INTEGRATED M. TECH BIOTECHNOLOGY

SEMESTER 4

Detailed Syllabus

Lecture wise Breakup

Course Code	15B11BT411	**Semester: Even**	**Semester:** IV	**Session 2022-23**
Course Name	Introduction to Bioinformatics			
Credits	4	**Contact Hours**	**LTP 3 1 0**	
Faculty (Names)	**Coordinator(s)**	Dr Shazia Haider		
	Teacher(s) (Alphabetically)	Dr Shazia Haider		

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Summarize biological databases, storage and retrieval methods, file formats	**Remembering** (C1)
CO2	Explain Bioinformatics resources, computational tools and associated Algorithms	**Understanding** (C2)
CO3	Apply the bioinformatics concepts in genomics, proteomics and Drug discovery.	**Applying** (C3)
CO4	Analyze evolutionary tree to understand evolutionary genetics	**Analyzing** (C4)
CO5	Compare sequence alignment tools to predict structures & functions of gene, RNA and proteins	**Evaluating** (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Biological data and Internet	Network terminologies, Introduction to Bioinformatics, Information flow, Scope of Bioinformatics, Growth of databases, genome sequencing, basics of internet, www, IP address, domain, Network-based services (Cloud & Grid Computing).	5
2.	Biological sequence databases	Basics of Database designing and modeling, Designing policies, File formats (FASTA, PIR, Genbank), data storage, retrieval, Genbank, Swissprot, PIR, PDB, Pfam, KEGG, Brenda	6
3.	Sequence analysis (Sequence, retrieval, methods, substitution matrices, submission and analysis)	String comparison (substring, subsequences), Hammingand Levenshtein distance, Sequence alignment (pair wise, multiple) Dot plot method, Dynamic programming, Needleman–Wunsch *and* Smith–Waterman algorithm, BLAST algorithm, FASTA algorithm comparison, PSIblast, gap penalty, e-value, statistical importance, PAM and BLOSUM matrices, log odd score, Sequence submission tools (Banklt, Sequin)	10
4.	Gene predictions, promoter analysis and genome analysis tools	Gene structure (prokaryotes and eukaryotes), Genscan, Grail, Genemark, promoter region identification, promoter signals, repeats and identification in genome and computational tools	6

5.	RNA and protein structure predictions	RNA sequence and structures (secondary), Non-coding RNAs Primary, Secondary and Tertiary structure prediction, protparam, Chou–Fasman algorithm, GOR method, Concepts of structural modeling and tools (Comparative homology modeling, Threading),	4
6.	Phylogenetic analysis	Phylogeny, Phylogenetic reconstruction distance matrix, types of trees, Rooted un-rooted, distance based methods (UPGMA, FM, NJ Methods), Character based methods (Parsimony method, Maximum likelihood method), tree evaluation, (bootstrapping, Jackknifing), Substitution models (Juke-Cantor, Kimura-2 parameter), Issues in Phylogenic Reconstruction, Biological inferences.	5
7.	Tools for proteome studies	AA complement, SOPMA PHD, ANOLEA, Transmembrane protein prediction tools	2
8.	Pharmacogenomics and comparative, Functional Genomics	Introduction of pharmacogenomics, comparative and functional genomics, microarray analysis, NGS and systems biology	4
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, MCQ, Presentations, PBL, Viva)
Total	**100**

PBL: Students will choose any protein prediction and proteome analysis tools to solve the biological problem linked to a particular disease. How is it commercially used as a therapeutic molecule or as a target to manage the disease?

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Attwood T.K. & Smith Parry., "Introduction to Bioinformatics", Benjamin Cummings, 2001
2.	BaxevanisA., D & Ouellette "Bioinformatics A practical guide to analysis of genes and protein", Wiley- Interscience, 1998.
3.	David Mount "Bioinformatics: Sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2001.

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B1NHS435**	**Semester: Even**	**Semester: IV** **Session:** 2022-23
Course Name	**Financial Accounting**		
Credits	3	**Contact Hours**	3 (2,1,0)
Faculty (Names)	**Coordinator(s)**	Dr. Mukta Mani (Sec-62), Dr. Sakshi Varshney (Sec-128)	
	Teacher(s) (Alphabetically)	Dr. Mukta Mani, Dr. Sakshi Varshney	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C206-8.1	Understand the basic concepts of accounting.	Understanding level (C2)
C206-8.2	Apply accounting concepts for recording of business transactions.	Applying level (C3)
C206-8.3	Compare and reconcile the accounting records with other sources of information	Analyzing level (C4)
C206-8.4	Evaluate the accounting records to identify and rectify the errors made during accounting process.	Evaluating level (C5)
C206-8.5	Construct the final accounts and cash flow statement of a business	Creating (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Accounting	Meaning of Accounting, Objectives of Accounting, Understanding Company Management, Stakeholders versus Shareholders, Financial Reporting Standards, Financial Reporting	2
2.	Understanding Accounting elements	Elements of Financial Statements- Assets, Current assets, Liabilities, Current liabilities, Equity, Income, Expenses, Accounting Equation	2
3.	Accounting Concepts	Business entity concept, Money measurement concept, Going concern, Consistency, Matching concept, Cost concept, Dual aspect concept, Materiality, Full disclosure, Generally Accepted Accounting Principles (GAAP)	2
4.	Journal Transactions	Journal, Rules of Debit and Credit, Compound Journal entry, Opening entry	2
5.	Ledger Posting and Trial Balance	Ledger, Posting, relationship between Journal and Ledger, Rules regarding Posting, Trial balance	3
6.	Rectification of Errors	Different types of errors, their effect on trial balance, rectification and preparation of suspense account	5

