JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program: T.Y.B.Sc.

Proposed Course: BOTANY

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2019 - 20

T.Y.B.Sc. Botany Syllabus

Academic year 2019 -2020

Semester VI			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SBOT601	**BRYOPHYTA, PTERIDOPHYTA & GYMNOSPERMS**	2.5	4
SBOT602	**ANGIOSPERMS, ANATOMY, EMBRYOLOGY & ECONOMIC BOTANY**	2.5	4
SBOT603	**PHYSIOLOGY, GENETICS & BIOSTATISTICS**	2.5	4
SBOT604	**BIOTECHNOLOGY, BIOINFORMATICS, BIODIVERSITY & RESEARCH METHODOLOGY**	2.5	4
SBOT6PRI	**Practicals based on paper I and II**	3	8
SBOT6PRII	**Practicals based on paper III and IV**	3	8

Semester VI – Theory

Course code: SBOT601	**PAPER I : BRYOPHYTA, PTERIDOPHYTA & GYMNOSPERMS (Credits : 2.5 Lectures/Week:4)**	
	Learning Objectives: • They will learn in depth different classes of bryophytes and Pteridophytes. It covers origin and evolution, economic and ecological importance of bryophytes and pteridophytes • They learn lifecycles of three genera belonging to an important class coniferophyta of Gymnosperms along with the economic importance of Gymnosperms. **Learning Outcomes:** • They will be able to differentiate between different classes of bryophytes and Pteridophytes and also understand their evolutionary aspect as well as ecological significance. • They will be able to differentiate between different between genera belonging to class coniferophyta and also learn their economic significance.	
Unit I	**Unit I : Bryophyta** • Life cycle of *Marchantia* • Life cycle of *Pellia* • Life cycle of *Pogonatum* • Life cycle of *Sphagnum*	**15 L**
Unit II	**Unit II : Pteridophyta** • Lepidophyta – Classification, general characters; Life cycle of *Lycopodium* • Calamophyta – Classification, general characters; Life cycle of *Equisetum* • Pterophyta – Classification and general characters, Life cycle of *Adiantum* and *Marselia*	**15 L**
Unit III	**Unit III : Bryophytes and Pteridophytes: Applied aspects** • Ecology of Bryophytes • Economic importance of Bryophytes • Bryophytes as indicators • Evolution of Sporophyte and Gametophyte • Origin of Byrophytes and Pteridophytes • Economic importance of Pteridophytes • Types of sori and evolution of sori	**15 L**
Unit IV	**Unit IV : Gymnosperms** • Life cycle of *Biota (Thuja*), • Life cycle of *Gnetum*, • Life cycle of *Ephedra* • Economic importance of Gymnosperms	**15 L**
References: • Gangulee, Das & Datta, College Botany, Volume II, New Central Book Agency,2006 • Vashishta B. R. &Sinha, A. K., Botany for degree studentsBryophyta, S. Chand, 1st		

Edition,2010
- Vashishta B. R. & Sinha, A. K., Botany for degree studentsPteridophyta, S. Chand, 1st Edition,2010
- Vashishta B. R. & Sinha, A. K., Botany for degree students Gymnosperms, S. Chand, 1st Edition, 2010

Course code: SBOT602	**PAPER II: ANGIOSPERMS, ANATOMY, EMBRYOLOGY & ECONOMIC BOTANY** **(Credits : 2.5 Lectures/Week:4)**	
	Learning Objectives: • Students will study different systems of classification and will be made aware of recent development in the field of taxonomy and systematics. They will also study of morphological characters in detail. • Students will be taught the relation of anatomy with ecology. • Students will learn the process of gametogenesis as well as different types of embryos and its development in plants. • Student will learn about extraction processes for oils and fats as well as their economic value. **Learning Outcomes:** • Students will be familiarised with recent trends in systematics • Study of morphological characters will help them to easily identify the field plants. • Students will be able to understand anatomical adaptations for different environments • Students will understand the principle behind the use of different extraction procedures for oils and uses of essential oils fixed oils and vegetable fats.	
Unit I	**<u>Angiosperms</u>** Systems of Classification • Natural System: Bentham and Hooker • Artificial System: Linneaus • Phylogenetic: Engler and Prantl, Hutchinson • APG Classification of plants Study of following plant families • Combretaceae • Rhamnaceae • Asclepiadaceae • Labiatae • Euphorbiaceae • Scitaminae	**15 L**
Unit II	**<u>Anatomy</u>** Ecological anatomy • Hydrophytes – submerged, floating, rooted • Hygrophytes • Mesophytes • Sciophytes • Halophytes • Epiphytes • Xerophytes	**15 L**

