

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Sciences <i>(Honors)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BOSC –VIII T	
2	Course Title	Molecular biology and Biostatistics	
3	Course Type	Discipline Specific course (DSC)	
4	Pre-requisite (if, any)	<i>As per program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> ➤ Students should know about cellular and gene regulation to understand genomic functions ➤ Understand the concept of ‘one gene one enzyme hypothesis’ along with the molecular mechanism of mutation ➤ Students will be familiar with the genetic material DNA structure its role and defects and repairing ➤ Students will be familiar with the RNA structure its role ➤ Students will be familiar with data handling. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Nucleic acids: Carriers of genetic information. Introduction, DNA as the carrier of genetic information (Griffith's, McLeod & McCarty experiment). The Structures of DNA and RNA / Genetic Material DNA Structure: Watson and Crick model, Salient features of double helix, Organization of DNA Prokaryotes, Viruses, Eukaryotes. Types- A-DNA, B-DNA C- DNA Z- DNA RNA Structure –mRNA, tRNA and rRNA Organelle DNA -- mitochondria and chloroplast DNA. The replication of DNA Chemistry of DNA synthesis General principles – bidirectional, semiconservative and semi discontinuous replication Enzymes involved in DNA replication.		12
II	Mutation and DNA repair Structural and numerical changes in the chromosomes- chromosomal aberration- duplication, deletion, inversion, translocation, gene mutation- transition and transversion, polyploidy- euploidy and aneuploidy., DNA damage and repair		11
III	Protein synthesis and gene regulation Genetic code Genetic code (deciphering and salient features) Transcription Concept of central dogma, Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Gene silencing. Processing and modification of RNA Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA tail). Translation Ribosome structure and assembly, mRNA; aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.		11
IV	Biostatistics : Graph, central tendency (Mean, median and mode) Standard Deviation, Standard error Chi square test, regression, degree of freedom		11
<i>Keywords</i>	<i>DNA, RNA, protein synthesis, gene regulation, central tendency</i>		
Signature of Convener & Members (CBoS) :			

1. *R. Kumar*
2. *Kumar*
3. *Indira*
4. *M. S.*
5. *H.*

6. *Deep*
7. *Shanti*
8. *Meera*
9. *H.*
10. *Deep*

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th ed.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
5. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
6. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.

Reference books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
2. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
3. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. 6. W. H. Freeman and Co., U.S.A. 10th edition.
4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Online Resources–

➤ e-Resources / e-learning portals

- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

➤ e-Resources / e-books and e-learning portals

- <https://www.springer.com/gp/book/9789811391767>
- <https://www.springer.com/gp/book/9789811550720>
- https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
- <https://www.mooc-list.com/tags/genetics>
- <https://www.coursera.org/learn/genetics-evolution>
- <https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

① R. Roy
② Anand
③ Anshu
④ M. Anshu
⑤ Anshu
⑥ Anshu
⑦ Anshu
⑧ Anshu
⑨ Anshu
⑩ Anshu

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSC -08	
2	Course Title	Lab. Course-08 (Molecular biology and Biostatistics)	
3	Course Type	Laboratory course	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	After the completion of the course the students will be able to: <ul style="list-style-type: none"> ➤ Isolate DNA from plant cell and <i>E.Coli</i>. ➤ Learn chimera formation in various plants. ➤ Understand the functioning and application of spectrophotometer. ➤ Understand the interpretation of data with the help of statistical data. 	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ Isolation of DNA from plant cells. ➤ Quantitative measurement of DNA by Spectrophotometric method. ➤ Feulgen or hydrolytic staining of DNA. ➤ Chimera formation in Bougainvillea and other ornamental and other different plants. ➤ Isolation of plasmid DNA from <i>E. coli</i> . ➤ Isolation of <i>Rhizobium</i> from root nodules of leguminous plants. ➤ Isolation of <i>Agrobacterium tumifaciens</i> from tumours of dicot plants. ➤ Preparation of LB medium and raising <i>E. Coli</i>. ➤ DNA estimation by diphenylamine reagent/UV Spectrophotometry. ➤ Analysis of statistical data: Statistical tables, Central tendency - mean mode, median, standard deviation and standard error (using seedling population /leaflet size etc). ➤ Calculation of correlation coefficient values and finding out the probability. ➤ Computer application in biostatistics - MS Excel and SPSS 		30
Keywords	Spectrophotometer, Plasmid, colchicine, E.Coli, Central tendencies.		
Signature of Convener & Members (CBoS) :			

① *R. Divoor*
 ② *Leeds*
 ③ *Melvin*
 ④ *M*

⑤ *[Signature]*
 ⑥ *[Signature]*
 ⑦ *[Signature]*
 ⑧ *Amey*
 ⑨ *[Signature]*
 ⑩ *[Signature]*

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Raghvan, V. (1997) Molecular Biology of Flowering Plants. Cambridge Univ. Press, New York, USA.
2. Biotechnology by B.D. Singh
3. Biotechnology by R.S. Singh
4. Practical Biotechnology: Principles and Protocols by Swagat Kumar Das Hrudayanath Thatoi, Supriya Dash.

Reference Books Recommended –

1. Zar, J.H. (2012). *Biostatistical Analysis*. Pearson Publication. U.S.A. 4th edition.
2. Brown, T. A. (1999) Genomes. John Willey and Sons Asia Pvt. Ltd., Singapore.
3. Callow, J. A. Ford-Loyd, B. V. and Newbury, H. J. (1997) Biotechnology and Genetic Resources: Conservation and Use. Cab International, Oxon, UK.
4. Glazer, A. N. and Nikaido, H. (1995) Microbial Biotechnology. Freeman and Company, New York, USA.
5. Hennery, R. J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall, London UK.
6. Jolles, O. And Jornvali, H. (2000) Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
7. Old, R. W. Primerose, S. B. (1989) Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford UK.
8. Primrose, S. B. (1995) Principles of Genome Analysis, Blackwell Scientific Publications, Oxford, UK

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- e-Resources / e-books and e-learning portals
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4890884/>
- https://www.k-state.edu/wgrc/electronic_lab/feul_stain_prot.html
- https://www.westga.edu/academics/research/vrc/assets/docs/spss_basics.pdf
- <https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/>
- <https://handelsmanlab.discovery.wisc.edu/wp-content/uploads/2018/01/Arapidmethod1989.pdf>
- <https://byjus.com/maths/central-tendency/>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05 Total Marks - 15	
End Semester Exam (ESE):35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

① Shriyash
 ② Nanda
 ③ Mallikarjun
 ④ [Signature]
 ⑤ [Signature]
 ⑥ [Signature]
 ⑦ [Signature]
 ⑧ [Signature]
 ⑨ [Signature]
 ⑩ [Signature]

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester -VIII	Session: 2024-2025
1	Course Code	BOSE -09 T	
2	Course Title	Plant Biotechnology and Crop Improvement	
3	Course Type	Discipline specific Elective (DSE)	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	<input type="checkbox"/> At the end of this course, the students will be able to <ul style="list-style-type: none"> ➤ The basic concept, scope and significance of Biotechnology. ➤ Micropropagation using meristem and shoot culture to produce large number of identical individuals. ➤ The role of biotechnology in crop improvement. ➤ Various applications of Biotechnology in different fields. 	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Fundamentals of Biotechnology: Basic concepts, principles and scope. Plant Cell and Tissue Culture: General concept, history, scope, totipotency, concept of cellular differentiation, tissue culture media and explants. Applications of Plant Biotechnology.		12
II	Organogenesis and Embryogenesis: Concept of morphogenesis, organogenesis and embryogenesis; Fundamental aspects of organogenesis in plant tissue culture, factors influencing organogenesis; somatic embryogenesis and androgenesis - mechanism, techniques and utility.		11
III	Somatic Hybridization: Concept of somatic fusion and hybridization; Protoplast isolation, fusion and culture, hybrid selection and regeneration; progress, possibilities, achievements and limitations of protoplast research.		11
IV	Application of Plant Tissue Culture in crop improvement: Clonal propagation, artificial seed, production of hybrids and soma clones, Soma clonal variation – cause & advantages and its application in crop improvement; production of secondary metabolites / natural products, cryopreservation and germplasm storage.		11 (11Hr)
Keywords	Biotechnology, Tissue Culture, Crop improvement, Clonal propagation		

Signature of Convener & Members (CBoS) :

① R. D. Saha
 ② K. S. Choudhary
 ③ K. S. Choudhary
 ④ K. S. Choudhary

⑦ S. K. Saha
 ⑧ S. K. Saha
 ⑨ S. K. Saha
 ⑩ S. K. Saha

⑤ S. K. Saha
 ⑥ S. K. Saha

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S. S and Razdan, N.K. (1996) Plant Tissue Culture: Theory and Practice, Elsevier Science Publishers, New York, USA
2. .Kantha, K.K. (1985) Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
3. Vasil, I. K. and Thorbe, T. A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, Netherlands.

Reference Books Recommended –

1. Smith, R. H. (2000) Plant Tissue Culture; Techniques and Experiments, Academic Press, New York.
2. Collins, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios. Scientific Publisher Oxford, U.K.

Online Resources–

- e-Resources / e-books and e-learning portals
- <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commercialization.>
- <https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology>
- <https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2>
-

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

① P. P. P.
② P. P. P.
③ P. P. P.
④ P. P. P.
⑤ P. P. P.
⑥ P. P. P.

⑦ P. P. P.
⑧ P. P. P.
⑨ P. P. P.
⑩ P. P. P.