7.	Bank Reconciliation Statement	Meaning of Bank Reconciliation Statement, technique of preparing BRS, Causes of difference	2
8.	Final Accounts	Trading account, Profit and Loss account, Balance sheet, Adjustment entries	6
9.	Cash Flow Statement	Introduction of Cash Flow Statement, Classification of Cash inflows and Cash Outflows Activities, prepare the statement of cash flows using direct and Indirect method	4
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project + Class test/Quiz +Class Participation)
Total	**100**

Project Based learning: Students form a group of 4-5 students. Each group is required to choose a company listed in Indian stock exchange and download its latest annual report. Students are required to describe the company, composition of board of directors, number of company's executives, independent directors, background of independent directors. They are required to find out financing, investing and operating activities and examines the change in total assets, sales and net profit of the company. As per auditor's report, company's position, and future plans for growth of the company is also analyzed.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Maheshwari S. N., Financial and Management Accounting, 5th Ed., S. Chand & Sons Publication, 2014. ISBN No.: 978-81-8054-529-0
2.	Ghosh, T.P., Financial Accounting for Managers, 4th Ed., Taxmann Publications, 2009
3.	Tulsian, P., Financial Accounting,1st Ed., Pearson Education India,2002
4.	Bhattacharya, A., Financial Accounting for Business Managers, 4th Ed., Prentice Hall of India,2012
5.	Weygandt.J., Kimmel, P., Kieso,D., Accounting Principles, 12th Edition, John Wiley & Sons,2015
6.	Barton,M., Bhutta, P.,S. O'Rourke,J., Satyam Computer Services Ltd: Accounting fraud in India, London, SAGE Publications Ltd, 2017,

Detailed Syllabus

Lecture wise Breakup

Subject Code	**15B11HS111**	**Semester: EVEN**	**Semester: IV Session: 2022-23**
Subject Name	**LIFE SKILLS**		
Credits	**2**	**Contact Hours**	**2 (1 1 0)**
Faculty (Names)	**Coordinator(s)**	Dr. Praveen Sharma & Dr. Deepak Verma	
	Teacher(s) (Alphabetically)	Dr. Akarsh Arora,Dr. Amandeep Kaur, Dr. Badri Bajaj, Dr. Kanupriya Bakhru, Dr Praveen Sharma, Dr. Anshu Banwari, Dr. Deepak Verma, Dr. Ekta Shrivastava, Dr. Nilu Choudhary	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C209.1	Understand Life Skill required to manage self and one's Environment	Understand (C2)
C209.2	Apply comprehensive set of skills for life success for self and others	Apply (C3)
C209.3	Analyze group dynamics for its effective functioning	Analysing (C4)
C209.4	Evaluate the role of women leadership and gender issues	Evaluate (C5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Introduction to Life Skills; basic Concepts and Relevance for Engineers	1
2.	Individual-1	Emotional Intelligence, Stress Management, Goal Setting	4
3.	Individual-II	Dimensions of Personality, Values and Attitudes, Assertiveness, well being	3
4.	Group Dynamics	Group, Group types, Group Relationship, Social Loafing, Social Facilitation	3
5.	Women Leadership	Gender Sensitization, Women Leadership.	3
		Total number of Hours	14

Evaluation Criteria Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 **(Assignment & Project)**
Total	**100**

Project Based Learning: Students are supposed to form a group (Maximum 5 students in each group) and identify a Women leader of their choice. They are supposed to do the in-depth study on the leadership style of their identified leader and explain it. They are also supposed to explain identified women leader's personality traits by referring the Big five personality traits model. The project provides understanding to students on Women leadership and personality traits.	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Stephen P. Robbins, Organizational Behaviour, 9th Edition, Prentice-Hall India 2001
2.	Smith, E., Hoeksema, S., Fredrickson, B., & Loftus, G. Introduction to Psychology. Thompsons and Wadsworth Co, 2003
3.	Daniel Goleman, Working With Emotional Intelligence, Bantom Books 1998
4.	Sue Bishop, Assertiveness Skills Training, Viva Books, New Delhi, 2004
5.	Adele B. Lynn 50 Activities for Developing Emotional Intelligence, Ane Books, 2003
6.	Sivasailam Thiagarajan, Glenn M. Parker; Teamwork and Teamplay, Games and Activities for Building and Training Teams., Jossey-Bass, 1999
7.	Kaul A.& Singh M., *"New Paradigms for Gender Inclusivity*", PHI Pvt Ltd 2012