Unit III	**Embryology** • Microsporogenesis and development of male gametophyte • Megasporogenesis - Development of monosporic type, examples of all embryo sacs • Types of ovules • Double fertilization • Development of embryo – *Capsella*	**15 L**
Unit IV	**Economic Botany** Study extraction, characterization and uses of: • Essential Oils: Extraction, perfume oils, oil of rose, sandalwood, patchouli, champaca, grass oils: *Citronella*, vetiver. • Fatty oils : Drying oil (linseed, soyabean and Tung oil), semidrying oils(cotton seed, sesame oil) and non-drying oils (olive oil and peanut oil, Coconut and Palm oil) • Vegetable Fats: Kokam Butter, Coco Butter	**15 L**

References:

- Gangulee, Das & Datta, College Botany, Volume II, New Central Book Agency, 2006
- Chopra G.L., Angiosperms,S. Nagin & Co. 1969
- Sharma O.P., Plant Taxonomy,Tata McGraw – Hill Publishing Co. Ltd., 1993
- Singh Gurucharan, Plant systematics, Oxford & IBH publishing Co. Pvt. Ltd., 3rd edition, 2012
- Davis P. H., & Heywood V. H., Principles of Angiosperm Taxonomy, Scientific Publishers, 2011
- Pandey B. P., Plant anatomy, S. Chand & Co. Ltd., 2012
- Fahn A., Plant anatomy, Pergamon Press,1967
- Esau K., Plant anatomy, John Wiley & Sons, 1953
- Roy P., Plant anatomy, New Central Book Agency, 2006
- Bhojawani S.S. & Bhatnagar S.P., The embryology of Angiosperms, Vikas Publishing House, 2009
- Maheshwari P., An introduction to embryology of Angiosperms, McGraw-Hill, NewYork, 1950
- Kochhar S. L., Economic Botany in the tropics, MacMillan India Limited, 1981
- Hill A., Economic Botany, McGraw Hill Publication, 1937

Course code: SBOT603	**PAPER III: PHYSIOLOGY, GENETICS & BIOSTATISTICS** **(Credits : 2.5 Lectures/Week:4)**	
	Learning Objectives: • Students will learn the structures, classification and nomenclature of important primary metabolites. Students will learn the basics of enzymology and its practical applications in the field of research. • The topic covers entire in depth knowledge on Nitrogen metabolism within the plant as well as in the surrounding atmosphere. • Students learn the important topics of linkage and crossing over and mutations its causes and types and some diseases caused due to mutations • Students will learn use of statistics in analysing biological data. **Learning Outcomes:** • Study of structures of primary biomolecules will help students understand and relate to other chemical molecules present in plants. • Enzymology studies will help students understand better the chemical aspect of reactions taking place in plants and teach them to think to provide solutions to agricultural problems. • Students will now be able to relate the earlier studied processes of photosynthesis with Nitrogen metabolism and its effects on overall growth of plants.. The measures to increase availability of nitrogen will also be understood • Students get an idea of genetical basis of variations seen in progeny as well as basis of genetically inherited diseases. • Students understand the role and importance of biostatistics in analysing biological data.	
Unit I	**<u>Plant Biochemistry</u>** • Structure of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids) • Enzymes: Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis Menten equation, competitive non-competitive, and uncompetitive inhibitors.	**15 L**
Unit II	**<u>Plant Physiology</u>** • Nitrogen Metabolism: Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia,(amination and transamination reactions) , nitrogen assimilation and carbohydrate utilisation. • Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins and Abscisic acid	**15 L**
Unit III	**<u>Genetics</u>** • Genetic mapping in eukaryotes: discovery of genetic linkage, gene recombination, construction of genetic maps, three point crosses and mapping chromosomes, problems based on the same	**15 L**

	• Gene mutations: definition, types of mutations, causes of mutations, induced mutations, the Ame's test • Metabolic disorders – enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenyl ketone urea, albinism, sickle cell anaemia	
Unit IV	**<u>Biostatistics</u>** • Test of significance student's *t*-test (paired and unpaired) • Regression • ANOVA (one way, two way) • Probability	**15 L**

Reference:

- De Robertis E. D. P., Saez F. A.& De Robertis E.M.F.,Cell Biology,Saunders, 1975
- Verma P.S. & Agarwal V.K., Cell Biology, S.Chand and Company, 2016
- Russell P.,IGenetics: A Molecular Approach,Pearson/Benjamin Cummings, 2nd Edition, 2006
- Russell P.,IGenetics: A Molecular Approach, Pearson Education, 3rd Edition, 2011
- Odum E.P. Barrett & Gary W.,Fundamentals of Ecology, Brooks Cole Publishing House, 2005
- Verma P.S.& Agarwal V.K., Environmental Biology, S.Chand and Company, 1996
- Taiz L. & Zeiger E., Plant Physiology, Sinauer Associates, 2010
- Verma V., Textbook of Plant Physiology, Ane Books India, 2007
- Mahajan B.K., Methods in Biostatistics: For medical students and research workers, Jaytee Medical Publishers, 2008

Course code: SBOT604	**PAPER IV: BIOTECHNOLOGY, BIOINFORMATICS, BIODIVERSITY & RESEARCH METHODOLOGY** **(Credits : 2.5 Lectures/Week:4)**	
	Learning Objectives: • Students further learn the applied aspects of biotechnology which includes gene sequencing techniques, PCR, DNA fingerprinting and DNA barcoding which are taught in detail. • Students are introduced to the field of bioinformatics. They learn about the various data bases which store biological data and also about the softwares which retrieve data. Application of bioinformatics in phylogenetic analysis and its role in designing or searching new molecules as potentially beneficial medicinal drugs is also covered. • The research methodology unit will make the students understand the concept of research, its types and a detail account of the research design. • The publication basics will make the student understand the structured writing of a report, referencing and plagiarism. **Learning Outcomes:** • Students will be able to use their knowledge of biotechnology and bioinformatics to understand current research articles on most recent developments in recombinant DNA technology. They will also understand its applications in the field of evolutionary studies, medicine and forensic science. • The student will use the basics studied about research in their academics for conducting projects and present them	
Unit I	**<u>Biotechnology</u>** • DNA sequence analysis – Maxam – Gilbert Method and Sanger's method • Polymerase Chain reaction • DNA fingerprinting • DNA barcoding: Basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat*K gene sequence, present status of barcoding in plants	**15 L**
Unit II	**<u>Bioinformatics</u>** • Organization of biological data, databases • Exploration of data bases, retrieval of desired data, BLAST. • Protein structure analysis and application • Multiple sequence analysis and phylogenetic analysis	**15 L**
Unit III	**<u>Biodiversity</u>** •Definition, diversity of flora found in various places •Evolution of biodiversity with one example of an evolutionary tree •Levels of biodiversity •Importance and status of biodiversity •Loss of biodiversity •Conservation of biodiversity: In situ (National Parks), ex situ (seed banks and gene banks), LBSAP (local biodiversity strategic action plan),	**15 L**

	•Genetic diversity- Molecular characteristics	
Unit IV	**<u>Research Methodology</u>** • Research Methodology • Meaning of Research: need and general objectives of research, • significance of research (emphasis on botany), criteria for good research • Types of research: Types of research, Research methods versus • methodology • Research problem – definition, selection and technique involved in Defining a problem. • Research Design – Meaning and need of research design, principles and features of a design, Concept of developing a research plan • Publication basics – Meaning, Types, Referencing- offline and online. • Report writing and scientific paper writing –Mechanics of writing and Precautions • Plagiarism- types and consequences, Oral and poster presentations –designing, colour combinations and use of videos and animations.	**15 L**

References:

- Russell P., I Genetics: A Molecular Approach, Pearson Education, 3rd Edition, 2011
- Molecular Biotechnology Principles and Applications of Recombinant DNA Technology By Bernard R Glick , Jack Pasternack and Cheryl Patten, 4th edition , American Society of Microbiology.
- Russell P., I-Genetics: A Molecular Approach, Pearson/Benjamin Cummings, 2nd Edition, 2006.
- Singh B.D., Plant biotechnology, Kalyani Pub. 2006
- Ignacimuthu S., Plant Biotechnology, Oxford & Ibh Publishing Company Pvt Limited, 2005
- Mahajan B.K., Methods in Biostatistics: For medical students and research workers, Jaypee Brothers Medical publishers, 2008.
- Kothari C.R., Research methodology – Methods and Techniques (Second Revised Edition), New Age International Publishers, 2004
- Roig M., Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. U.S. Department of Health & Human Services: Office of Research Integrity, 2011