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE-09 P	
2	Course Title	Lab. Course -09 (Plant biotechnology and crop improvement)	
3	Course Type	Laboratory course	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to understand- ➤ The basic techniques of Plant Tissue Culture. ➤ Screening programmes of cells, rather than plants, for advantageous characters. ➤ The biochemical and physiological aspects of plant growth. ➤ How to explore entrepreneurship avenues in this field.	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Familiarization with basic equipments in tissue culture. 2. Preparation of tissue culture (MS) medium. 3. Study of techniques of tissue culture: sterilization of glass wares and plant materials, transfer of explants on culture media, incubation.Up to callus formation 4. Initiation of organogenesis and embryogenesis using appropriate explants. 5. Isolation of plant protoplast by mechanical and enzymatic method 6. Test of viability by tetrazolium chloride (TZ) method. 7. Counting of protoplast in the suspension by haemocytometre method 8. Effect of physical and chemical factors in protoplast yield. 9. Demonstration of protoplast fusion employing PEG. 10. Visit to any tissue culture lab of your locality and a prepare project report.		30
Keywords	Medium, protoplast, tissue culture, TZ		

Signature of Convener & Members (CBoS) :

① <i>R. Sivey</i>	⑦ <i>Sudhin</i>
② <i>Sumit</i>	⑧ <i>Aniraj</i>
③ <i>M</i>	⑨ <i>H</i>
④ <i>[Signature]</i>	⑩ <i>[Signature]</i>
⑤ <i>[Signature]</i>	
⑥ <i>[Signature]</i>	

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. "Plant Tissue and Organ Culture fundamental Methods" by Gamburg OL and Philips GC, Publisher – Springer- verlag Heidelberg GmbH & Co. K
2. Practical Biotechnology by Ramadass Jaypee Brothers Medical Publishers

Reference Books Recommended

1. Biotechnology : fundamental and application by Ashok Ganguli, Publisher- Oxford book company

Online Resources–

- e-Resources / e-books and e-learning portals
- <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commericalization.>
- <https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology>
- <https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2>

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egvankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	

End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment		Managed by Course teacher as per lab. status
	A. Performed the Task based on lab. work	- 20 Marks	
	B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks		

Name and Signature of Convener & Members of CBoS:

① P. Siroor
② P. Siroor
③ M. Siroor
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⑤ M. Siroor
⑥ M. Siroor

⑦ M. Siroor
⑧ M. Siroor
⑨ M. Siroor
⑩ M. Siroor

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE -10 T	
2	Course Title	Applied Botany and Intellectual property right (IPR)	
3	Course Type	Discipline specific Elective (DSE)	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	At the end of the course, the students will be able to: <ul style="list-style-type: none"> ➤ Understand the scope and importance of Social forestry and establishment of orchard. ➤ Learn silvics of some important timber plants of India. ➤ Learn post-harvest management, marketing and value addition of commercial ornamental plants. ➤ Develop a deep understanding of different forms of intellectual property Rights (IPR) 	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Social forestry: Introduction, Definition, scope and objectives of social forestry. Classification of social forestry, Economic importance of social forestry, important scheme, choice of species for reclamation of waste land, over damp area, saline and alkaline area Layout and Establishment of Orchards: Pruning and training; propagation, Climatic requirement and cultivation of fruits like Mango, Banana, Citrus, Guava.		12
II	Silviculture: Definition, objective and scope of silviculture. Status of forest in India and their role. Trees and their distinguishing features. Regeneration: Natural, artificial and factors affecting it. Regeneration Survey. Tending operation: Weeding, cleaning, thinning and improvement felling. Silvics of important forest tree species e.g. Teak, Shorea, Sheesam.		11
III	Floriculture; History of Floriculture. Importance and scope of floriculture in India. Flower production - water and nutrient management, weed management, thinning and pruning, disbudding, use of growth regulators, physiological disorders and remedies, Harvesting techniques, post-harvest handling, pre-cooling, pulsing, packing, storage & transportation. Prolonging the vase life of flowers. Marketing and export potential of flowers, institutional support.		11
IV	IPR: Definition and significance of intellectual property rights (IPR), Overview of different types of IPR, including patents and its filing process, copyrights, trademarks their registration and infringement, trade secrets, Historical development and international frame works for protecting IPR, Salient feature of Patent Act 1970.		11
Keywords Social forestry, Orchard, Harvesting technique, Trademark			

Signature of Convener & Members (CBOS) :

① <i>R. Bose</i>	⑦ <i>Shelina</i>
② <i>Devi</i>	⑧ <i>Amity</i>
③ <i>...</i>	⑨ <i>...</i>
④ <i>...</i>	⑩ <i>...</i>
⑤ <i>...</i>	
⑥ <i>...</i>	

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended—

1. S, S, Negi: Social forestry
2. S.A.Shah & K.M.Tiwari: Forestry and people
3. G.P.D.Vyas: Social forestry and rural development
4. Jyoti Rattan 2024.Intellectual Property Rights

Reference Books Recommended –

1. Khanna,L.S.(1984).Principles and Practice of Silviculture,Khanna Bhandu,DehraDun.
2. Ram Prakash and L.S.Khanna.(1991)Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.
3. Champman ,G.W.and Allan,T.G.(1978).Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
4. Anonymous.(1976)Indian forest utilization.Volume Iand III CFRE Publication,Dehradun.
5. Mehta,T.(1981)A hand book of forest utilization.Periodical Expert Book Agency,Delhi.298

OnlineResources –

e-Resources/e-books and e-learning portals

www.ipindia.gov.in

www.wipo.int/aboutip/en/

[www.india.gov.in /topics/agriculture/floriculture](http://www.india.gov.in/topics/agriculture/floriculture)

[https://byjus.com/free-ias-prep/ipr-in-india-upsc notes/](https://byjus.com/free-ias-prep/ipr-in-india-upsc-notes/)

<https://vikaspedia.in/agriculture/farm-based-enterprises/floriculture>

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

① R.P. Singh
② S. S. Negi
③ M. S. Negi
④ S. S. Negi
⑤ S. S. Negi
⑥ S. S. Negi

⑦ S. S. Negi
⑧ S. S. Negi
⑨ S. S. Negi
⑩ S. S. Negi

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE-10 P	
2	Course Title	Lab. Course -10 (Applied Botany and Intellectual Property Rights)	
3	Course Type	Laboratory course	
4	Pre-requisite (if, any)	<i>As per program</i>	
5	Course Learning Outcomes (CLO)	At the end of this course, students will be able to: <ul style="list-style-type: none"> ➤ Understand forest structure and composition. ➤ Get knowledge about phenology of various species. ➤ Learn nursery bed preparation technique. ➤ Analyze the density and moisture content of wood. 	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> • Study of forest composition. • Recording the observations on phenological characteristics of different tree species. • Study of the natural and artificial regeneration. • Lay outting of nursery bed and soil preparation, types of seed sowing in nursery bed. • Study of gross features of different types of wood; straight interlocked, spiral and wavy grain, texture, lusture, etc. • Study of characteristics of trees/shrubs/grasses for agroforestry. • Volume and biomass estimation. • Crown measurement. • Study of vase life extension in cut flower using chemicals. • Study and description of botanical features of floricultural plants studied in theory paper. • Drafting a patent application: Students can learn how to draft a patent application for a new invention . • Trademark registration process: Students can learn how to register a trademark in India. 		30
Keywords	<i>Phenological, Wood grain, Nursery bed, Regeneration</i>		

Signature of Convener & Members (CBoS) :

① R. Pooja
 ② Renuka
 ③ M. S. Srinivasan
 ④ [Signature]
 ⑤ [Signature]
 ⑥ [Signature]
 ⑦ [Signature]
 ⑧ [Signature]
 ⑨ [Signature]
 ⑩ [Signature]

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Chundawat D S and Gautam SK (2010) Textbook of agroforestry. Oxford and IBH publishing co Pvt. Ltd.
2. . Nair, P.K.R. (1993) An introduction to agroforestry. Kluwer Academic Publishers. 499 p. 4. Huxley, P. (1999) Tropical agroforestry. Blackwell Science, Oxford.
3. Khosla, P.K. and Khurana, D.K. (1987) Agroforestry for rural needs. Vol. I and II, ISTS, Solan, H.P.
4. Ong, C.K. and Huxley, P.K. (1996) Tree crop interactions - A physiological approach. ICRAF, Kenya.
5. . Ramakrishnan, P.S. (1992) Shifting agriculture and sustainable development. Man and biosphere series. The Parthenon Publishing Group.
6. . SenSarma, P.K. and Jha, L.K. (1993) Agroforestry. Indian Perspectives. Ashish Publishers, Delhi.5. Khanna, L. S. (1984). Principles and Practice of Silviculture, KhannaBhandu, Dehra Dun.
7. 7. Ram Prakash and L.S. Khanna. (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.

Reference Books Recommended –

1. Champman, G.W. and Allan, T.G. (1978). Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
2. Anonymous. (1976) Indian forest utilization. Volume I and II ICFRE Publication, Dehradun.
3. Mehta, T.(1981) A handbook of forest utilization. Periodical Expert Book Agency, Delhi. 298
4. "Floriculture Principles and Species" by Dhiman Mukherjee
5. "Floriculture in India" by Jyotsna Singh and Ramesh Chandra
6. "Floriculture: A Basic Guide" by K.V. Peter
7. "Handbook of Flowering" by Jitendra Kumar
8. "Commercial Floriculture: Principles and Practices" by A.P. Misra and V.P. Singh
9. Intellectual Property Rights and Biotechnology by Shashikala Gupur and Sreenivasulu N.S.
10. Intellectual Property Rights and Plant Biotechnology by Ramanujam Srinivasan
11. Intellectual Property Rights: An Overview by Arul George Scaria

Online Resources–

> e-Resources / e-books and e-learning portals

- <https://ipindia.gov.in/form-and-fees.htm>
- <https://www.indiafilings.com/trademark-registration?matchtype=e&device>
- <https://www.youtube.com/watch?v=S7F6bCRBUDg&t=111s>
- <https://www.youtube.com/watch?v=SrWcYWzJJJ8>
- <https://www.youtube.com/watch?v=tYysC0dwtU0>
- https://www.youtube.com/watch?v=U5_nynPVdTY
- <https://www.youtube.com/watch?v=7faqx7N-pS4>
- <https://www.youtube.com/watch?v=AQdEXkVFGew>
- <https://www.youtube.com/watch?v=uDWiLCvc3IQ>

Online Resources–

> e-Resources / e-books and e-learning portals

- > www.swayam.ac.in
- > www.ignou.ac.in
- > www.egyankosh.ac.in
- > www.iitm.ac.in
- > www.eskillindia.org
- > www.eshiksha.mp.gov.in
- > www.vlab.co.in
- > www.internshala.com
- > www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBOS:

① *Rajiv*
 ② *Arundo*
 ③ *[Signature]*
 ④ *[Signature]*
 ⑤ *[Signature]*
 ⑥ *[Signature]*
 ⑦ *[Signature]*
 ⑧ *[Signature]*