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Lecture wise Breakup

Course Code	**15B1NHS431**	**Semester: EVEN**	**Semester: IV**	**Session** 2022-23
Course Name	**Introduction to Literature**			
Credits	**3**	**Contact Hours**	**3 (2-1-0)**	
Faculty (Names)	**Coordinator(s)**	Dr. Monali Bhattacharya (Sector 62) & Dr. Ekta Srivastava (Sector 128)		
	Teacher(s) (Alphabetically)	Dr. Ekta Srivastava, Dr. Monali Bhattacharya		

COURSE OUTCOMES		**COGNITIVE LEVELS**
C206-5.1	Understand figurative language to demonstrate communication skills individually and in a group.	CL-2 Understanding
C206-5.2	Develop a critical appreciation of life and society through a close reading of select texts.	CL-3 Applying
C206-5.3	Analyse a literary text thematically and stylistically and examine it as representing different spectrum of life, human behavior and moral consciousness of society.	CL-4 Analyzing
C206-5.4	To interpret Literature as reflection of cultural and moral values of life and society.	CL-5 Evaluating

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Literature & Genres	Introduction Literary Genres Literary Devices Learning Communication Skills through Literature	5
2.	Poems	On His Blindness: John Milton My Last Duchess: Robert Browning's "Hope" is the thing with feathers: Emily Dickinson A Prayer before Birth: Louis MacNeice Goodbye Party for Miss Pushpa T.S.: Nissim Ezekiel	6
3.	Prose & Short Stories	The Spectator Club: Richard Steele Evidence: Isaac Asimov Toba Tek Singh: Saadat Hasan Manto	6

4.	Plays & Drama	Andher Nagari Chaupat Raja: Bhartendu Harishchandra The Characters of Macbeth & Lady Macbeth as Universal Characters. Arms & The Man: G B Shaw	7
5.	Novel	To Sir With Love: E.R. Braithwaite	4
		Total number of Lectures	28

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Project, Class participation)
Total	**100**

Recommended Reading material:

1	M.H. Abrams, *'A Glossary of Literary Terms'*, 7th Edition, Hienle & Hienle: Thomson Learning, USA, 1999
2	Mark William Roche, *'Why Literature matters in the 21st Century'*, First Edition, Yale University Press, 2004.
3	E.R. Braithwaite, *'To Sir With Live'*, First Edition, Bodley Head, UK, 1959. Susie Thomas(Ed), "E. R. Braithwaite: 'To Sir, with Love' – 1959", Available at http://www.londonfictions.com
4	Khalid Hasan (Translator), *'Saadat Hasan Maanto : Toba Tek Singh'* Reprint, Penguin Books, India, 2008.
5	G.B Shaw, 'Arms & The Man', Paperback, 2013 https://onemorelibrary.com/index.php/en/?option=com_djclassifieds&format=raw&view=download&task =download&fid=10428
6	Anon, (n.d.). *The Spectator Club. Sir Richard Steele. 1909-14. English.* [online] Available at: http://www.bartleby.com/27/7.html [Accessed 2018].
7	*All poems online: http://www.poetryfoundation .org*
8	Wolfgang Clemen, '*Shakespeare's Soliloquies'*, First Edition, Routledge, London, 1987.

Project Based Learning:

The students take up a project in a group of 4-5. The Project consists of 2 components: A Digital Poster & a Report. The students pick a text (Novel /Play) of their choice which has not been covered in the syllabus. The analysis of the text is to be submitted in the form of a Narrative Digital Poster. The analysis should include: Introduction, Objectives/Research Questions, Background Study / literature review, Method/ Discussion (Themes, Narrative Structure, Plot in the context of Conflicts, Freitag's model and any 3 Major Literary Devices used by the writer and application of Psychoanalysis) & Analysis. The students should identify the themes in context of the following: a) Different spectrum of life as explored in the text b) Human behavior as exhibited in the text c) Cultural aspects as portrayed in the text d) Moral consciousness of an individual and the society as analyzed in the text. The project includes a brief 2-3 pages report which should highlight the following: a) The Names of the team members along with individual contribution in the whole. b) The channels undertaken for team coordination and for remote collaboration. c) Challenges faced and Lessons learnt in virtual coordination/communication. d) Rationale for choosing the text. e) Abstract of the entire poster in 250 words, highlighting introduction, objectives, methodology adopted, discussion, analysis, and conclusion. f) Learning of the team from the poster-based project work done. g) Relevance of the findings/ study for the society and future h) Limitations of the study done.

