**Strictly Confidential: (For Internal and Restricted use only)**
**Senior School Certificate Examination**
**March 2019**
**Marking Scheme – BIOTECHNOLOGY (SUBJECT CODE :045)**

**General Instructions: -**

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 1-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.

12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

**MARKING SCHEME**

**SUBJECT : BIOTECHNOLOGY THEORY (045)**

**SESSION: 2018-19**

**SERIES : BVM/1**

| QUES NO | SUB PART | VALUE POINTS | MARKS |
|---|---|---|---|
| 1 | | • RFLP(Restriction Fragment Length Polymorphism)/ Variation in length or size or number of restriction enzyme generated fragments between individual's DNA.<br>**OR**<br>• Using Alkaline Phosphatase enzyme to remove 5'Phosphate group. | 1 |
| 2 | | To anneal the primers to the DNA strands.<br>**OR**<br>Taq DNA Polymerase is thermostable/ stable at temperature more than 80 C | 1 |
| 3 | | Barnase is RNA hydrolyzing enzyme that prevents formation of pollen grains in the tapetal cells. | 1 |
| 4 | | George Gay | 1 |
| 5 | | Specific growth rate is inversely proportional to the doubling time/ $\mu \alpha 1/td$ where $\mu$ = specific growth rate. td= doubling time. $td \alpha 0.693/\mu$ | 1 |
| 6 | | Phytohormones / Auxins/ Cytokinin/Gibberellins<br>**OR**<br>To inactivate tumour inducing genes | 1 |
| 7 | | • Biosynthesis of muscle proteins<br>• Serve as fuel or energy source(any other relevant point as on page no 53)<br>**OR**<br>• Nutraceutical proteins are those which have pharmaceutical and nutritional value<br>• Whey/ curd/ infant food formula/lactose free milk (any two as on pg 49-50) | 1+1 |

<table>
<tr><td>8</td><td></td><td>Any two points as on pg 86-87</td><td>1+1</td></tr>
<tr><td>9</td><td></td><td>• More steps will lead to lower yield<br>• increases the cost of production</td><td>1+1</td></tr>
<tr><td>10</td><td>A<br>B</td><td>• Sharing of a hydrogen atom between two electronegative atoms<br>• They are strongest when nuclei of all the three atoms are in a linear arrangement<br>OR<br>• To create pH gradient<br>• To stain proteins</td><td>1+1</td></tr>
<tr><td>11</td><td></td><td>• SNPs are DNA sequence variations which occur when a single base is altered so that different individuals may have different bases at these positions<br>• Example as on pg 63 and 64(any one)</td><td>1+1</td></tr>
<tr><td>12</td><td></td><td>Transgenic plants can be created which over express genes, for production of osmolytes or an example as on pg 128</td><td>2</td></tr>
<tr><td>13</td><td></td><td>Any two examples as given on pg 120, table 2<br>OR<br>Maintains pH in animal cell culture/maintains temperature/ maintains fixed levels of 5-10% of carbon dioxide/(any two as on pg 143)</td><td>1+1</td></tr>
<tr><td>14</td><td></td><td>• To maintain optimum pH for growth of animal cells in culture<br>• To neutralize the effect of increased carbon dioxide/<br>$H_2O + CO2 \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$ /Any Other Point As On Page 141</td><td>1+1</td></tr>
<tr><td>15</td><td></td><td>Any three points as on page 132-133</td><td>1+1+1</td></tr>
<tr><td>16</td><td></td><td>
<table>
<tr><th>cDNA Library</th><th>Genomic Library</th></tr>
<tr><td>1. Complementary DNA</td><td>1. Genomic DNA</td></tr>
<tr><td>2. Starting material is mRNA</td><td>2. Starting material is whole Genome</td></tr>
<tr><td>3. Contains expressed sequences</td><td>3. Contains both coding and non coding sequences.</td></tr>
<tr><td colspan="2">Any other point as on page 21, 22</td></tr>
</table>
</td><td>1+1+1</td></tr>
</table>