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE -11 T	
2	Course Title	Biochemistry and Enzymology	
3	Course Type	Discipline specific Elective (DSE)	
4	Pre-requisite (if, any)	<i>As per program</i>	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to > Basic idea of life building block biomolecules. > Energy status of the cell > Basic carbohydrates, lipids and proteins structure > Biocatalyst enzymes	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<ul style="list-style-type: none"> • Structure of atoms, molecules and chemical bonds. • Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). • Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).. • Composition, structure and function of biomolecules (carbohydrates,). 		12
II	<ul style="list-style-type: none"> • Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. • Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP. 		11
III	<ul style="list-style-type: none"> • Lipids : structure and function, alpha and beta oxidation and anabolism. • Nucleic acids : DNA, RNA, Conformation of nucleic acids (helix (A, B,C, Z), t-RNA, mRNA, rRNA, HnRNA micro-RNA).hoogestein bridge, hairpin DNA 		11
IV	<ul style="list-style-type: none"> • Proteins- amino acids, primary, secondary, tertiary and quaternary structure. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). • Fundamentals of Enzymology: General aspect, classification, nature of enzymes, mode of enzyme action, allosteric mechanism, feedback method of inhibition, regulatory and active sites, isoenzymes, Ribozyme, Abzymes, kinetics of enzymatic catalysis, Michaelis – Menton equation and its significance. 		11
Keywords reaction kinetics, inhibition. active sites, Conformation, ATP			

Signature of Convener & Members (CBoS) :

Biophysical chemistry
Bioenergetics
Lipids
Nucleic acid
Protein
Enzymology

① *R. Prasad*
② *Harsh*
③ *M. S.*
④ *S. K.*
⑤ *...*
⑥ *...*
⑦ *...*
⑧ *...*
⑨ *...*
⑩ *...*

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books recommended:

1. Galaston, A. W., (1989) Life Processes in Plants. Scientific American Library, Springer- Verlag, New York, USA.
2. Hopkins, W. G. (1995) Introduction to Plant Physiology John Willey and Sons, Inc. New York, USA.
3. Dennis D. T., Turpin, D. H., Lefebvre D. D. and Layzell, D. B. (1997) Plant Metabolism. Longman, Essex, England.
4. Moore, T. C. (1989) Biochemistry and Physiology of Plant Hormone. Springer Verlag, New York.
5. Nobel, P. S. (1999) Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, USA.
6. Thomas, B. and Vince-Prue(1997) Photoperiodism in Plants. Academic Press; San Diego, USA.

Reference Books Recommended-

1. Taiz, L. and Zeiger, E., (1989) Plant Physiology. Sinauer Associates, Inc. Publishers, Massachusetts, USA.
2. Salisbury F. B. and Ross, C. W., (1992) Plant Physiology Wadsworth Publishing Co., California, USA
3. Lehninger : Principles Of Biochemistry by David L Nelson, Michael M Cox 2021

Online Resources-

> e-Resources / e-books and e-learning portals

1. <https://www.mdpi.com/journal/biomolecules>
2. <https://www.news-medical.net/life-sciences/An-Overview-of-Enzymology.aspx#:~:text=Enzymology%20is%20the%20study%20of,products%20control%20by%20equilibrium%20properties.>
3. [https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/06%3A_Metabolism/6.02%3A_Energy_and_Metabolism_-_Types_of_Energy](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/06%3A_Metabolism/6.02%3A_Energy_and_Metabolism_-_Types_of_Energy)
4. <https://www.thoughtco.com/dna-versus-rna-608191>

Online Resources-

> e-Resources / e-books and e-learning portals

- > www.swayam.ac.in
- > www.ignou.ac.in
- > www.egyankosh.ac.in
- > www.iitm.ac.in
- > www.eskillindia.org
- > www.eshiksha.mp.gov.in
- > www.vlab.co.in
- > www.internshala.com
- > www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

① R. P. Das
② M. S. Hund
③ K. S.
④ K. S.
⑤ K. S.
⑥ K. S.

⑦ S. S. S.
⑧ S. S. S.
⑨ S. S. S.
⑩ S. S. S.

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester -VIII	Session: 2024-2025
1	Course Code	BOSE -11 P	
2	Course Title	Lab. Course -11 P (Biochemistry and enzymology)	
3	Course Type	Laboratory course	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> ➤ Students will be familiar with the common biobuilding block ➤ Biochemical analysis of common biomolecules ➤ Enzyme kinetics and its role ➤ Characterization of light harvesting molecule chlorophyll. 	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/Experiment Contents of Course	<ol style="list-style-type: none"> 1) Biochemical test of carbohydrates, sucrose, glucose proteins, lipids 2) Biochemical test of Catalase, dehydrogenase, peroxidase test 3) Preparation of chlorophyll extract 4) Separation of chlorophyll by paper chromatography. 5) Separation of chlorophyll amino acids by paper chromatography. 6) Effect of temperature on enzyme activity 7) Effect of pH on enzyme activity 		30
Keywords	Biochemical test, Catalase, dehydrogenase, chlorophyll, enzyme		
Signature of Convener & Members (CBoS) :			

① R. Singh
 ② Kundu
 ③ M. S. ...
 ④ ...
 ⑤ ...
 ⑥ ...

⑦ ...
 ⑧ ...
 ⑨ ...
 ⑩ ...

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Biochemistry by Damodaran Geetha K (Author) Jaypee Brothers Medical Publishers
2. *Practical Manual of Biochemistry*, CBS Publishers & Distributors Pvt. Ltd. (1 January 2020); CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. Introductory Practical Biochemistry Paperback – 2 January 2001 by S.K. Sawhney (Editor), R. Singh (Editor) Narosa Publishing House
2. Practical Enzymology Author(s): Prof. Dr. Hans Bisswanger First published: 23 February 2011 Print ISBN: 9783527320769 | Online ISBN: 9783527659227 | DOI: 10.1002/9783527659227 Copyright © 2011 Wiley-VCH Verlag GmbH & Co. KGaA

Online Resources–

> e-Resources / e-books and e-learning portals

- 1) https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=KAUSHIK+G+G&search-alias=stripbooks
- 2) https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.mlsu.ac.in/econtents/1616_Biochemical%20Tests%20of%20Carbohydrate,%20protein,%20lipids%20and%20salivary%20amylase.pdf
- 3) <https://alevelbiology.co.uk/notes/tests-for-carbohydrates/>
- 4) <https://alevelbiology.co.uk/notes/test-for-proteins/>
- 5) <https://studymind.co.uk/notes/test-for-lipids-and-proteins/>
- 6) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121948/>

Online Resources–

> e-Resources / e-books and e-learning portals

- > www.swayam.ac.in
- > www.ignou.ac.in
- > www.egyankosh.ac.in
- > www.iitm.ac.in
- > www.eskillindia.org
- > www.eshiksha.mp.gov.in
- > www.vlab.co.in
- > www.internshala.com
- > www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05 Total Marks - 15	
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

① *Ramesh*
② *Ramesh*
③ *M*

④ *Ramesh*
⑤ *Ramesh*
⑥ *Ramesh*

⑦ *Mullin*
⑧ *Das*
⑨ *S*
⑩ *Uday*

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE- 12 T	<i>Genetic</i>
2	Course Title	Bioinformatics and Gené Technology	
3	Course Type	Discipline specific Elective (DSE)	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	At the end of the course, the students will be able : > Understand basics of bioinformatics and it's tools. > Learn application of bioinformatics in various areas. > Analyse and perform RAPD,RFLP,PCR etc. > Understand GMO and ethics behind the cloning.	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Biological Databases,Basic bimolecular concepts: Protein, and amino acid, DNA & RNA, Sequence Classification format ofBiological Databases.. National Center for Biotechnology Information (NCBI),Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB .		12
II	Applications of Bioinformatics : Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, protein sequencing, gene sequencing, Crop improvement.		11
III	Genetic technology : Recombinant DNA technology; restriction endonuclease, cloning vectors. Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting;Molecular DNA markers i.e. RAPD, RFLP. DNA sequencing, PCR and ReverseTranscriptase-PCR.		11
IV	Application of genetic technology: Genetically modified organism; bt cotton and btbrinjal.Transgenic crop; Golden rice. <i>Agrobacterium</i> transformation,Hybridomaand monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy, social, legal and ethical aspect of cloning.		11
Keywords Bioinformatics, Durg design, Crop improvement, ELISA			

Signature of Convener & Members (CBoS) :

① <i>R. S. S. S.</i>	⑥ <i>Blank</i>
② <i>Hand</i>	⑦ <i>Indira</i>
③ <i>M</i>	⑧ <i>Prity</i>
④ <i>Hand</i>	⑨ <i>K</i>
⑤ <i>Hand</i>	⑩ <i>Hand</i>

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A

Reference Books Recommended –

1. Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
2. Baxevanis, A.D. and Francis Ouellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
3. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
4. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.
5. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

Online Resources–

➤ e-Resources / e-books and e-learning portals

- <https://pubmed.ncbi.nlm.nih.gov/24272431/#:~:text=Bioinformatics%20is%20an%20interdisciplinary%20field,a%20computational%20point%20of%20view.>
- <https://byjus.com/biology/bioinformatics/>
- https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
- <https://www.geeksforgeeks.org/types-of-biological-database-in-bioinformatics/>
- <https://www.umass.edu/microbio/rasmol/techintr.htm#:~:text=RasMol%20is%20a%20molecular%20graphics,generation%20of%20publication%20quality%20images.>
- <https://www.intechopen.com/chapters/88596>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9696050/#:~:text=Bioinformatics%2C%20next%2Dgeneration%20sequencing%2C,improving%20crop%20quality%20%5B87%5D.>
- <https://www.enzolifesciences.com/science-center/technotes/2017/march/what-are-the-differences-between-pcr-rt-pcr-qpcr-and-rt-qpcr?/>
- <https://education.nationalgeographic.org/resource/genetically-modified-organisms/>

Online Resources–

➤ e-Resources / e-books and e-learning portals

- www.swavam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

① *R.P. Rao*
② *Sharma*
③ *...*

④ *...*
⑤ *...*
⑥ *...*

⑦ *...*
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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honours)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE -12 P	
2	Course Title	Lab. Course -12 (Bioinformatics and Gene Technology)	
3	Course Type	Laboratory course	
4	Pre-requisite (if, any)	As per program	
5	Course Learning Outcomes (CLO)	At the end of this course, students will be able to: <ul style="list-style-type: none"> ➤ Retrieve gene and protein from gene bank. ➤ Understand steps of production of GMO. ➤ Learn the isolation of plasmid DNA. ➤ Understand use and application of PCR. 	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> • Retrieve the gene from Gene bank and to save the sequence in FASTA format. • Retrieve the protein from Gene bank and to save the sequence in FASTA format. • Find the similarity of sequence for the given nucleotide or protein sequence. • Find the similarity of sequence for the given protein sequence. • Study of steps of genetic engineering for production of Bt cotton, Golden rice through photographs. • Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, micro projectile, bombardment. • Isolation of plasmid DNA. • Restriction digestion and gel electrophoresis of plasmid DNA. • Demonstration of PCR. 		30
Keywords	Gene bank , FASTA, Agrobacterium, PCR		