Detailed Syllabus

Lecture wise Breakup

Subject Code	**15B1NHS432**	**Semester: Even**	**Semester: IV Session 2022-23**
Subject Name	**INTRODUCTION TO PSYCHOLOGY**		
Credits	**3**	**Contact Hours**	**(2-1-0)**
Faculty (Names)	**Coordinator(s)**	Dr. Badri Bajaj	
	Teacher(s) (Alphabetically)	Dr. Badri Bajaj	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C206-6.1	Demonstrate a basic understanding of different perspectives and concepts of psychology	Understanding (Level 2)
C206-6.2	Apply the concepts of psychology in day-to-day life	Applying (Level 3)
C206-6.3	Examine the different theoretical perspectives and models of psychology	Analyzing (Level 4)
C206-6.4	Develop solutions for problems related to psychology using appropriate tools/models	Creating (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	**Introduction to Psychology**	Definition, Nature, and Scope of Psychology; Approaches: Biological, Psychodynamic, Behaviorist, and Cognitive. Methods: Experimental, Observation and Case study; Fields of application.	**3**
2.	**Basic Concepts**	Person, Consciousness, Behavior and Experience, Perception and learning	**5**
3.	**Memory**	Process of Memory: Encoding, Storage, Retrieval; Stages of Memory: Sensory, Short term and Long term	**3**
4.	**Motivation**	Motives: Intrinsic and Extrinsic Frame Work, Theories of Motivation; Techniques of Assessment of Motivations; Frustration and Conflict.	**3**
5.	**Emotions**	Concept, Development, Expression, Theories of Emotions.	**2**
6.	**Intelligence**	Nature, Theories, Measurement and Approaches - Genetic and Environmental	**3**
7.	**Personality**	Nature, Approaches, Determinants and Theories; Techniques of Assessment: Psychometric and Projective Techniques.	**5**

8.	**Psychology of Adjustment**	Psychological Disorders: Anxiety, Stress, Depression; Psychotherapies.	**4**
		Total:	**28**

Evaluation Criteria
Components Maximum Marks

T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Assignment, Oral Questions)
Total	**100**

Project based learning: Students in a group will choose a research topic from the syllabi of psychology. Students will cover the following points to prepare project reports: Understanding of concept, related theories and perspectives; Describe the relevance of the chosen concept for personal growth; Discuss the application of chosen topic for your professional life; Elaborate the relevance of the topic at group level and societal level. Discussions on these practical aspects will enhance students' understanding & application of concepts of psychology in day to day life.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	R.A. Baron and G. Misra, Psychology, 5th Ed., Pearson, 2015
2.	S. Nolen-Hoeksema, B. L. Fredrickson, G. R. Loftus, and C. Luts, Introduction to Psychology, 16th Ed., Cengage Learning, 2014.
3.	S. K. Ciccarelli and G. E. Meyer, Psychology, Pearson, 5th Ed., 2017.
4.	Clifford Morgan, Richard King, John Weisz, John Schopler, Introduction to Psychology, 7th Ed., McGraw Hill Education, 2017.
5.	James W. Kalat, Introduction to Psychology, 9th Ed., Wadsworth Publishing; 2010
6.	Gregory Feist and Erika Rosenberg, Psychology: Perspectives and Connections, 5th Ed., McGraw-Hill Education, 2021

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B1NHS433**	**Semester:** EVEN	**Semester:** IV	**Session:** 2022-23
Course Name	**INTRODUCTION TO SOCIOLOGY**			
Credits	**3(2-1-0)**		**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Prof Alka Sharma		
	Teacher(s) (Alphabetically)	Prof Alka Sharma		

COURSE OUTCOMES		**COGNITIVE LEVELS**
C206-7.1	Demonstrate an understanding of sociological perspectives and concepts.	Remembering (C1)
C206-7.2	Explain the concept of social stratification and types of stratification as class, caste and gender.	Understanding (C2)
C206-7.3	Apply the major sociological perspectives, social concepts and methods in the systematic study of society	Applying(C3)
C206-7.4	Analyze the relevance of various social Institutions and how it shapes and influences social interactions.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Emergence of Sociology- forces and historical background, nature and scope, relationship with other social sciences, difference between common sense and sociology, Major sociological perspective and methods, the sociological imagination	5
2.	Basic Concepts of Sociology	Society, Culture, Groups, sub-groups, Communities, Association, Organization, social interaction and social structure: status and role	4
3.	Social stratificatio n	Stratification-concept, theories and type. Basis of stratification caste, class, gender and race, status and Roles	4
4.	Sociology of Institutions	Kinship, Family, Religion, Education &Economy in Society	5
5.	Process of Change and Mobility	Concept, theories and Agents of Social Change, Process of Social Change in Indian Society: Sanskritization, Westernization, Modernization, Urbanization	6
6.	Politics and Society	Power, Elite, Bureaucracy, Pressure groups, Political parties, nation, state and civil society, protest, agitation and Social Movements	4

Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20 (Project based)
End Semester Examination	35
TA	25 (Presentation, assignment, quiz and tutorial participation)
Total	**100**

PBL: Each student will be assigned a project based on primary data collection through in-depth interviews with their parents, grandparents, and other relatives

Topic of the project- the students will conduct a multidimensional analysis of their class with the Occupation, Education, Income, and Wealth variable, using their parents, grandparents, and themselves as examples to find out how do these variables relate to Social Class and social mobility? How has the Social Class of their family changed (or not) over the past three generations?