<table>
<tr><td>17</td><td>A<br>B<br>C</td><td>No synthesis of complementary DNA strand.<br>No further extension as the chain terminates.<br>For chain elongation</td><td>1+1+1</td></tr>
<tr><td>18</td><td>A<br>B<br>C</td><td>Allow cells at the bottom of culture vessels to be visualized.<br>For animal cell cultures, only low-speed centrifugation is required.<br>Serum has growth factors and other important components required for animal cell culture (any example from pg 142)</td><td>1+1+1</td></tr>
<tr><td>19</td><td></td><td>• Recombinant vaccines are more safe.<br>• Epitope specific<br>• No side effects like fever<br>(any other relevant point as on pg 53)<br><br>OR<br>Any three points as on pg 39</td><td>1+1+1</td></tr>
<tr><td>20</td><td></td><td>• Freezing of a culture followed by drying under vacuum<br>• Strain may be lost<br>• Decline in production of metabolite.</td><td>1+1+1</td></tr>
<tr><td>21</td><td>A<br>B<br><br><br><br>A<br>B</td><td>Hormone that stimulates erythropoiesis.<br>No donor required/ no transfusion facility required/ more safety/ no risk of transfusion associated diseases (any two)<br><br>OR<br>t-PA is a serine protease which catalyses dissolution of blood clots.<br>Flow chart as on pg no. 148</td><td>1+1+1<br><br><br><br><br>1+2</td></tr>
<tr><td>22</td><td></td><td>• Strong inducible promoters<br>• capable of post translation modifications<br>• Downstream processing simpler as it dose not secrete its own proteins in fermentation medium</td><td>1+1+1</td></tr>
<tr><td>23</td><td>A<br><br>B</td><td>Specific sequences of amino acids in proteins which induce immune response.<br>Diagram/ explanation as on pg 149</td><td>1+2</td></tr>
<tr><td>24</td><td></td><td>Technique of peptide mapping as on pg 36-37</td><td>3</td></tr>
<tr><td>25</td><td></td><td>As on pg 80-81 (any three)<br>OR
<table>
<tr><td>Structural Genomics</td><td>Functional Genomics</td></tr>
<tr><td>High-throughput DNA sequence organization and management of DNA sequences.</td><td>Reconstruction of genome to determine the biological function of genes.</td></tr>
<tr><td>Information provided is used to design experiment to identify functions.</td><td>Deals with biological investigation from studying genes to proteins.</td></tr>
<tr><td>Represents initial phase of</td><td>Represents new phase of analysis</td></tr>
</table></td><td>1+1+1</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | genome analysis. \| based on information provided by structural genomics. | |
| 26 | A<br><br>B<br>C<br><br><br><br><br>A<br><br>B<br>C | A technology to monitor whole genomes using a single chip containing a micro array of DNA fragments.<br>Nick Translation as on pg 65<br>FISH/ to create fluorescently labelled DNA probes/ to introduce fluorescent colours in various chromosomes/ to detect the effect of chemotherapy and status of a disease (any one as on page 65-67).<br>**OR**<br>Complementary base pairing or DNA hybridization using a fluorescently labeled DNA probe<br>No<br>Existence of overlapping genes/ presence of splice variants/ no correlation between number of genes and complexity of the organism (any two as on page 61-62, page 71-72) | 1+3+1<br><br><br><br><br><br>2+1+2 |
| 27 | A<br><br><br><br><br><br><br>B<br><br><br><br>A<br>B<br><br>C | 1,00,000g of protein corresponds to one mole of enzyme i.e. 6.023 x 10 $^{23}$ molecules.<br>1 g of enzyme has 6.023x10$^{18}$ molecules<br>3000 molecules are present in a cell.<br>6.023x10$^{18}$molecules are present in<br>[6.023x10$^{18}$/3000] = 2.007x10$^{15}$cells.<br>Obtaining a product from the fermentation culture involving various steps is known as downstream processing<br>**OR**<br>Inactive precursors of enzyme<br>In-situ activation of trypsin involves proteolytic cuts in chymotrypsiongen in duodenum which results in conformational change exposing the substrate binding pocket.<br>No as glutamic acid is similar to aspartic acid and can create charge- relay system | 4<br><br><br><br><br><br><br>1<br><br><br><br>1+2+2 |
| 28 | A<br><br>B | Fig 1, pg 3<br>Steps pg4<br>Any two scientists involved | 4+1 |