Signature of Convener & Members (CBoS) :

①	⑦
②	⑧
③	⑨
④	⑩
⑤	
⑥	

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Baxevanis, A.D. and Francis Ouellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
4. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

Reference Books Recommended –

1. Sarma, P V G K, 2021. A Practical Textbook of Genetic Engineering in Bacteria .
2. Yves Tourte, 2003 . Genetically Modified Organisms Transgenesis in Plants

Online Resources–

➤ e-Resources / e-books and e-learning portals

- <https://vvvcollege.org/dbt/LabManual-Bioinformatics.pdf>
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI0505%20LAB%20MANUAL.pdf
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7712542/#:~:text=Transfer%20the%20supernatant%20that%20contains,the%20purity%20of%20the%20DNA.>
- <https://miteshshrestha.wordpress.com/wp-content/uploads/2018/03/flavr-savr-tomato-golden-rice-bt-cotton.pdf>
- [https://www.deshbandhucollege.ac.in/pdf/resources/1589512616_Z\(H\)-VI-Biotech-1.pdf](https://www.deshbandhucollege.ac.in/pdf/resources/1589512616_Z(H)-VI-Biotech-1.pdf)
- https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.12%3A_Restriction_Digest_with_Gel_Electrophoresis
- <https://www.youtube.com/watch?v=matsiHSuoOw>

Online Resources–

➤ e-Resources / e-books and e-learning portals

- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2):	10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance -	05	
Total Marks -		15	

End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment	Managed by
	A. Performed the Task based on lab. work - 20 Marks	Course teacher
	B. Spotting based on tools & technology (written) - 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	as per lab. status

Name and Signature of Convener & Members of CBoS:

① Rajeev
② Mund
③ ...

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors / Honors With Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSC-08T	
2	Course Title	Biotechniques	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if, any)	<i>As per program</i>	
5	Course Learning Outcomes (CLO)	<p style="text-align: center;"><i>At the end of course, students will be able to -</i></p> <ul style="list-style-type: none"> ➤ Have comprehensive understanding of various tools and techniques commonly employed in scientific research across disciplines ➤ Learn utilizing essential laboratory instruments such as microscopes, pH meter, spectrophotometers, chromatography systems, and centrifuges. ➤ Understand cell culture techniques ➤ Develop skills in experimental design, data acquisition, and analysis using modern software tools. ➤ Develop critical thinking on the application of various modern instruments and correlate the knowledge for better development of society. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Microscopy and Microtomy: Types of Microscope: Basic Principle, configuration and working of Light Microscope (Bright and Dark Field), Magnification & Resolution, and Numerical Aperture. Phase Contrast Microscope, Fluorescence Microscope, Confocal Microscope. Electron Microscope (SEM and TEM). Microtomy: Permanent slide preparation through microtome: Tissue - preparation fixation, dehydration, block - preparation, trimming, cutting sections (sectioning /Ribbon) - handling, affixing on the side, labeling and storage, staining the microtomy slides.		11
II	Tools and techniques in Physiology: Principle and applications of pH meter, Centrifugation, Colorimetry and Spectrophotometry- UV, visible spectrophotometer, Infra-red spectrophotometer, NMR and ESR.		11
III	Chromatography and Eletrophoresis: Chromatography: Principle and Applications of Paper chromatography, Thin layer chromatography and Gel-filtration chromatography. Electrophoresis: Principle and Applications of Agarose gel electrophoresis, Polyacrylamide Gel electrophoresis, PAGE, 2D PAGE.		12
IV	Cell culture and Lab Bioethics: Cell culture and its basic requirements. Culture media: Nutrient and Non-nutrient media, Types of animal cell culture: Pure Culture- Pour Plate Method, Streak Plate Method and Spread Plate Method. Media preparation of Animal Cell culture, viability testing, cell harvesting and storage method with special reference to Lymphocytes and stem cell culture. <i>In Vitro</i> culture of <i>Entamoeba histolytica</i> , <i>Coenorhabditis elegans</i> . Sterilization technique (Physical Method: Autoclave sterilization, Hot air Sterlization, U V sterilization, filtration and chemical Method: alcohol, Formalin and Chromic acid), sterilization of glass wares, Media and laminar flow, Flow cytometry. Lab Bioethics: Lab safety, disposal of bio-waste.		11
Keywords	Cell culture, Sterilization, Cryopreservation, Media, viability testing, cell harvesting, Lymphocytes, stem cell.		
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Robert Braun, Introduction to instrumental analysis, McGraw Hill Publication
- Clark and Swizer, Experimental Biochemistry, Freeman, 2000
- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Sharma B.K., Principles of Instrumentation Goel Publishing House
- Upadhayay Upadhayay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House
- Arumugam N, Kumaresan V, Biotechniques Saras Publication
- Ghatak K L, Techniques and Methods in Biology PHI Learning

Online Resources–

- <https://www.youtube.com/watch?v=t9Zh3PJ4F4>

Online Resources–

- e-Resources / e-books and e-learning portals

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

SRahakar *Dr* *Arund* *Prof* *SRUK*
oh *eng*

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSC-08P	
2	Course Title	Biotechniques	
3	Course Type	Discipline Specific Lab Course	
4	Pre-requisite (if, any)	<i>As Per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Understand the purpose of the technique, its proper use and possible modifications/improvement. ➤ Developed skills in handling instruments. ➤ Developed skills in the performance of experiments through scientific planning. ➤ Develop critical thinking on reviewing, discussing and reporting the results. ➤ Applied and Correlate the knowledge for better development of society. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<p style="text-align: center;">List of labs to be conducted</p> <ul style="list-style-type: none"> • Study and handling of Compound Microscope, pH meter, Colorimeter, Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophoresis Unit, Microtome. • Sterilization of Lab equipments. • Determination of pH of different soil samples & water samples. • Determination of maximum absorption. • Separation of Amino acids, plant pigment and sugar by paper and thin layer chromatography • Separation of DNA and RNA through Paper & Gel Electrophoresis • Separation of particles by Centrifuge. • Preparation of Permanent slides through Microtome. • Preparation of Temporary and Permanente slides of some microscopic organisms. • Pure culture of cell. • Cell fractionation • Contour drawing through Camera Lusida • Preparation of Practical Record. • Group discussion/Viva or Seminar presentation on above mentioned and related topics. 		30
Keywords	Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophoresis Unit, Microtome, Cell fractionation, Camera Lusida.		

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sharma B.K., Principles of Instrumentation-
- Upadhyay Upadhyay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House

Reference Books Recommended –

- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Robert Braun, Introduction to Instrumental analysis

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayam_prabha/gb9ai2cttte

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks	
	Assignment/Seminar +Attendance - 05 Total Marks - 15		
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment		Managed by Course teacher as per lab. status
	A. Performed the Task based on lab. work - 20 Marks		
	B. Spotting based on tools & technology (written) – 10 Marks		
	C. Viva-voce (based on principle/technology) - 05 Marks		

Name and Signature of Convener & Members of CBoS:

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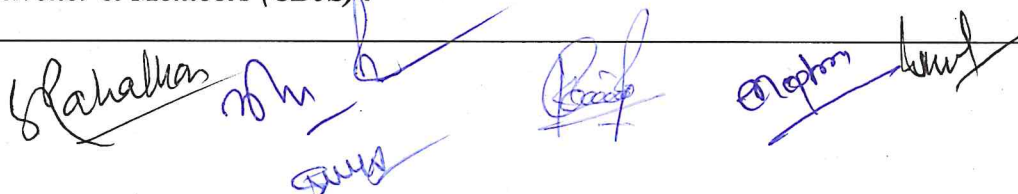
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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE- 09T	
2	Course Title	Basics of Computer and Biostatistics	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Understand the computer, its applications and use in biostatistics. ➤ Understand collection of biological data and analysis of the data. ➤ Learn about how the statistical data present. ➤ Developed critical thinking to analyze and represent the significance of the statistical data. ➤ Apply the knowledge in future for Research. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Unit-I: Computer structure and Applications: History of Computers, Structure of Computers, Classification of Computers, Introduction to digital computer- basic knowledge of hardware & software, CPU, Input and Output devices, Computer Codes: Decimal System, Binary number system, hexadecimal system, octal system, conversion of numbers. Introduction to MS Office- MS Word, MS Excel, MS Power point, Introduction of Internet, web-mail, various search engine, Plagiarism, Artificial Intelligence (AI).		12
II	Unit-II: Data collection, presentation, and Measures of central tendency: Collection and classification of data. Presentation of data: by Tables - rules for making tables, use of tables, Types of tables, By Graphs: rules for making graph & it's uses, Pie chart, Bar diagram, Histogram, Frequency polygon, Cumulative frequency curve (Ogive and Polygon). Measures of central tendency: Arithmetic Mean, Median, Mode.		11
III	Dispersion Correlation and Regression: Measures of dispersion: Standard deviation and Standard error. Correlation: Types, significance and application of correlation, calculation of correlation in continuous data and ordinal data. Regression: Linear regression, regression coefficient.		11
IV	Probability and Analysis of Significant Test: Probability: normal, binomial distribution and Poisson distributions. Hypothesis testing, Test of significance: Paired and unpaired t-test and Chi square test. Analysis of Variance (one & two way ANOVA).		11
Keywords	<i>Computer, MS Word, MS Excel, MS Power point, web-mail, central tendency, ANOVA, Hypothesis testing</i>		
Signature of Convener & Members (CBoS):			



PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and Health Sciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

National Digital Library

- <https://drive.google.com/file/d/1EaBH4SfE4AcdmoDzQ7iFwMSJkmSfIQet/view>
- <http://ndl.iitkgp.ac.in/he document/swayam ugc moocs/swayam ugc moocs/IN S U M 1 P C 3 B a M B 233 234?e=2|biostatistics||>
- <http://ndl.iitkgp.ac.in/he document/bharat skills/bharat skills/01 2434?e=0|basic%20computer||>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