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	Johnson, Harry M. *Sociology: a systematic introduction*. Routledge, 2013.
2	Rawat, H. K. *Sociology: basic concepts*. Rawat Publications, 2007.
3	Macionis, John J. *Society: the basics*. Pearson/Prentice Hall, 2009.
4	C. Wright. And Mills, *The Sociological Imagination*, Oxford: Oxford University Press, 1959.
5	Peter L Berger, The Social Construction of Reality: a Treatise in the Sociology of Knowledge. Garden City, New York: Anchor, 1966.
6	Conley and Dalton, *You May Ask Yourself: An Introduction to Thinking Like a Sociologist*, 2nd Ed, W. W. Norton & Company New York, 2011. ISBN: 0393935175 or 978-0393935172
7	Ballentine and Roberts, *Our Social World: Introduction to Sociology*, 4th Edition, Sage. 2013.
8	Robert Parkinand Linda Stone, (ed.). *Kinship and Family: An Anthropological Reader*, U.S.A.: Blackwell, 2000, selected chapters

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B17BT373**	**Semester:** EVEN	**Semester: IV**	**Session 2022-23**
Course Name	Genetics and Developmental Biology Lab			
Credits	1	**Contact Hours**	3	
Faculty (Names)	**Coordinator(s)**	Prof Neeraj Wadhwa		
	Teacher(s) (Alphabetically)			

COURSE OUTCOMES		**COGNITIVE LEVELS**
C272.1	Understand the different stages of cell division	Level 2 (Understand)
C272.2	Interpret the inheritance of human genetic traits.	Level 2 (Understand)
C272.3	Make use of Drosophila as model organism in genetics studies.	Level 3 (Applying)
C272.4	Compare the developmental stages of different organisms.	Level 4 (Analyze)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Cell architecture and Division	Observation of cells undergoing mitotic phases of cell division, using permanent slides	**1**
		Observation of cells undergoing meiotic phases of cell division using permanent slides	**1**
		Calculating the mitotic index from onion root tip	**1**
2.	Genotype vs. Phenotype	Introduction to Genetic model Drosophila, Study of life cycle,	**3**
		Sex comb-based species identification, Wild and mutant strain	**3**
3.	Specialised Chromosome	Cytogenetic preparation of polytene chromosome,	**3**
		Study of banding pattern and puff region, distinguishing hetero and euchromatic region	**3**
4.	Gene and allele frequency	Blood group test, Principle of antigen-antibody reaction, possible genotype. Calculation of genotype and allele frequency in the class population	**2**
		Study of inheritance pattern of common human genetic traits	**2**

5.	Reproductive system	Dissection of reproductive organs in plants, pollen germination and pollen tube observation	**4**
		Dissection of reproductive organs in Drosophila, No. of ovariole and sperm count	**4**
6.	Development	Permanent slides of various stages of frog and chick embryo development.	**4**

Evaluation Criteria

Components	**Maximum Marks**
Mid Term lab exam	20
End term lab exam	20
Day to Day	60
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	M Demerec, *Biology of Drosophila*, Cold Spring Harbour laboratory Press.
2.	Monroe W Strickberger, *Genetics,* Prentice Hall.
3	B N Behera, *Genetics through Problems*, Sarup and Sons
4	Design of experiments, principle and the expected outcome and related literature will be provided to the student

Project based learning: By learning different experiments in related subject, students will be able to use Drosophila in different advanced research. Also the understanding of developmental biology further trains the students to appreciate the significant of different developmental stages and their coordination as well.

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B17BT372**	**Semester** Even	**Semester:** IV **Session: 2022-23**
Course Name	Microbiology Lab		
Credits	1	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Dr. Garima Mathur	
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
C372.1	Understand media preparation and sterilization techniques.	**(C2)**
C372.2	Understand culturing sub culturing.	**(C2)**
C372.3	Apply basic microbiological techniques to characterize microbes	**(C3)**
C372.4	Analyze enumeration techniques for microorganism and estimation of antimicrobial activity.	**(C4)**

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Media preparation and sterilization	Sterilization techniques: Autoclaving, incineration, hot air oven, filtration and non-ionic radiation.	**C372.1**
2.	Media preparation and sterilization	Preparation of plates (pouring of culture media).	**C372.1**
3.	Culturing sub culturing.	To learn different methods of Streaking.	**C372.2**
4.	Culturing sub culturing.	Miniaturized assay for growth curve of bacteria and calculation of generation.	**C372.2**
5.	Culturing sub culturing..	Preparation of plates (pouring of culture media).	**C372.2**
6.	Characterize of microbes	Staining techniques for bacteria: Endospore staining.	**C372.3**
7.	Characterize of microbes	Staining techniques for bacteria: Gram staining.	**C372.3**
8.	Characterize of microbes	Staining techniques for fungi: Lactophenol Cotton Blue and Methylene Blue staining. (Yeast/ fungus staining).	**C372.3**

9.	Characterize of microbes	Morphological characterization of microbes	**C372.3**
10.	Enumeration	Serial dilution with solid.	**C372.4**
11.	Enumeration.	Serial dilution with liquid.	**C372.4**
12.	Antimicrobial activity.	Antibacterial disc diffusion assay	**C372.4**

Evaluation Criteria

Components	**Maximum Marks**
Lab Record	15
Performance based test	15
Mid term	20
viva voce	
End term	20
viva voce	
Day to day evaluation	20
Attendance	10
Total	**100**

