ADMISSION & EXAMINATION
BYE-LAWS

FOR

MASTER OF TECHNOLOGY
(BIO-INFORMATICS)
M. TECH. (BI)

CHOICE BASED CREDIT SYSTEM (CBCS)
(2019-20)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
School of Engineering Sciences & Technology
JAMIA HAMDARD
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ADMISSION & EXAMINATION RULES
for
MASTER OF TECHNOLOGY
(Bioinformatics)

Three M. Tech. Programs has been offered by the Department of Computer Science & Engineering namely:

1. **M. Tech. (Bioinformatics)**

1. PROGRAM OBJECTIVE

To prepare highly skilled professionals with a strong conceptual, theoretical & practical proficiency and research ability in the field of Bioinformatics.

2. THE PROGRAM

Highlights of the program are described in the following table:

a.	*Name of the Programs*	M. Tech. (Bioinformatics).
b.	*Nature*	Regular and Full Time
c.	*Duration*	Two Years (4 Semesters)
d.	*Total number of credits*	68
e.	*Medium of Instruction and English Examinations*	English
f.	*Eligibility Criteria*	Passed B.Tech. orM.Sc or equivalent degree in: Bioinformatics / Information Technology / Computer Science / Bioelectronics / Biophysics / Biomathematics / Biotechnology / Biochemistry / Life Sciences, or Pharmacy, or in any allied disciplines (as decided by Jamia Hamdard), or MCA degree, with at least 55% marks (or equivalent CGPA) in aggregate.
g.	*Selection procedure*	Merit of the qualifying examination.
h.	*Period of Completion*	Not more than 04 years (8 Semesters)
i.	*Commencement of the Program*	July of the every academic session
j.	*Number of seats*	18

3. PROGRAM STRUCTURE *(Common for all M. Tech. Programs)*

Semester-wise program structures, guidelines for teaching, practical and associated assessments of **M. Tech.** programs are described in the following tables:

Program Summary

Course Type	Abbreviation	Credits
Program Core	PC	12
Program Elective	PE	15
Open Elective (OE)	OE	3
Research Methodology & IPR	RMIPR	2
Audit Course	AC	0

Laboratory	LAB	8
Mini Project with Seminar	MPS	2
Dissertation	DISS	26
Total Credits		**68**

Semester – I

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTBI 101	Mathematical Foundations of Computer Science	PC	25	75	100	3-0-0	3
MTBI 102	Advanced Data Structures	PC	25	75	100	3-0-0	3
	Program Elective – I	PE	25	75	100	3-0-0	3
	Program Elective – II	PE	25	75	100	3-0-0	3
MTBI 103	Research Methodology & IPR	RMIPR	25	75	100	2-0-0	2
	Audit Course – I	AC	25	75	100	2-0-0	0
MTBI 104	Lab – I (Data Structures and Algorithm Design)	LAB	25	75	100	0-0-4	2
MTBI 105	Lab – II (Based on Electives)	LAB	25	75	100	0-0-4	2
Total					**800**	**16-0-8**	**18**

L-T-P stands for number of contact hours as Lecture-Tutorial-Practical in a week.

Semester – II

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTBI 201	Proteomics and Genomics	PC	25	75	100	3-0-0	3
MTBI 202	Structural and System Biology	PC	25	75	100	3-0-0	3
	Program Elective – III	PE	25	75	100	3-0-0	3
	Program Elective – IV	PE	25	75	100	3-0-0	3
	Audit Course – II	AC	25	75	100	2-0-0	0
MTBI 203	Lab – III (Based on Core)	LAB	25	75	100	0-0-4	2
MTBI 204	Lab – IV (Based on Electives)	LAB	25	75	100	0-0-4	2
MTBI 205	Mini Project with Seminar@ #	MPS	25	75	100	2-0-0	2
Total					**800**	**16-0-8**	**18**

*Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.

Semester – III

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
	Program Elective – V	PE	25	75	100	3-0-0	3
	Open Elective	OE	25	75	100	3-0-0	3
MTBI 301	Dissertation – I//Industrial Project @ #	DISS	200	100	300	0-0-20	10
Total					**500**	**6-0-20**	**16**

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

Semester – IV

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MTBI 401	Dissertation – II@ # $	DISS	300	200	500	0-0-32	16

Grand Total of Credits = 68

@ Dissertation/Mini Project shall be based on latest research topics in the field of Bioinformatics.