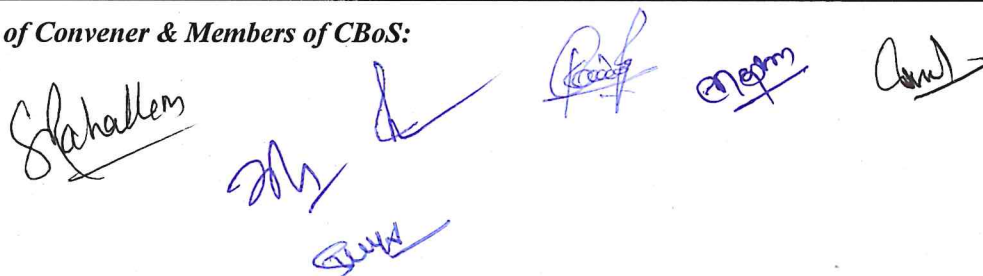
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE-09P	
2	Course Title	Basics of Computer and Biostatistics	
3	Course Type	Discipline Specific Elective Lab Course	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing lab course the students will be able to</p> <ul style="list-style-type: none"> ➤ Understand the computer, its applications and use in biostatistics practically. ➤ Understand and learn collection of biological data and analyzes them. ➤ Learn to present and interpret the analyzed data. ➤ Developed critical thinking to assess the significance of the statistical data and discuss the result. ➤ Apply the knowledge in future for Research. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<p style="text-align: center;">List of labs to be conducted</p> <ul style="list-style-type: none"> ➤ Exercise based on Microsoft word. ➤ Study of hardware & software. ➤ PPT Slide preparation using Microsoft Power Point. ➤ Data collection. ➤ Analyzing Data manually and through computer: Mean, Median, Mode, SD, SE, Correlation and regression and its interpretation. ➤ Tabular & Graphical presentation of data manually and using excel. ➤ Hypothesis testing by <i>t</i>-test, Chi-square test and ANOVA. ➤ Group discussion/Quiz/Seminar presentation on related topics. ➤ Practical Record or Lab assignment. 		30
Keywords	<i>Graphical presentation, hardware & software, Microsoft Power Point, Microsoft word.</i>		
Signature of Convener & Members (CBoS):			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and HealthSciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/libretexts/libretexts/ee0516013368a11b75812bda4e208f6?e=0|MEAN%20MODE%20MEADIAN||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

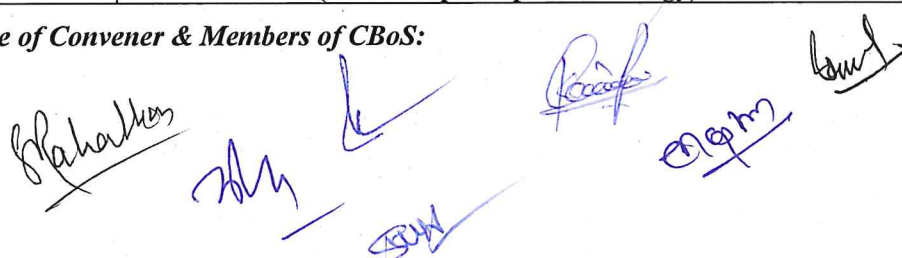
Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment	
	A. Performed the Task based on lab. work - 20 Marks	Managed by Course teacher as per lab. status
	B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE- 10T	
2	Course Title	Behaviour and Chronobiology	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Learn a wide range of theoretical knowledge about the animal behavior. ➤ Develop skills, to understand the responses of animal according to stimuli. ➤ Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. ➤ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. ➤ Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment. 	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Behaviour and the response invoking stimuli: Animal behavior: Scope and importance of study. Ethology: history & branches. Ethogram: analysis of behavior. Causation of Behaviour: Proximate and ultimate causes of behavior. Stimulus: Definition, Types of stimuli invoking response: internal and external. Patterns of behaviour: Foraging behaviour, Aggressive behavior, Territorial behaviour. Allelomimetic behavior. Stereotyped Behaviors: Taxis and Reflexes: Taxis: Phototaxis, Geotaxis, Thermotaxis, Thigmotaxis, Galvanotaxis, Chemotaxis and Rheotaxis, Klinotaxis and Telotaxis. Reflexes: Definition, Kinds- Localized, Tonic & Phasic, Types of reflex action unconditioned reflexes and Conditioned reflexes		12
II	Innate and Learning Behavior: Innate or Instinct Behaviour: Fixed action Pattern: Definition and Characteristics: Constancy, Resistance to Phylogenetic Changes, Concept of Sign, Innate Releasing Mechanism (IRM) and Action Specific Energy (ASE). Bird migration, Navigation and Orientation. Learning Behavior: Classical conditioning (Pavlov Experiment), Types of Conditioning: Forward, Backward, Simultaneous and Temporal conditioning. Properties of Conditioning: Generalization, Discrimination, Extinction, Recovery from Extinction, Acquisition, Reinforce, Positive and Negative conditioning. Habituation. Instrumental learning / trial and error. Imprinting: types of imprinting: filial and sexual. Reasoning and Insight learning. Neural mechanism of learning.		11
III	Social behavior and Evolutionary aspects of Behavior: Social organization in honey bee & Primates. Elements of Socio-biology: Eusociality, Selfishness, cooperation, altruism, kinship, reciprocation and inclusive fitness. Communication: chemical, visual, light, tactile and audio. Evolutionary aspects of behavior: feeding strategies, Mimicry and Colouration, Evolution of reproductive behavior: Theory of Sexual Selection, secondary sex characteristics, Parental care in Fish and Amphibia.		11
IV	Chronobiology: Biological Rhythm: Types of biological rhythm: Ultradian, Circadian and Infradian. Characteristics of rhythm: mesor, amplitude, acrophase, period and phase. Patterns of biological rhythm: Exogenous and Endogenous rhythm; Entrained and Free run rhythm. Advantages of biological rhythms. Biological clock: components of clock, functions of biological clock. Applications of chronobiology.		11
Keywords		Ethogram, Mimicry, Reflexes, biological rhythm, Parental care, Imprinting, Biological clock	
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer -Verlag, Germany.

Reference Books Recommended –

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition) Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology Biological Timekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- <https://g.co/kgs/TGgyveE>
- https://www.researchgate.net/profile/Atanu-Pati/publication/278157972_Chronobiology_The_Dimension_of_Time_in_Biology_and_Medicine/links/557c8b1208aec87640db4e73/Chronobiology-The-Dimension-of-Time-in-Biology-and-Medicine.pdf
- https://jimpas.com/admin/assets/article_issue/1643653535JMPAS_JANUARY_-FEBRUARY_2022.pdf
- <https://www.amazon.in/Concise-Book-Animal-Behaviour-Chronobiology/dp/819580571X>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

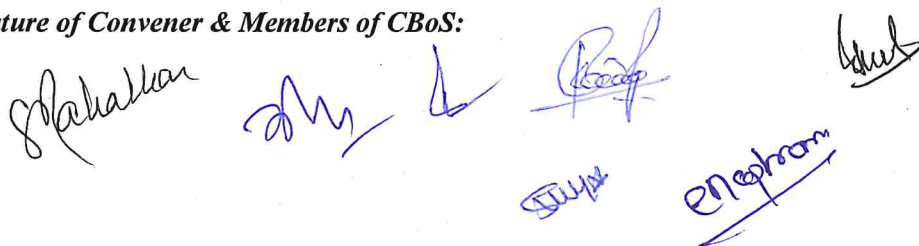
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE-10P	
2	Course Title	Behaviour and Chronobiology	
3	Course Type	Discipline Specific Elective Lab Course	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Learn a wide range of practical knowledge about the animal behavior. ➤ Develop skills, to understand the response of animals according to stimuli in lab. ➤ Objectively understand and evaluate information about animal behaviour and learn to form the ethogram. ➤ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the surroundings. ➤ Consider and evaluate behaviour of animals, including Human in the nature. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ Orientation of an animal in response to stimulus: To study geotaxis in earthworm and phototaxis in insect larvae. ➤ Constructing an Ethogram. ➤ Demonstration of learning behaviour in wasps to locate their burrow by using landmarks. ➤ Chemical communication in ants. ➤ Study of selective predation of coloured prey items through video/charts. ➤ Predatory behaviour of a carnivorous animal. ➤ Nests and nesting habits of the birds and social insects. ➤ Study the behavioural responses of wood lice to dry and humid conditions. ➤ Study of mimic animals in nature and take photographs. ➤ Study of circadian functions in humans (daily eating, sleep and temperature patterns). ➤ Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report. ➤ Group discussion or Seminar presentation on related topics. ➤ An “Animal album or Practical Record” containing sketches, photographs, cut outs, with appropriate write up about the above mentioned behavioural patterns. 		30
Keywords:	<i>Phototaxis, geotaxis, Predatory behavior, wood lice, circadian functions, temperature pattern, ethogram</i>		
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer - Verlag, Germany.

Reference Books Recommended –

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition) Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology Biological Timekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/1fvtujeiyjw?e=0|*||
- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/7j0mtol4jrc?e=11|*||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

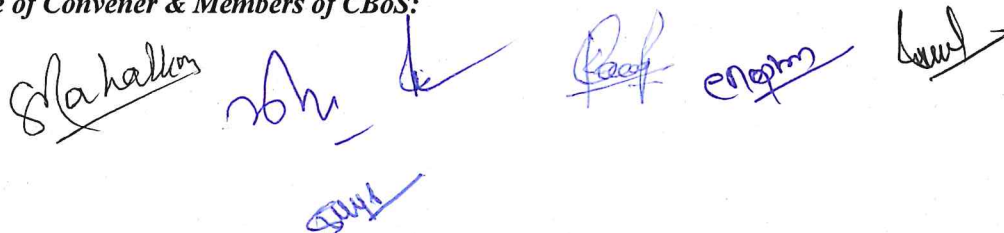
Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05	
	Total Marks - 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment	
	A. Performed the Task based on lab. work - 20 Marks	Managed by Course teacher as per lab. status
	B. Spotting based on tools & technology (written) – 10 Marks	
C. Viva-voce (based on principle/technology) - 05 Marks		