PBL based learning: The lab experiments are designed in such a way that the students can learn the microbiological techniques in a step wise manner. Microbiological techniques are makes the base of biotechnology course which makes student to join research labs or industries which use microbiological techniques for research labs/institutes and industries. Even if some industries don't have microbiology-based products but they have to use such techniques for their quality control.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Maniatis Molecular Cloning A Laboratory Manual, Michael R. Green and Joseph Sambrook, FOURTH EDITION 2012 by Cold Spring Harbor Laboratory Press
2.	.https://microbeonline.com/imvic-tests-principle-procedure-and-results/
3	Rompre A, Servais P, Baudart J, De- Roubin M and Laurent P. (2002)), Detection and enumeration of coliforms in drinking water: current methods and emerging approaches. Journal of Microbiological Methods; vol 49: 31- 54.
4	Vashist Hemraj , Sharma Diksha, Gupta Avneet (2013), A review on commonly used biochemical test for bacteria Innovare Journal of Life Science, Vol 1: Issue 1, 1-7

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B11BT313**	**Semester: EVEN**	**Semester: IV**	**Session: 2022-23**
Course Name	**Genetics and Developmental Biology**			
Credits	4	**Contact Hours**	4	
Faculty (Names)	**Coordinator(s)**	Dr. Priyadarshini		
	Teacher(s) (Alphabetically)			

COURSE OUTCOMES		**COGNITIVE LEVELS**
C212.1	Explain principles of inheritance in genetics	Understand Level (C2)
C212.2	Compare early developmental mechanics in invertebrates, vertebrates and plants	Understand Level (C2)
C212.3	Analyze and solve the problems related to population genetics	Analyze Level (C4)
C212.4	Identify Human birth defects and genetic Disorders	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Cell – The unit of life, Chromosomes and Heredity	I. Cell cycle II. Chromosomal theory of inheritance III. Chromosome – structure, karyotyping, and abnormalities (structural and numerical abberations) IV. Human Genetic Disorders arising due to chromosomal aberrations : Basis and Symptoms V. DNA – validation of DNA as hereditary material, basic biochemical and molecular structure	06
2.	Principles of Inheritance: Mendelism	I. Genotype and phenotype II. Inheritance of characters/genes from parents to offspring III. Mendelian laws of inheritance: Genes and Alleles	02
3.	Principles of Inheritance: Beyond Mendelism and Extra-chromosomal	I. Beyond Mendelism: Lethal and Multiple alleles, Gene-gene interaction, Pleiotropism, Penetrance and expressivity II. Sex determination and dosage compensation, Sex chromosomes in human, Human Sex-linked Genetic Disorders :Basis and symptoms III. Extra-chromosomal inheritance: maternal inheritance	06
4.	Mutations, linkage and recombination	I. Molecular basis and functional relevance of mutations – spontaneous vs induced mutations, mutations in the coding regions of genes, loss of function vs gain of function mutations germline and somatic mutations,.	04

		II. Chi Square test in genetics data, Linkage & Recombination, Molecular mechanism of recombination, Calculating Recombinant Frequencies, Linkage maps	
5.	Population and Evolutionary genetics	I. Introduction to terms – evolution, variation, population, gene pool and Modern Theory of Evolution (Darwin's Theory) II. Calculation of genotypic frequency, allelic frequency and Hardy-Weinberg Principle III. Forces responsible for evolution: Mutation, recombination, migration, genetic drift.	03
6.	Introduction to early developmental process	Fertilization, Cleavage, gastrulation, axis formation and fate map	4
7.	Developmental mechanics of cell specification	Autonomous Specification, Conditional specification, Syncytial specification, Mosaic and regulative development,	3
8.	Early development in Invertebrates and Vertebrates	Axis specification in *Drosophila*, Patterning and Axis specification in *Xenopus*, Gastrulation in Bird	7
9.	Regeneration & aging	Epimorphic Regeneration, Morphallactic Regeneration, compensatory regeneration. Causes of Aging, Genetic aging programs.	3
10.	Organogenesis	Development of tetrapod limb, heart	4
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1 and 2, Class Test 1 and 2)
Total	**100**

Project Based Learning (PBL): Students in a group of 3-4 will choose a human genetic/congenital disorder from OMIM portal (https://www.ncbi.nlm.nih.gov/omim) and will prepare a short report/presentation on the genetic disorder etiology, symptoms and current diagnostics and therapies. This will give the students a perspective of the latest research and findings in the field of human genetic diseases.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Griffiths et al. *An Introduction to Genetic Analysis*, Ninth Edition ,2007, W. H. Freeman
2.	L.H. Hartwell et al.*Genetics: from Genes to Genomes*, 2nd Edition.2004, McGraw-Hill
3.	Strickberger M. W.,*Genetics*, McMillan, New York.
4.	E J Gardner, M J Simmons and D P Snustad, *Principles of Genetics*, John Wiley and Sons. New York.

