was protein rich. It contained human alpha lactalbumin. This milk was nutritionally richer and balanced as compared to that of normal cow.

**Q. 10. Assertion (A) :** An American company is allowed the company to sell a 'new' variety of Basmati rice.

**Reason (R) :** Indian Basmati was crossed with semi-dwarf varieties and claimed as a novelty.

**Ans. Option (B) is correct.**

**Explanation :** In 1997, an American company got patent rights on Basmati rice through the US Patent and Trademark Office. This allowed the company to sell a 'new' variety of Basmati which had actually been derived from Indian farmer's varieties. Indian Basmati was crossed with semi-dwarf varieties and claimed as a novelty.







## CASE-BASED MCQs

Attempt any four sub-parts from each question.  
Each sub-part carries 1 mark.

I. Read the following and answer questions from Q.1. to Q.5. given below:

Plants having foreign genes in their genome through genetic engineering are called transgenic plants. Genes can be incorporated either through a vector or through direct introduction of DNA. Bt cotton is a genetically modified organism which is pest resistant. It contains gene *cry* I Ac and *cry* II Ab of *Bacillus thuringiensis*. It is used to control lepidopterans, coleopterans and dipterans. Bt cotton can resist cotton bollworm and produce higher yields. *Cry* gene produces *cry* protein or Bt toxin. It is an endotoxin which remains as protoxin in plants and converted to active toxin after getting ingested by the insects. Alkaline pH of the insect gut solubilizes the protein crystals, the activated toxin creates pores to the mid guts wall of the insects which cause them to death.

Q. 1. What is true about Bt cotton crops?

- (A) They are fungal resistant
- (B) They are insect resistant
- (C) They are drought resistant
- (D) All of these

Ans. Option (D) is correct.

**Explanation :** Bt cotton crops are fungal resistant, insect resistant and drought resistant.

Q. 2. Cotton bollworms are killed by the protein encoded by the gene

- (A) *cry* I Ac
- (B) *cry* I Ab
- (C) *cry* II Ab
- (D) both A and C

Ans. Option (D) is correct.

**Explanation :** Bt cotton is a genetically modified organism which is pest resistant. It contains gene *cry* I Ac and *cry* II Ab of *Bacillus thuringiensis*. It is used to control lepidopterans, coleopterans and dipterans. Bt cotton can resist cotton bollworm and produce higher yields.

Q. 3. Identify which of the following is not an advantage of GM crops?

- (A) GM plants enhance nutritional value of food.
- (B) GM plants are more tolerant to abiotic stresses.
- (C) GM plants have helped to reduce post-harvest losses.

(D) GM plants can cause gene transfer to non-target plant species.

Ans. Option (D) is correct.

**Explanation :** The advantage of GM plants are they enhance nutritional value of food, are more tolerant to abiotic stresses, have helped to reduce post-harvest losses.

Q. 4. *Bacillus thuringiensis* is a

- (A) air borne bacteria
- (B) soil borne fungus
- (C) soil borne bacteria
- (D) food borne bacteria

Ans. Option (B) is correct.

**Explanation :** Bt is a microbe naturally found in soil. It makes proteins that are toxic to immature insects (larvae). There are many types of Bt. Each target different insect groups.

Q. 5. Some strains of *Bacillus thuringiensis* can kill certain insects such as \_\_\_\_\_

- (A) lepidopterans
- (B) scorpion
- (C) fruit fly
- (D) dragonfly

Ans. Option (A) is correct.

**Explanation :** Lepidopterans are an order of insects consisting of moths and butterflies. Some insects of this order can be killed by the bacteria *Bacillus thuringiensis*.

II. Read the following text and answer the following questions on the basis of the same:

Transgenic animals have their DNA manipulated to possess and express an extra gene. The genome of these animals has been changed and they can carry genes from other species. The first transgenic sheep was Tracy. The reason behind producing these transgenic animals are for specific economic trait, some are produced as disease models (animals genetically manipulated to exhibit disease symptoms so that effective treatment can be studied).