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science (Honors/ Honors with Research)		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE-11T	
2	Course Title	Developmental Biology	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Understand of the fundamental processes involved in embryonic development, including cell differentiation, morphogenesis, and patterning ➤ Explain mechanisms underlying developmental processes, ➤ Learn reproductive techniques commonly used in developmental biology ➤ Aware of current trends and advances in developmental biology research, including emerging technologies. ➤ Understand the relevance of developmental biology in medicine or its role in development of diseases. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<p>Gametes Biology: Biology of sex determination and differentiation, Origin of primordial germ cells. Morphology of different types of gametes: Male gamete and female gamete. Formation of Gametes: Process of Spermatogenesis, Biochemical changes in spermatogenesis and control of spermatogenesis, Semination. Process of Oogenesis, Biochemical changes in Oogenesis and control of Oogenesis, Vitellogenesis: Structure and composition of yolk. Ovulation and ovum transport in mammals. Infertility in Male and female: Causes and Cure. Fertilization: external and internal fertilization, Recognition of gametes, capacitation, acrosome reaction, activation of egg metabolism, migration of pronuclei, amphimixis and post fertilization changes in the egg cytoplasm. Block to polyspermy. Parthenogenesis.</p>		11
II	<p>Embryology: Cleavage: pattern and mechanism of cleavage, physiology of cleavage. Mosaic and regulative development, Direct and indirect development, Body plan and symmetries. Germ layer differentiation. Tubulation. Morphogenesis: Epiboly, Emboly/invasion, involution and ingression. Fate maps: Methods of construction of fate map, fate map of Amphioxus, Amphibians and Chick. Formative movements, Metamorphosis: In Insect and in frog. Hormonal regulation of metamorphosis. Cell signaling, cell adhesion during tissue organization, lateral inhibition, induction, and recruitment. Organogenesis: formation of gut, heart, kidney and muscles, molecular mechanism involved. Pleuropotency.</p>		11
III	<p>Developmental Biology: Organizer concept: Types, characteristics & mechanism of organizer. Extra embryonic membranes: Development and functions in chick. Axis Formation in Drosophila, Metamorphosis in insect and in Frog. Hormonal regulation of metamorphosis. Placenta: Structure, functions and its types. Regeneration: Types- epimorphosis, morphallaxis and compensatory regeneration, mechanisms and physiological processes involved in regeneration, ability of regeneration in invertebrates and vertebrates, difference between embryogenesis and regeneration and tissue repair. Concept of competence, determination and differentiation and growth. Ageing and apoptosis.</p>		11
IV	<p>Reproductive Technology and Reproductive Health: In vitro fertilization: Artificial insemination (AI); Gamete intra-fallopian transfer (GIFT), Intra-cytoplasmic sperm injection (ICSI), Zygote Intra Fallopian Transfer (ZIFT), Test tube baby. Causes of Infertility. Multiple ovulation and embryo transfer technology (IVF and IVET), Pre implantation genetic diagnosis (PGD). Ethics in surrogacy. Teratology & teratogens: wound healing, birth defects, developmental brain disorders. Neuro degeneration. Endocrine Disruptors & Cancer. Causes of Sexually transmitted diseases: HIV/AIDS & Human Papilloma virus (HPV), Syphilis. Menstrual Disorders, Polycystic Ovarian Disease & Polycystic Ovarian Syndrome (PCOD & PCOS).</p>		12
Keywords	Spermatogenesis, Oogenesis, Gametes, Fertilization, Development, Cleavage, Fate maps, Organizers, Teratology		
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Agrawal V K, Evolution and Developmental Biology, S Chand Publication
- Verma P S, Agrawal V K, Chordate Embryology, S Chand Publication
- Arumugam N, Embryology, Saras Publication
- Shasrti K V, Shukla Vinita, Developmental Biology, Rastogi Publication

Reference Books Recommended –

- Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
- Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
- Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press

Online Resources–

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>
- http://ndl.iitkgp.ac.in/he document/aklectures/aklectures/4 3 2 1638?e=15|*||
- http://ndl.iitkgp.ac.in/he document/swayamprabha/swayam prabha/cnqxwmzey1w?e=1|*||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

**Continuous Internal Assessment (CIA):
(By Course Teacher)**

Internal Test / Quiz-(2): 20 +20
Assignment / Seminar - 10
Total Marks - 30

Better marks out of the two Test / Quiz
+ obtained marks in Assignment shall be
considered against 30 Marks

End Semester Exam (ESE):

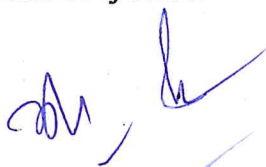
Two section – A & B

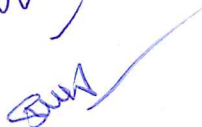
Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks

Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks

Name and Signature of Convener & Members of CBoS:







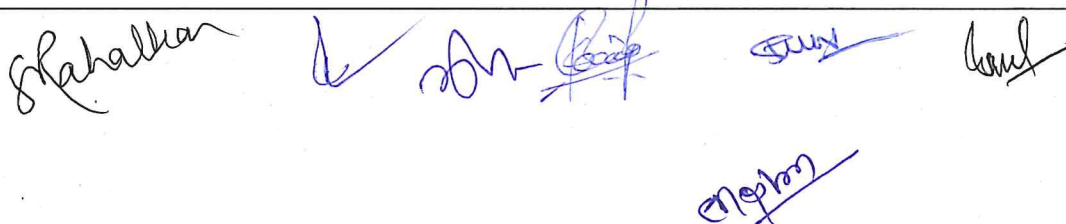






FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE-11P	
2	Course Title	Developmental Biology	
3	Course Type	Discipline Specific Elective Lab Course	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Acquire knowledge of the fundamental processes involved in embryonic development, Types of eggs ➤ Explain developmental processes and identify various stages of development through study of permanent slides , ➤ Learn experimental techniques commonly used in developmental biology ➤ Aware of current trends and advances in developmental biology research, including emerging technologies. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ Types of eggs based on quantity and distribution of yolk: sea urchin, insect frog, Chick. ➤ Comparative study of cleavage patterns in Frog and Amphioxus models. ➤ Study of cell movement, shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick through models and charts. ➤ Study of whole mounts and sections of developmental stages of frog through permanent slides: blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages) ➤ Study of whole mounts of developmental stages of chick through permanent slides -18 hours, 24 hours, 33 hours, 48 hours, 72 hours and 96 hours of incubation ➤ Extra embryonic membranes of chick through models and charts. ➤ In vivo study of chick embryo development by windowing and candling methods. (Demonstration only) ➤ Some videos to develop understanding on the process of development. ➤ Group Discussion / Quiz /Seminar / Project related topics ➤ Prepare practical record 		30
Keywords	<i>Types of eggs, Cleavage, frog, Chick Embryology, Chick Embryo Development Windowing</i>		
Signature of Convener & Members (CBoS) :			



PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- *Lal S S, Vertebrate Practical*
- *Phukan Luna Developmental Biology Practical, Mahaveer Publication*

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/pttau909f8a?e=0|living%20chick%20embryos%20%E2%80%93%20observations|||
- <https://egyankosh.ac.in/bitstream/123456789/16460/1/Unit-26.pdf>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment	
	A. Performed the Task based on lab. work - 20 Marks	Managed by Course teacher as per lab. status
	B. Spotting based on tools & technology (written) – 10 Marks	
C. Viva-voce (based on principle/technology) - 05 Marks		

Name and Signature of Convener & Members of CBoS:

(Mahalkar) *(S)* *(B)* *(S)* *(S)* *(S)*

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	ZOSE-12T	
2	Course Title	Molecular Biology	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario. ➤ Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields. ➤ Apply their knowledge in problem solving and future course of their career development in higher education and research. ➤ Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Chromosomes and Nucleic Acids: Chromosomes structure: Chromatin (Euchromatin and heterochromatin), Types of chromosomes. Histones, Histone-modifications. Structure of Nucleic acids: Structure and functions of DNA, DNA forms: Plasmid DNA, Genomic DNA and Repetitive DNA. DNA polymorphisms. DNA modifications. Structure and Function of RNA: Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA. RNA Induced Silencing Complex and CRISPR Technology. Mutation: Chromosomal and gene mutation.		11
II	Central dogma and DNA replication: Central dogma of Molecular Biology. DNA methylation. DNA-Protein interaction. DNA Replication, plasmid DNA replication and genomic DNA replication, Centromeric and Telomeric DNA replication, DNA replication and cell cycle regulation. DNA polymerases. DNA-damaging agents. DNA repairing.		11
III	Transcription: Concept of Transcription, RNA polymerase I, II, III, transcription factors. RNA processing, splicing of hnRNA into mRNA, 5'-capping and 3'-polyadenylation of mRNA, rRNA and tRNA modifications and processing. RNA editing, alternative splicing, trans-splicing, miRNA, siRNA, piRNA, lncRNA, RNA-protein complex.		11
IV	Translation: Structure of Ribosomes, Genetic Code, triplet codons, Wobble base, synonymous codons, degeneracy of codon. Translation in prokaryotic and Eukaryotic cells (Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome). Post-translational modifications and processing of proteins, large protein-protein complexes and protein trafficking Reregulation of protein synthesis in prokaryotic and eukaryotic cell.		12
Keywords	<i>Chromosomes, Nucleic Acids, CRISPR, tRNA, Transcription, Translation, Central dogma</i>		
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chaudhari K, Molecular Biology Text book IFAS Publication
- Verma P.S., Agrawal V.K., Molecular Biology S Chand

Reference Books Recommended –

- Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
- Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
- Cell Biology by De Roberties
- Gene by Lewine 7th to 11th edition

Online Resources–

- https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology,
- <https://www.tezu.ernet.in/Library/index.php/e-journals/55-microbiology-and-molecular-biology-education-0a>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

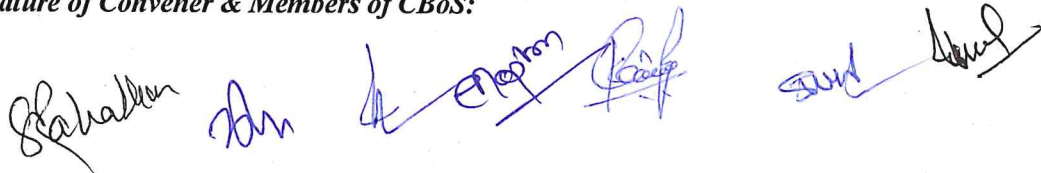
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Science <i>(Honors/ Honors with research)</i>		Semester VIII	Session: 2024-2025
1	Course Code	ZOSE-12P	
2	Course Title	Molecular Biology	
3	Course Type	Discipline Specific Elective Lab Course	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Mastery of fundamental laboratory techniques used in molecular biology, such as DNA extraction, PCR (Polymerase Chain Reaction), gel electrophoresis, DNA sequencing, and cloning. ➤ Ability to design experiments, including selecting appropriate methodologies, controls, and troubleshooting potential issues that may arise during experiments. ➤ Proficiency in analyzing experimental data, including interpreting ➤ Development of critical thinking skills to evaluate experimental results. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs). ➤ Preparation of RNA model for tRNA, mRNA and rRNA molecule (A=U and G=C base pairs) ➤ Preparation of Central dogma model with reference to Replication, Transcription and Translation i.e., Linear flow of genetic information. ➤ Isolation of genomic DNA by ethanol precipitation method. ➤ Preparation of model pBR322 ➤ Agarose gel electrophoresis of the plasmid DNA and the genomic DNA. ➤ Chromosomal staining ➤ Temporary slide preparation of Salivary gland chromosome from drosophila larva. ➤ Group discussion/Quiz/Seminar presentation on related topics. ➤ Practical Record or Lab assignment. 		30
Keywords	<i>Molecular Biology, DNA model, Central Dogma, Agrose Gel electrophoresis, chromosome, salivary gland chromosomes of Drosophila</i>		
Signature of Convener & Members (CBoS) :			

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sarma. PVGK, Molecular Biology Practical Manual, MJP Publisher
- Pranav Kumar, Fundamentals and Techniques of Biophysics and Molecular Biology, Pathfinder Publication

Reference Books Recommended

- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.