5.	Lewin, *Genes VIII*, 8th Edition, Prentice Hall,
6.	Daniel L. Hartl and Andrew G. Clark, *Principles of Population Genetics*, 3rd Edition, Sinauer Associates
7.	L. Wolpert, "*Principles of Development*", Edition:4th, Oxford University Press,2011
8.	S.F. Gilbert, "*Developmental Biology*", Edition: 7th, Snaeur Associates Inc., 2003(eBook available)
9.	B. Pierce, "*Genetics: a conceptual approach*", Edition: 7th, MacMillan International Higher Education, 2020

Detailed Syllabus

Lecture wise Breakup

Course Code	**15B11BT312**	**Semester:** Even	**Semester:** IV **Session:** 2022-23 Month from: **January to June**
Course Name	Microbiology		
Credits	3-1	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Prof. Indira P Sarethy
	Teacher(s) (Alphabetically)	Dr. Ashwani Mathur Prof. Indira P Sarethy

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain history and scope of microbiology	Understand (level II)
CO2	Summarize Microbial taxonomy and different forms of microorganisms	Understand (level II)
CO3	Apply the concept of microbial nutrition, growth and control methods	Apply (level III)
CO4	Identify the microbial metabolism, gene transfer methods and host pathogen interaction	Apply (level III)
CO5	Examine the suitability of microorganism for industrial applications	Analyzing (level IV)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	History and scope of microbiology	A timeline with emphasis on Pasteur's experiments disproving spontaneous generation, Koch's postulates [CO1]	**3**
2.	Forms of microorganisms	Prokaryotes: Archaea & Bacteria (including cyanobacteria, mycoplasma &actinomycetes) Eukaryotes: Fungi, Algae, Protozoa, Viruses Morphological features and characteristics with emphasis on Gram positive and Gram negative bacteria, composition and functions of cellular structures. [CO1]	**6**
3.	Microbial taxonomy and phylogeny	Taxonomic ranks, classification systems (phenetic, numerical, phylogenetic), major characteristics used for classification (classical and molecular approaches), the three domain system [CO2]	**5**
4.	Methods in microbiology	Pure culture techniques, theory and practice of sterilization, principles of microbial nutrition, culture media and types (simple, complex, enriched, enrichment, selective & differential), replica	**6**

		plating techniques, preservation techniques ,growth of microorganisms, control of microbes [CO3]	
5.	Microbial metabolism	Photosynthetic mechanisms, CO_2 fixation mechanisms, fermentation, anaerobic respiration. [CO4]	**6**
6.	Microbial genetics	Conjugation, Transformation, Transduction [CO4]	**5**
7.	Host-pathogen interactions	Defense mechanisms against microbes, Pathogenic microbes: Bacteria: (Pneumonia, Tuberculosis), Fungi: (Mycoses), Virus: (HIV), Protozoa (Malaria); [CO4]	**7**
8.	Industrial applications with case studies	Biofertilizers, Biopesticides, Fermented foods, Single cell protein, Bioterrorism, Extremophiles [CO5]	**4**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (class test, PBL)
Total	**100**

Project based learning: Each student will choose a topic based on the application sector where microorganisms can be used such as food, pharmaceuticals, detergent, environmental remediation, etc. They will get an insight into how different microorganisms can be employed for different biotechnological industrial applications.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	M. J. Pelczar, E. C. S. Chan and N. R. Krieg. *Microbiology: Concepts and Applications.* India: Tata McGraw Hill, 1993.
2.	M. T. Madigan, J. M. Martinko and J. Parker. *Brock Biology of Microorganisms*, 10th Edition. New Jersey, USA: Prentice Hall, 2003.
3.	G. J. Tortora, B. R. Funke and C. L. Case. *Microbiology: An Introduction*, 8th Edition. San Francisco, USA: Pearson/Benjamin Cummings, 2004.
4.	J. Black. *Microbiology: Principles and Applications*. New Jersey, USA: Prentice Hall, 2004.
5.	L. M. Prescott, J. P. Harley and D. A. Klein. *Microbiology*, 6th edition. New York, USA: McGraw Hill, 2005.
6.	E. W. Nester. *Microbiology Study Guide*. New York, USA: McGraw Hill, 2004.

Detailed Syllabus

Lecture wise Breakup

Course Code	15B17BT471	**Semester: Even**	**Semester:** IV	**Session: 2022-23**
Course Name	Bioinformatics Lab			
Credits	1	**Contact Hours**	**LTP0 0 2**	
Faculty (Names)	**Coordinator(s)**	Dr Shazia Haider		
	Teacher(s)(Alphabetically)			