Semester VI – Practical

Course Code: SBOT6PRI	**PRACTICAL PAPER I AND PAPER II (Credits : Practicals/Week: 8)**
	Learning Objectives: • They will observe microcopical details of genera belonging to different classes of bryophytes and Pteridophytes. They will also observe specific types of soral arrangements as seen in Pteridophytes. Along with this they will observe microscopic details of three genera belonging to an important class Coniferophyta of Gymnosperms and visually compare the differences. • Students will observe anatomical adaptation in plants growing in different ecological habitats. • Students will observe different stages of development of process of megsporogenesis, microsporogenesis and embryo development in Angiosperms. • Student will learn perform the extraction of essential oils using Clavenger's Apparatus. • Students will perform various tests and experiments for detecting adulterants in edible oils. **Learning Outcomes:** • They will be able to identify and differentiate between different genera belonging to classes of Bryophytes, Pteridophytes and Gymnosperms on field. • Students will be able to differentiate between different stages of megaspore, microspore and embryo development. • Students will understand the principle behind the use of different extraction procedures for oils and uses of essential oils, fixed oils and vegetable fats. • Students will understand the importance of analysis to detect adulterants.
	Bryophyta Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides • *Marchantia* • *Pellia* • *Pogonatum* • *Sphagnum* **Pteridophyta** Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides • *Lycopodium* • *Equisetum* • *Adiantum* • *Marselia* **Bryophytes and Pteridophytes: Applied aspects**

- Economic importance of Byrophyta
- Economic importance of Pteridophyta
- Types of sporophytes in Bryophyta (from Permanent slides)
- Types of sori and soral arrangement in Pteridophytes

Gymnosperms

Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides

- *Thuja/ Biota*
- *Gnetum*
- *Ephedra*
- Economic importance of Gymnosperms

Angiosperms

Study of one plant from each of the following Angiosperm families

- Combretaceae
- Rhamnaceae
- Asclepiadaceae
- Labiatae
- Euphorbiaceae
- Scitaminae

Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families

- Identify the genus and species with the help of flora

Anatomy

Study of Ecological Anatomy of:

- Hydrophytes: *Hydrilla* (stem), *Nymphaea* (petiole), *Eichhornia* (offset)
- Epiphytes: *Vanda* (Hanging root)
- Sciophytes: *Peperomia* (leaf)
- Xerophytes: *Nerium* (leaf), *Opuntia* (phylloclade)
- Halophytes: *Avicennia* (leaf and pneumatophore), *Sesuvium* / *Sueda (*leaf)
- Mesophytes: Vinca/ Sunflower (leaf)

Embryology

- Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs
- Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo

Economic Botany

- Demonstration : Extraction of essential oil using Clevenger.
- Thin layer chromatography of essential oil of patchouli and *Citronella.*
- Saponification value of palm oil.
- Determination of Nickel in Vanaspati.
- Test for presence of Argemone oil in Mustard oil.

	• TLC for Mustard oil • Test for presence of Olive residue oil in Olive oils. • Test for presence of mineral oil in edible oils. • Test for presence of Rancidity. • Test for presence of Linseed oil • Test for sesame oil.
Course Code: SBOT6PRII	**PRACTICAL PAPER III AND PAPER IV (Credits : Practicals/Week: 8)**
	Learning Objectives: • Students will perform enzymatic assays and biochemical analysis to detect plant metabolites. • Students will learn to determine the sequence of genes on chromosomes by using given biological data. • Students will learn to detect mutations occurring in given sequence of messenger RNA strands. • Students will learn to observe and detect effects of mutagens on chromosome microscopically. • They will learn to use the knowledge of biostatistics to analyze biological data. • Students will use various softwares tools to compare gene and protein sequences with data available online in databases and will also be able to derive phyllogenetically compared data for required samples . They will also be able to use softwares for comparing the structures of proteins under study. • Techniques to determine DNA barcoding analysis will be taught. • Students will actually undertake, design, perform and analyse experiments and derive and interpret results. They will also be able to test their observed data for its statistical significance using the principles of biostatistics. **Learning Outcomes:** • Students will master the technique of biochemical analysis to analyze large number of samples. • Students will be able to use the softwares and computers for analysis of biological data. • The student will use the basics studied about research in their academics for conducting projects and present them.
	Biochemistry • Estimation of proteins by Biuret method • Effect of temperature on the activity of amylase • Effect of pH on the activity of amylase • Effect of substrate variation on the activity of amylase **Physiology** • Determination of alpha-amino nitrogen • Study of NR activity • Effect of GA on seed germination • Estimation of reducing sugars by DNSA method

	Genetics • Problems based on three point crosses, construction of chromosome maps • Identification of types of mutations from given DNA sequences • Study of mitosis using pre-treated root tips of *Allium* **Biostatistics** • *t*-test (paired and unpaired) • Problems based on regression analysis • ANOVA • Probability **Plant Biotechnology** • DNA sequencing (Sanger's Method) • DNA barcoding of plant material by using suitable data **Bioinformatics** • BLAST: nBLAST, pBLAST • Multiple sequence alignment • Phylogenetic analysis • RASMOL/ SPDBV **Biodiversity** • Preparation of vegetation map using Garmin's GPS Instrument • Problems based on Simpson's diversity Index **Research Methodology** • Research projects