Online Resources–

- http://ndl.iitkgp.ac.in/he document/inflibnet epgp/inflibnet epgp/IN I e P P 1 Z 512 96 P 1 M c b 51376 51377?e=16*|||
- <http://ndl.iitkgp.ac.in/he document/swayam prabha/ke040dcj 84>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance -	05	
	Total Marks -	15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment		Managed by Course teacher as per lab. status
	A. Performed the Task based on lab. work	- 20 Marks	
	B. Spotting based on tools & technology (written)	- 10 Marks	
	C. Viva-voce (based on principle/technology)	- 05 Marks	

Name and Signature of Convener & Members of CBoS:

Shahar

Sh

Sunil

Prof

Dr

Dr

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

Department of Biochemistry

Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSC-08 T	
2	Course Title	Nutraceutical Biochemistry and Functional Foods	
3	Course Type	Discipline Specific Course (Theory)	
4	Pre-requisite (if, any)	As per the Program	
5	Course Learning Outcomes (CLO)	<p><i>On successful completion of the course, the student shall be able to:</i></p> <ul style="list-style-type: none"> ➤ Understand the Nutraceuticals in the context of the human well-being. ➤ Demonstrate necessary to understand the diet-health relationships and the importance of human evidence-based nutrition. ➤ Apply regulatory aspects of functional foods and the requirements for safety and efficacy assessment of nutraceutical and functional food. ➤ Apply the use of perspectives for improving the formulation of potential functional ingredients/foods. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Introduction to Nutraceuticals as Science: Historical perspective, classification, scope and future prospects. Scrutinising the term ‘nutraceutical’, Regulation of various countries. Medicinal Plants: Ethnomedicine in India, Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition		12
II	Properties, structure and functions of various Nutraceuticals: Glucosamine, Octacosanol, Lycopene, Flavonoids, Carnitine, Melatonin and Ornithine alpha, ketoglutarate. Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals. Nutraceutical Industry and Market Information, New technologies in development of Nutraceuticals and functional foods Functional Foods, Scope of Genetic engineering, Nutritional Genomics		11
III	Food as remedies: Nutraceuticals bridging the gap between food and drug, Special Dietary Needs, Disease and Nutrition; Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.		11
IV	Anti-nutritional Factors present in Foods: Types of inhibitors present in various foods and how they can be inactivated. General idea about role of Probiotics and Prebiotics as nutraceuticals. Recent advances in techniques & feeding of substrates. Assessment of nutritional status and Recommended Daily allowances.		11
Keywords	Plant product, Active compounds, food, remedy		

Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources		
Text Books, Reference Books and Others		
<i>Text Books Recommended –</i>		
<ul style="list-style-type: none"> ➤ Stryer E.A., Biochemistry ➤ Zubay, Geoffrey L. Biochemistry, ➤ Greenberg David M. Metabolic Pathways, Vol 3 Todd and others, Clinical Diagnosis and Management, 17th Ed, ➤ Gopalan C., et al Dietary Allowances for Indians, NIH, Hyderabad. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks:		100 Marks
Continuous Internal Assessment (CIA):		30 Marks
End Semester Exam (ESE):		70 Marks
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors / Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 09 T	
2	Course Title	Bioinformatics	
3	Course Type	Discipline Specific Elective (Theory)	
4	Pre-requisite (if, any)	As per the Program	
5	Course Learning Outcomes (CLO)	<p><i>On successful completion of the course, the student shall be able to:</i></p> <ul style="list-style-type: none"> ➤ Understand various databases and GenBank used in storing biological data. ➤ Analyze the basic concepts of sequence similarity by BLAST and FASTA algorithms. ➤ Explain the phylogenetic analysis and various genome projects. ➤ Apply the techniques for the protein structure prediction.chem.-informatics and medicinal biochemistry. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Introduction to bioinformatics and data generation: Bioinformatics and its relation with molecular biology Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pub med, PDB) and software (RASMOL, Ligand Explorer). Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.		12
II	Biological Database and its Types: Introduction to data types and Source. Population and sample. Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB sum)		11
III	Data storage and retrieval and Interoperability: Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. Data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.		11
IV	Gene Expression and Representation of patterns and relationship General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes). Genetic variability and connections to clinical data.		11
Keywords		FASTA, BLAST, BLAT, RASMOL, NCBI, DDBJ, SNP, EST, STS	

Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources**Text Books, Reference Books and Others****Text Books Recommended –**

- BAXEVANIS, AD & OUELLETTE, BFF : Bioinformatics: a practical guide to the analysis of genes and proteins. 2nd Ed.. 2002.
- BAXEVANIS, AD, DAVISON, DB, PAGE: Current protocols in bioinformatics. 2004.
- RDM & PETSKO, GA ORENGO, C, JONES, D & : Bioinformatics: genes, proteins and computers. 2003
- THORNTON, J Ingvar Eidhammer, IngeJonassen, : Protein Bioinformatics. 2003
- William R Taylor HIGGINS, D & TAYLOR, W : Bioinformatics: sequence, structure, and databank. 2000.
 - David Mount: Bioinformatics: sequence and genome analysis. 2004

PART -D: Assessment and Evaluation**Suggested Continuous Evaluation Methods:****Maximum Marks: 100 Marks****Continuous Internal Assessment (CIA): 30 Marks****End Semester Exam (ESE): 70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
Total Marks - 30		
End Semester Exam (ESE):	Two section – A & B	
	Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks	
	Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 09 P	
2	Course Title	Bioinformatics	
3	Course Type	Discipline Specific Elective (Practical)	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<i>On successful completion of the course, the student shall be able to:</i> <ul style="list-style-type: none"> ➤ Demonstrate the use of databases. ➤ Demonstrate the gene and protein sequence retrieval techniques. ➤ Produce novel DNA and protein structures to be used in therapeutics. ➤ Perform phylogenetic studies to establish the relationship between two genomes. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ Retrieval of sequences from NCBI, EBI and EMBL databases. ➤ Retrieval of sequences from NBRF-PIR, SWISSPROT and P databases. ➤ Transition and Translation of sequences. ➤ Retrieval of genome from genome databases. ➤ Exploring DIP and PPI. ➤ Exploring BIND and PIM. ➤ Exploring MINT and GRID. ➤ Analysis of phylogenetic tree ➤ Exploring PDB file. ➤ Analysis of active site by pymol 		30
Keywords	DIP, MINT and GRID, PDB file		



Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources**Text Books, Reference Books and Others****Text Books Recommended –**

- DA Bender Nutritional Biochemistry of the Vitamins
- R.L. Pike and M.L. Brown Nutrition: An integrated approach -
- G.P. Talwar Text book of Biochemistry and Human Biology
- DWS Wong Mechanism and theory in food chemistry
- M.S. Banji N P. Rao & V. Reddy Text book of Human Nutrition
- Linten Nutritional Biochemistry and Metabolism

PART -D: Assessment and Evaluation**Suggested Continuous Evaluation Methods:****Maximum Marks: 50 Marks****Continuous Internal Assessment (CIA): 15 Marks****End Semester Exam (ESE): 35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar + Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors / Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 10 T	
2	Course Title	Industrial Biochemistry	
3	Course Type	Discipline Specific Elective (Theory)	
4	Pre-requisite (if, any)	As per the Program	
5	Course Learning Outcomes (CLO)	<i>On successful completion of the course, the student shall be able to:</i> <ul style="list-style-type: none"> ➤ Understand Industrial production of Bio substance ➤ Analyze the basic concepts of industrial operations of bioreactors. ➤ Demonstrate the Various control points of industrial operations. ➤ Apply control mechanism of bioreactor in an industry. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Bioreactors and its Operations: Bioreactor design. Concept of bioreactor. Type of bioreactors. Working scales. Elements of a bioreactor. Requirements of industrial bioreactors. Auxiliary facilities. Operation of a bioreactor. Aseptic operations. Aseptic inoculation and sampling. Seals and valves. Measurement and control of fermentation conditions: temperature, pH, dissolved oxygen concentration (DO), foaming, consumption and formation of gases and products.		12
II	Sterilization, Aeration and Agitation in Bioreactor: Sterilization of the bioreactor and culture media. General considerations. Sterilization of the culture medium. Methods of sterilization. Heat sterilization. Theory of heat sterilization. Calculation of the duration of media sterilization. Continuous sterilization. Sterilization by filtration. Air sterilization. Aeration of the bioreactor. General considerations. Transfer of gas-liquid matter. Specific rate of oxygen uptake. Critical oxygen concentration (C). Stirring of the bioreactor. Geometry and types of agitators. Required power for stirring: power number and Reynolds number.		11
III	Down Stream Processing- Separation of cells and other insoluble from fermented broth. Filtration and microfiltration, centrifugation (batch, continuous, basket). Cell disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods Products isolation: Extraction and adsorption method, precipitation (ammonium sulphate. Organic solvents, high molecular weight polymers), column chromatography; ultra filtration, Products polishing: Crystallization and drying.		11
IV	Bioreactor Products: Production of enzymes on an industrial scale. Production of ethanol, acetone-butanol. Production of antibiotics. Production of food and fermented beverages. Authorized microorganisms (GRAS). Biochemistry of the production of alcoholic beverages. Biochemistry of the production of lactic and meat products. Biochemistry of bread fermentation. Biochemistry of food additives. Quality assurance.		11
Keywords	Cell product, production, harvesting, bioreactor		

Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources**Text Books, Reference Books and Others****Text Books Recommended –**

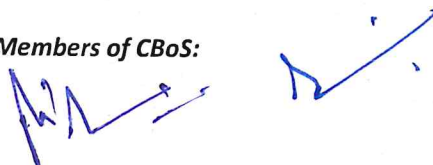
- Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
- Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
- Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
- Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
- Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.