COURSE OUTCOMES		**COGNITIVE LEVELS**
C273.1	Outline various computers hardware, operating system databases, storage and retrievals, file formats.	Understand Level(C2)
C273.2	Apply the bioinformatics tools in homology search, genome annotation, Expression analysis.	Understand Level(C2)
C273.3	Test for evolutionary relationship using sequence analysis and phylogenetic tree	Apply Level(C3)
C273.4	Predict structure and function of DNA, RNA and protein	Analyze Level(C4)
C273.5	Compare the existing tools to address the biological problems	Evaluate Level(C5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Bioinformatics Resources and databases	To explore NCBI and its resources	CO1
2.	Bioinformatics Resources and databases	To use literature mining tool such as PubMed, GoogleScholar & CitationManager	CO1
3.	Computer environment and network	To explore and understand the operating system (LINUX)	CO1
4.	Computer environment and network	To retrieve the sequences from FTP Sites. Perform Web-based Repeat Masker.	CO2
5.	Genomics	To identify the “open reading frames (ORF‟s)" and genes in the given genomic sequence using ORF finder and Genscan.	CO2
6.	Genomics	Study the repeats, invert sequences and sequence alignment using alignment tools (Dotplot).	CO3
7.	Genomics	Global and Local alignment of two sequences using Needle Nand Smith Waterman algorithm.	CO3
8.	Genomics	To perform pairwise and multiple sequence alignment using CLUSTALW and BLAST.	CO3

9.	Genomics	To study the physiochemical properties of the residual sequences using computational method/Tools Prot-Param, CATH, Pfam.	CO4
10.	Phylogenetic	To find the evolutionary relationship and analyze changes in an organism using PHYLIP.	CO3
11.	Proteomics	To perform structure modelling using Swiss Model	CO4
12.	Proteomics	To perform advance proteomics based (Mass spectrometry) experiment using computational tools.	CO4
13.	Proteomics and structural biology	To perform macromolecular structural analysis using RASMOL/SWISS PDB viewer	CO5

Evaluation criteria

Components	**Maximum Marks**
Mid Term Exam/Viva	20
End Term Exam/Viva	20
D2D(Report/Attendance/Experiment/PBL)	60
Total	**100**

PBL: Students will choose any protein linked to a particular disease. How is it commercially used as a therapeutic molecule or as a target to manage the disease?

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication, etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEEformat)

1.	Baxevanis, Andreas D., and BF Francis Ouellette. Bioinformatics: a practical guide to the analysis of genes and proteins. Vol.43. John Wiley & Sons, 2004.
2.	J. Dudley and A.Butte, "A Quick Guide for Developing Effective Bioinformatics Programming Skills", PLoS Computational Biology, vol.5, no. 12, p.e1000589, 2009.

Detailed Syllabus

Lecture wise Breakup

Course Code	**16B1NHS332**	**Semester: Even**	**Semester:** IV	**Session** 2022-23
Course Name	**Quantitative Methods for Social Sciences**			
Credits	**03**	**Contact Hours**	**2-1-0**	
Faculty (Names)	**Coordinator(s)**	Manas Ranjan Behera		
	Teacher(s) (Alphabetically)	Manas Ranjan Behera		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
C206-3.1	Demonstrate the key concepts of different quantitative methods used in social sciences.	Understanding Level- (C2)
C206-3.2	Classify and summarize the data to be used for analysis.	Understanding Level- (C2)
C206-3.3	Apply the theoretical concept to perform basic data analysis in social sciences.	Apply Level –(C3)
C206-3.4	Examine different statistical methods and be able to discuss the merits and limitations of a particular method	Analyze Level –(C4)
C206-3.5	Recommend appropriate conclusions following empirical analysis	Evaluation Level- (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to Quantitative Methods, Classification & Presentation of Data: Tabulation-Types of Table, Diagrammatical and Graphical presentation.	3
2.	Mathematical Concepts	Mathematical basis of Managerial Decision-Concepts, Frequency Distribution and their Analysis	3
3.	Statistical Concepts	Measures of Central Tendency, Measures of Dispersion, Measures of Association, Sampling and sample size estimation, Point estimation, Statistical Intervals based on Single sample.	4
4.	Hypothesis Testing	Hypothesis Testing based on single sample, Inferences based on Two samples, t, Z and chi- square and F tests	8
5.	Regression Analysis	Simple Linear Regression and Correlation, Multiple Regression Model	3
6.	Time Series Analysis	Trend Projection, Moving averages and Exponential smoothing Techniques, Index Numbers	3
7.	Multivariate Analysis	ANOVA, MANOVA, Factor Analysis, Discriminant Analysis	4
Total number of Lectures			**28**

Evaluation Criteria	
Components Maximum Marks	
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+ Project+ Viva-voce)
Total	**100**

Project based Learning: Students have to form a group (maximum 5 students in each group) and have to do a project on quantitative research techniques and strategies. The project emphasizes on objective measurement and the statistical analysis of data collected through surveys, questionnaires and polls. The students will gain a first-hand experience of data analysis which will help them in entering an analytical or research career.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Sirkin, RM. Statistics for the Social sciences. 3rd ed. Thousand Oaks, Calif: Sage Publications; 2006.
2.	Montgomery, DC. , George C. Runger. Applied statistics and probability for engineers. 3rd ed. Hoboken, NJ: Wiley.,2007
3.	Healey, JF. Statistics: A Tool for Social Research. 9th ed. Calif: Wadsworth Cengage Learning; 2012.
4.	Stockemer, D.Quantitative Methods for Social Sciences: A Practical Introduction with examples in SPSS and STATA 1st ed., Springer International Publishing, 2019
5.	Kaplan, DW. The SAGE Handbook of Quantitative Methodology for the Social Sciences. 1st ed. SAGE Publications Inc,2004