**MARKING SCHEME**

**SUBJECT : BIOTECHNOLOGY THEORY (045)**

**SESSION: 2018-19**

**SERIES : BVM**

<table>
<tr><th>QUES NO</th><th>SUB PART</th><th>VALUE POINTS</th><th>MARKS</th></tr>
<tr><td>1</td><td></td><td>Converts mRNA into cDNA<br>OR<br>Polylinker provides flexibility in the choice and use of restriction enzymes.</td><td>1</td></tr>
<tr><td>2</td><td></td><td>Macerozyme dissolves the middle lamella between the cells to release single cells.<br>OR<br>Ethylene Gas</td><td>1</td></tr>
<tr><td>3</td><td></td><td>Purine/ G or A/Arginine</td><td>1</td></tr>
<tr><td>4</td><td></td><td>Transfer of rDNA into host cells, using charged substances like cationic liposomes.</td><td>1</td></tr>
<tr><td>5</td><td></td><td>Complex medium/ Luria Broth/ Nutrient Broth/ Trypticase Soy Broth.</td><td>1</td></tr>
<tr><td>6</td><td></td><td>Van der Waals Forces</td><td>1</td></tr>
<tr><td>7</td><td></td><td>Nerve gas alkylates active serine in the brain enzyme acetyl choline esterase inactivating it and leading to death.</td><td>2</td></tr>
<tr><td>8</td><td></td><td><table><tr><th>Primary Metabolites</th><th>Secondary Metabolites</th></tr><tr><td><ul><li>Chemicals that are required for plant basic metabolic processes.</li><li>Eg. sugars, lipids, amino acids, nucleic acid.</li></ul></td><td><ul><li>Function is not clear but they are used in defense mechanism against pests and pathogens.</li><li>Eg Alkaloids, resins, tannin, latex.</li></ul></td></tr></table>Pg.119</td><td>1+1</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | **OR**<br>Intergeneric crosses are between distantly related plants which result in abnormal development of the endosperm causing premature death of embryo. | |
| 9 | | Golden rice is a transgenic plant in which three genes have been introduced which are involved in the biosynthetic pathway for carotenoid production. It is enriched in provitamin A ( Beta carotenoids) | 2 |
| 10 | | OKT3 acts by blocking the function of Tcells by binding to the CD3 cell surface receptors.<br>**OR**<br>tPA is a serine protease that catalyzes the dissolution of blood clots. | 2 |
| 11 | | Optimum pH is important for maintaining appropriate ion balance, maintaining optimal function of biomolecules. | 2 |
| 12 | | Programs scan the first 20 symbols. If the symbols switch between A, T, G, C then it is DNA. If instead of T we have U then it is RNA sequence.<br>If the symbols switch between more than 4 to 6 letters then it is a protein sequence. | 2 |
| 13 | | [M+nH]n+<br>[M+5H]5+ m/z = 20005/5 = 4001<br>[M+4H]4+ m/z = 20004/4 = 5001 | 1<br>½<br>½ |
| 14 | | • Post transcriptional modification like polyadenylation / mRNA editing. This could lead to the generation of various proteins from a single gene.<br>• Proteins after synthesis could undergo Post translational modifications.<br>**OR**<br>Provide snapshotsof all genes expressedin a cell under different environmental conditions. | 1<br>1 |
| 15 | A<br>B<br>C | Subtilisin<br>Due to oxidation of methionine at position 222.<br>Engineered enzyme has alanine in place of methionine at position 222. | 1<br>1<br>1 |
| 16 | | Page 100. Fig 10<br>**OR**<br>Page 106, any 3 | 3 |
| 17 | | DNA is extracted from sample of soil, water or other environmental niche and subjected to restriction digestion. Clones are screened for novel molecules. | 3 |