Evaluation Scheme

[A] Evaluation scheme for Theory courses

I. Semester End Examination (SEE)- 100 Marks

[B] Evaluation scheme for Practical courses: 50 Marks

Note:

1. A minimum of four field excursions (with at least one beyond the limits of Mumbai) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.
2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of TYBSc Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of TYBSc Botany as per the minimum requirements. In case of loss of journal a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were completed by the student. However such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

T.Y.B.Sc. Botany Practical Paper Pattern **Credit System**

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI

PRACTICAL I

Duration: 3 hours **Max. Marks: 50**

Q. 1 Identify, classify and describe specimen **A** and **B**. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. **10M**

Q. 2. Identify, classify and describe specimen **C** and **D**. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. **10M**

Q.3 Identify, classify and describe specimen '**E**'. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. **07M**

Q. 4. Identify and describe slides/specimen **'F'**, **'G' 'H', 'I' & 'J'.** **15M**

Q. 5. Viva – voce (based on Paper I and Paper II). **04M**

Q. 6. Journal **04M**

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A & B- *Marchantia, Pellia Pogonatum & Sphagnum*
C & D- *Lycopodium, Equisetum, Adiantum* & *Marsilea*

E-Gymnosperm- *Thuja, Gnetum & Ephedra*

F, G & H , **I & J**- [In random order]
Economic importance of Bryophytes
Economic importance of Pteridophytes
Types of sporophytes in Bryophyta
Types of Sori in Pteridophytes
Soral arrangement in Pteridophytes
Economic importance of Gymnosperms

T.Y.B.Sc. Botany Practical Paper Pattern **Credit System**

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI

PRACTICAL II

Duration: 3 hours **Max. Marks: 50**

Q. 1 A. Perform the given experiment **'A'** as per slip **6M**

Q. 1 B. Perform the given experiment **'B'** as per slip **8M**

Q. 2 A. Classify specimen '**C'** upto their families giving reasons. Give floral formula. Sketch and labelled L.S. of flower and T.S. ovary. **10M**

Q. 2.B. Identify genus and species of specimen '**D'** using flora. **05M**

Q. 3 Make a stained preparation of specimen '**E'** and comment on its ecological anatomy. **08M**

Q. 4 Identify and describe slide/specimen '**F', 'G' and** '**H'**. **09M**

Q. 5 Field diary **05M**

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Key- Paper-II

A & B- Experiments based on Economic botany

C- Families of T.Y.B.Sc (SEM VI) only

D-Plants from F.Y., S.Y. & T.Y.B.Sc SEM V Families to be included

E-Ecological anatomy

F, G & H [In random order]- Economic importance of specimen from prescribed families (sem VI only) & Embryology

T.Y.B.Sc. Botany Practical Paper Pattern **Credit System**

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI

PRACTICAL III

Duration: 3 hours **Max. Marks: 50**

Q. 1. Perform the experiment **'A'** allotted to you. **10**

Q. 2. Perform the experiment **'B'** allotted to you. **10**

Q.3. Make a squash preparation to show the stage of mitosis from the pre-treated root tips **'C'**. **05**

Q. 4. Construct a chromosome map from the given data **'D'**/ Identify the type of mutation and comment on them (any two types of mutations) **10**

Q. 5 From the given data/ material **'E'** determine test of significance using student's t test/regression analysis/ ANOVA/ Probability **10**

Q. 6. Journal. **05**

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A: Plant Biochemistry Experiment

B: Plant Physiology Experiment

C: PDB/ tobacco treated root tips

D: Problems on Linkage/point mutations

E: Problems from 't' test/ regression analysis/ANOVA/Probability

T.Y.B.Sc. Botany Practical Paper Pattern **Credit System**

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI

PRACTICAL IV

Duration: 3 hours **Max. Marks: 50**

Q. 1. Perform the DNA barcoding of plant material using given data **'A'** **06**

OR

Perform DNA sequencing by Sanger's method of the given sequence **'A'**. **06**

Q. 2. Calculate Simpson's Diversity Index from the given data **'B'**. **08**

Q. 3. Perform the given analysis of data **'C'** using computer (Bioinformatics – BLAST/MSA/RASMOL/SPDBV/Phylogenetic analysis). **06**

Q. 4. Submission of Project report and presentation. **30**

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