Q. 1. \_\_\_\_ were the first mammals to be transgenic animals.

- (A) Sheep
- (B) Mice
- (C) Fruit flies
- (D) None of these





Ans. Option (B) is correct.

**Explanation :** The first transgenic animal were mice created by Rudolf Jaenisch.

Q. 2. 95% transgenic animals are :

- (A) Mice                      (B) Cat  
(C) Dog                      (D) Sheep

Ans. Option (A) is correct.

**Explanation :** Mice were the first transgenic animal and they high successful rate of transformation among the mammals.

Q. 3. 1<sup>st</sup> cloned animals is :

- (A) Rat                      (B) Rabbit  
(C) Pig                      (D) Sheep.

Ans. Option (D) is correct.

**Explanation :** Dolly sheep was the first cloned animal from the somatic cell.

Q. 4. The 1<sup>st</sup> transgenic cow is :

- (A) Mosie                      (B) Rosie  
(C) Dosie                      (D) Cowsie.

Ans. Option (B) is correct.

**Explanation :** The Rosie was she first transgenic cow created in 1997 that consist of human alpha lactalbumin gene.

**Directions :** In the following questions a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

- (A) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).  
(B) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).  
(C) Assertion (A) is true but reason (R) is false.  
(D) Assertion (A) is false but reason (R) is true.

Q. 5. Assertion (A) : Dolly, was the first mammal to be cloned from an udder cell.

Reason (R) : To create, Dolly the Finn Dorset ewe, Ian Wilmut and Keith Campbell used aid from three mothers.

Ans. Option (A) is correct.

**Explanation :** Dolly was cloned from somatic cell taken from mammary gland.

III. Biotechnology can be defined as the use of biological processes in industry and technology. During the past three decades biotechnology has gained attention due to the gene cloning process. Biotechnological applications are playing important role in agriculture. They are used in agro-chemical based agriculture, in organic farming, genetically

engineered crop-based agriculture. The green revolution is the milestone or result of these biotechnological processes.

Q. 1. \_\_\_\_\_ has been called the "Father of Green Revolution."

- (A) Dr. Verghese Kurien  
(B) Norman E. Borlaug  
(C) Sam Pitroda  
(D) Dr. Arun Krishnan

Ans. Option (B) is correct.

**Explanation :** Father of white revolution - Dr. Verghese Kurien  
Father of yellow revolution - Sam Pitroda  
Father of blue revolution - Dr. Arun Krishnan

Q. 2. GEAC stand for \_\_\_\_\_ .

- (A) Genetic Extension Approval Committee  
(B) Genetic Engineering Approval Committee  
(C) Genetic Engineering Approval Committee  
(A) None of the above

Ans. Option (B) is correct.

Q. 3. When does 'Bt' in BT toxin represent ?

- (A) Bioterrorism  
(B) Blue tooth toxin  
(C) Bleeding toxin  
(D) *Bacillus thuringiensis*

Ans. Option (D) is correct.

**Explanation :** Bt represent the bacteria *Bacillus thuringiensis* that makes toxic protein for some insects.

Q. 4. Which among the following may be considered as an application of biotechnology ?

- (A) Energy production  
(B) Waste treatment  
(C) Bioremediation  
(D) All of these.

Ans. Option (D) is correct.

**Explanation :** Biotechnology is the production of modified product from organic compound, plants and animals for human welfare in waste treatment bioremediation and energy production.

**Directions :** In the following questions a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

- (A) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).





(B) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

(C) Assertion (A) is true but reason (R) is false.

(D) Assertion (A) is false but reason (R) is true.

**Q. 5. Assertion (A) :** Bt toxin is crystals contain insecticidal

protein.

**Reason (R) :** *B. thuringiensis* forms these protein crystals continuously during their growth period.

**Ans. Option (C) is correct.**

**Explanation :** *B. thuringiensis* form protein crystal during a particular phase of their growth.