PART -D: Assessment and Evaluation**Suggested Continuous Evaluation Methods:****Maximum Marks: 100 Marks****Continuous Internal Assessment (CIA): 30 Marks****End Semester Exam (ESE): 70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	

End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks
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Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 10 P	
2	Course Title	Industrial Biochemistry	
3	Course Type	Discipline Specific Elective (Practical)	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<i>On successful completion of the course, the student shall be able to:</i> <ul style="list-style-type: none"> ➤ Demonstrate production of bioactive compounds in an industry. ➤ Demonstrate the key features of Bioreactors. ➤ Produce novel mechanism for production. ➤ Apply knowledge of bioreactors in industry. 	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ To prepare broth media for microbial growth. ➤ To culture the microbial organisms in a shake flask using orbital shaker incubator. ➤ To estimate the Microbial biomass produced through shake flask culturing. ➤ To plot Microbial growth curve for shake flask culturing using turbidity method. ➤ To get familiarized with the lab scale fermenter (bench top fermenter) ➤ Heat balance across a batch sterilization process. ➤ Production of Ethanol in lab. ➤ Production of organic acid in lab. 		30
Keywords	Fermentation, Sterilization, Media, Broth		

Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources		
Text Books, Reference Books and Others		
<i>Text Books Recommended –</i>		
<ul style="list-style-type: none"> ➤ Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997. ➤ Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986. ➤ Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973. ➤ Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004. ➤ Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks: 50 Marks		
Continuous Internal Assessment (CIA): 15 Marks		
End Semester Exam (ESE): 35 Marks		
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors / Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 11 T	
2	Course Title	Entrepreneurship Development	
3	Course Type	Discipline Specific Elective (Theory)	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<i>On successful completion of the course, the student shall be able to:</i> <ul style="list-style-type: none"> ➤ Generate, evaluate and shape ideas. ➤ Identify the resources needed to establish and sustain a successful venture. ➤ Demonstrate an understanding of how basic science can be commercialized. ➤ Assess the commercial potential of a business opportunity. 	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning & Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	Introduction: Meaning, needs and importance of Entrepreneurship, Promotion of Entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship		10
II	Establishing an Enterprises- Forms of business, organisation, project identification, selection of the product, project formulation, assessment of project feasibility		10
III	Financing the Enterprise: importance of Finance loans and repayments characteristics of Business Finance fixed Capital Management source of fixed capital working capital its source and how to move for loans inventory direct and indirect raw materials and its management.		11
IV	Marketing Management Meaning and importance marketing, mix product management, product line, product mix, stages of product, like cycle marketing research and importance of service physical distribution and stock management. Entrepreneurship and International Business- Meaning of international business selection of a product selection of a market for international business expert financing institutional support for exports.		14
Keywords	Finance, Marketing		



 Name and Signature of Convener & Members of CBoS:

PART-C: Learning Resources		
Text Books, Reference Books and Others		
<i>Text Books Recommended –</i>		
<ul style="list-style-type: none"> ➤ Shreefal S. Mehta (2008) Commercializing Successful Biomedical Technologies: Basic Principles for the Development of Drugs, Diagnostics and Devices. Cambridge University Press ➤ Yali Friedman (2004) Building Biotechnology: Starting, Managing, And Understanding Biotechnology Companies. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks:		100 Marks
Continuous Internal Assessment (CIA):		30 Marks
End Semester Exam (ESE):		70 Marks
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

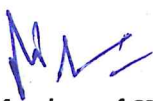
PART- A: Introduction			
Program: Bachelor in Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 11 P	
2	Course Title	Entrepreneurship Development	
3	Course Type	Discipline Specific Elective (Practical)	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<p><i>On successful completion of the course, the student shall be able to:</i></p> <ul style="list-style-type: none"> ➤ Critically evaluate information in order to improve decision making, formulate objectives, determine strategies and plan actions. ➤ Assess the commercial potential of a business opportunity. ➤ Evaluate the issues that can impact on the successful commercialisation of a business idea. ➤ Develop and utilise creative problem-solving skills. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ol style="list-style-type: none"> 1. Students will be allotted with a topic on a potential commercial application. Students have to go research the scientific background behind the given topic. Once the service/product is decided, one or two students will undertake the product development section which requires very applied and technical research. 2. Business/regulatory: All students will carry out a preliminary feasibility study for their commercial application. Once a concept is chosen, students will need to establish the regulatory paths, business model, value proposition, competition, market, operations 3. Students will present the bioscience behind their business idea to their supervisor and receive feedback on their draft poster. 		30
Keywords	Market, Business, product development		

Name and Signature of Convener & Members of CBoS:




PART-C: Learning Resources		
Text Books, Reference Books and Others		
<i>Text Books Recommended –</i>		
<ul style="list-style-type: none"> ➤ Shreefal S. Mehta (2008) Commercializing Successful Biomedical Technologies: Basic Principles for the Development of Drugs, Diagnostics and Devices. Cambridge University Press ➤ Yali Friedman (2004) Building Biotechnology: Starting, Managing, And Understanding Biotechnology Companies. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks:		50 Marks
Continuous Internal Assessment (CIA):		15 Marks
End Semester Exam (ESE):		35 Marks
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:




- FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

Department of Biochemistry

Course Curriculum

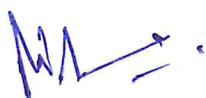
PART- A: Introduction			
Program: Bachelor in Science <i>(Honors / Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 12 T	
2	Course Title	Research Methodology	
3	Course Type	Discipline Specific Elective (Theory)	
4	Pre-requisite (if, any)	As per the Program	
5	Course Learning Outcomes (CLO)	<p><i>On successful completion of the course, the student shall be able to:</i></p> <ul style="list-style-type: none"> ➤ Understand, analyse the problem. ➤ Apply Scientific process know the cause of the problem. ➤ Apply different mathematical tools to correlate factors responsible for the problem. ➤ Apply knowledge of bioethics in research. 	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
PART -B: Content of the Course			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<p>Foundations of Research: Definition, purpose - Relevance and scope, Motivation and objectives – Research methods vs Methodology. Types of research- pure versus applied, incremental versus innovative; multidisciplinary research.</p> <p>Research Process and Design: Steps involved in research process; Identifying and defining research problems; Importance of literature review in defining a problem, Formulation of research objectives; Hypothesis, Research design- Meaning and need- induction - deduction. Features of good design- important concepts and different types; basic principles of experimental design.</p>		12
II	<p>Data Collection and Analysis : Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies – Measures of central tendency, standard deviation and standard error, ANOVA, Correlation, T test, Data Analysis with Statistical Packages, Generalisation and interpretation of results.</p>		11
III	<p>Scientific Reporting: Types of scientific reports – journal articles – Presentation at conferences- Thesis and dissertations – Books. Structure and components of scientific reports – Layout, Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication. Publication of scientific reports, Impact factor of Journals, h-index, i10-Index, g-index.</p>		10
IV	<p>Application of Results and Research Ethics: Commercialization – Copyright and Copy left – royalty - Intellectual property rights and patent law – Ethical issues - Ethics in human and animal experimentation. Guidelines for using animals in biological research- The Prevention of Cruelty to Animals Act, India. Scientific misconduct such as Fabrication, Falsification, Plagiarism and Self-Plagiarism; software for checking plagiarism. Conflicts of interests; Citation and acknowledgement - Reproducibility and accountability.</p>		12
Keywords	Research, hypothesis, Data analysis, impact factor, bioethics.		

Name and Signature of Convener & Members of CBoS:




PART-C: Learning Resources		
Text Books, Reference Books and Others		
Text Books Recommended –		
<ul style="list-style-type: none"> ➤ Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research methodology, RBSA Publishers. ➤ Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p. ➤ Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p ➤ Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes. ➤ Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks:		100 Marks
Continuous Internal Assessment (CIA):		30 Marks
End Semester Exam (ESE):		70 Marks
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:




FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction			
Program: Bachelor in Science <i>(Honors/ Honors with Research)</i>		Semester - VIII	Session: 2024-2025
1	Course Code	BCSE - 12 P	
2	Course Title	Research Methodology	
3	Course Type	Discipline Specific Elective (Practical)	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes (CLO)	<i>On successful completion of the course, the student shall be able to:</i> <ul style="list-style-type: none"> ➤ Understand, analyse the problem. ➤ Apply Scientific process to know the cause of the problem. ➤ Apply different mathematical tools to correlate factors responsible for the problem. ➤ Apply methods to represent results in scientific way. ➤ Apply knowledge of bioethics in research. 	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
PART -B: Content of the Course			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course	<ul style="list-style-type: none"> ➤ To prepare a word document of the Ph.D. synopsis with proper formatting. ➤ To prepare a word document of 20 references related to your Research work in a standard format. ➤ To write a short note on the importance of e-journals in research work using internet. ➤ Exercises for data distribution. ➤ Exercises for computation of measures of central tendency. ➤ Exercises for computation of measures of variability. ➤ Data analysis by ANOVA and multiple-range tests. ➤ Hypothesis testing by t-test, F-test, and Chi-square test. ➤ Graphical presentation of data using a suitable package. ➤ Statistical analysis of a data using a suitable package. ➤ Preparation of document using a suitable package. 		30
Keywords	Research, hypothesis, Data analysis, impact factor, bioethics.		

Name and Signature of Convener & Members of CBoS:




PART-C: Learning Resources		
Text Books, Reference Books and Others		
<i>Text Books Recommended –</i>		
<ul style="list-style-type: none"> ➤ Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p ➤ Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes. ➤ Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing. 		
PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks:		50 Marks
Continuous Internal Assessment (CIA):		15 Marks
End Semester Exam (ESE):		35 Marks
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment D. Performed the Task based on lab. work - 20 Marks E. Spotting based on tools & technology (written) – 10 Marks F. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