<table>
<tr><td>18</td><td></td><td>
<table>
<tr><th>Batch Culture</th><th>Continuous Culture</th></tr>
<tr><td>1. None of the nutrients are limited.</td><td>1. One nutrient in medium is limited.</td></tr>
<tr><td>2. All phases of growth can be seen</td><td>2.Extended Log phase.</td></tr>
<tr><td>3. Maximum Cell density is achieved.</td><td>3.Maximum Cell density and yield of products are achieved.</td></tr>
<tr><td>4. Closed culture</td><td>Open culture</td></tr>
<tr><td colspan="2">Any three points Or Graph for each culture page 91,92</td></tr>
</table>
OR<br>
A Aeration /to improve oxygen transfer<br>
B Provides hinderance to diffusion of air and denaturation of protein.<br>
C For mutagenesis to generate mutants for strain selection
</td><td>3<br><br>1<br>1<br>1</td></tr>
<tr><td>19</td><td></td><td>Crude homogenate(cell)added to biphasic mixture of dextran and PEG.<br>PEG is soluble constituent of cell homogenate.<br>Dextran is cellular debris, nucleic acid by nucleases and lipid by using glass wool.<br>Page 42</td><td>3</td></tr>
<tr><td>20</td><td>A<br><br><br><br>B<br><br><br>c</td><td>5’ A G↓C T 3’ Blunt End - Alu I<br>5’ T C↑G A 5’<br><br>5’ G↓A A T T C 3’ Sticky End- EcoR I<br>5’ C T T A A↑G 5’<br><br>Sticky ends can base pair and help ligation. Table 1 page 5</td><td>1<br><br><br><br>1<br><br><br>1</td></tr>
<tr><td>21</td><td></td><td>Southern Hybridisation technique page 20 , figure 10<br>OR<br>Page 9 , figure 4(a & c)<br>As YEp can be propagated in both prokaryotic (E.coli) and eukaryotic (Yeast) hosts therefore it is called a shuttle vector.</td><td>3<br><br><br>2+1</td></tr>
<tr><td>22</td><td></td><td>Transformation, transfection, electroporation, microinjection, biolistic, vectors (explanation of any three) page 14-15</td><td>3</td></tr>
<tr><td>23</td><td></td><td>Ref Seq: Ref Seq is a curated database of mRNA and proteins of humans, mouse, rat.<br>Homologues: Similarity due to common ancestry and have same function.<br>Paralogs : Duplicated Genes within a genome may have similarties but may differ in functions.<br>OR<br>BLAST: Basic Local Alignment Search Tool<br>A given sequence is compared with sequences in databases. Top scoring matches are ranked accordingly to set criteria that serve to distinguish</td><td>1<br><br>1<br><br>1<br><br><br>1</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | between similarity due to ancestral relationships or due to random chance. True matches are further examined thoroughly with other details accessible through ENTREZ and other tools. | 2 |
| 24 | | Page 80 table 6(any 3) | 3 |
| 25 | | Splice Variants, overlapping genes, Repeated Sequence and gaps between genome. Number of genes are not related to complexity of organisms. Page 61 | 3 |
| 26 | A<br>B<br><br><br><br>C<br><br><br><br>A<br>B<br><br>C | Can divide mitotically and differentiate into specialized cell types.<br>Pleuripotent can differentiate into all types of specialized cells and multipotent into limited no. of cells, lineage restricted.<br>Multipotent, by maintaining normal turnover of regenerative organs like blood, skin etc.<br>Leukemia, heart disease, paralysis, spinal cord injury, burns.<br>(any three)<br>**OR**<br><br>**Gene knock out-** selectively remove a gene.<br>Used to understand genetic basis of diseases, new diagnostic and therapeutic modalities.<br>James Thomson inner cell mass of blastocyst. | 1½<br>½ +½ +1<br><br><br>1½<br><br><br><br>1<br>2<br><br>2 |
| 27 | | • Collect leaf disc/embryo callus<br>• Infect with disarmed Ti containing Agrobacterium<br>• Infected Tissue cultured on shoot regeneration medium for 2-3 days to transfer T-DNA along with foreign gene.<br>• Transformed tissue, transfer to selection cum plant regeneration medium having lethal concentration of **kanamycin**.<br>• After 3-5 weeks, regenerated transformed shoot are transferred to root inducing medium.<br>• After another 3-4 weeks complete plants are transferred to field for hardening.<br><br>By looking for the desired trait in the transgenic plant (morphological or DNA marker)<br>Diagram page no 122<br>**OR** | ½x6=3<br><br><br><br><br><br><br><br><br><br>1<br>1 |
| | A<br><br>B | Edible vaccine- genes and encoding antigen, proteins are isolated and expressed in parts of edible plants such as fruits which can be eaten raw.<br>• No storage problem<br>• Easy Delivery System<br>• Low Cost<br>• Painless Delivery System<br>Any three as on page 130 | 2<br><br>3 |

| | | | |
|---|---|---|---|
| 28 | A<br>B<br>C<br><br>D | Proteins which have nutritive and pharmaceutical value.<br>It is a good source of beneficial bacteria and helps in Intestinal function.<br>Whey protein elevates the tripeptide glutathione which can treat a spectrum of illnesses.<br>Meat , sausages, cake and bread (any 1) | 2<br>1<br>1<br><br>1 |