 # Students are required to get approval of their title of Dissertation/Mini Project by Dissertation Assessment & Evaluation committee constituted by HOD. Supervisor of respective students must be member of the above committee. Students are required to give atleast three presentations/seminars for progress monitoring & assessment purpose to their respective supervisors. Viva-voce will be held only after the submission of completion report duly signed by the supervisor of the respective student. A plagiarism report duly signed by the students are mandatory to submit in compliance with UGC (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations, 2017 (or any such regulations notified time to time) by competent authority.

***$** Students are required to publish atleast one article related to their work of Dissertation in UGC approved International Refereed Journal/International Conference. Before submitting the paper Student **MUST** take the consent of their respective supervisor.*

PROGRAM OUTCOMES

At the end of the program a student is expected to have:

1. An understanding of the theoretical foundations and the limits of Bioinformatics.
2. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems in Bioinformatics
3. An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of healthcare.
4. Understanding and ability to use advanced computing techniques and tools in the field of biology.
5. An ability to undertake original research at the cutting edge of Bioinformatics& its related areas in bio based applications.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An understanding of professional and ethical responsibility.
8. An ability to communicate effectively with a wide range of audience.
9. An ability to learn independently and engage in lifelong learning.
10. An understanding of the impact of IT related solutions in an economic, social and environment context.

PROGRAM ELECTIVE (PE) for M.TECH. (Bioinformatics) PROGRAM

Course Code	Course Title	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Program Elective – I						
MTBI PE111	Introduction to Bioinformatics	25	75	100	3-0-0	3
MTBI PE112	Cell and Molecular Biology.	25	75	100	3-0-0	3
MTBI PE113	Physics and Chemistry Relevant to Bioinformatics	25	75	100	3-0-0	3
Program Elective – II						
MTBI PE121	Metabolic Engineering	25	75	100	3-0-0	3
MTBI PE122	Algorithms for Bioinformatics	25	75	100	3-0-0	3
MTBI PE123	Machine Learning	25	75	100	3-0-0	3
Program Elective – III						
MTBI PE231	Object-Oriented Programming using Java	25	75	100	3-0-0	3
MTBI PE232	RDBMS and data mining	25	75	100	3-0-0	3
MTBI PE233	Big data analytics	25	75	100	3-0-0	3
Program Elective – IV						
MTBI PE241	Sequence analysis	25	75	100	3-0-0	3
MTBI PE242	Molecular modeling and drug designing	25	75	100	3-0-0	3
MTBI PE243	Python for Bioinformatics	25	75	100	3-0-0	3
Program Elective – V						
MTBI PE351	Digital image analysis and image processing	25	75	100	3-0-0	3
MTBI PE352	Molecular structure prediction and visualization	25	75	100	3-0-0	3
MTBI PE353	Data analysis for microarrays	25	75	100	3-0-0	3

OPEN ELECTIVES (OE) COMMON FOR ALL M.TECH. PROGRAMS

Paper Code	Title of the Paper	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Open Elective						
MTBI OE311	Business Analytics	25	75	100	3-0-0	3
MTBI OE312	Industry Safety	25	75	100	3-0-0	3
MTBI OE313	Operation Research	25	75	100	3-0-0	3
MTBI OE314	Cost Management of Engineering Projects	25	75	100	3-0-0	3
MTBI OE315	Composite Materials	25	75	100	3-0-0	3
MTBI OE316	Waste to Energy	25	75	100	3-0-0	3

AUDIT COURSE (AC) COMMON FOR ALL M.TECH. PROGRAMS

Paper Code	Title of the Paper	Marks			L-T-P	Credits
		Internal Assessment	Semester Exam	Total		
Audit Course – I						
MTBI AC111	English for Research Paper Writing	25	75	100	2-0-0	0
MTBI AC112	Disaster Management	25	75	100	2-0-0	0
MTBI AC113	Pedagogy Studies	25	75	100	2-0-0	0
Audit Course – II						
MTBI AC221	Constitution of India	25	75	100	2-0-0	0
MTBI AC222	Value Education	25	75	100	2-0-0	0
MTBI AC223	Personality Development through Life Enlightenment Skills	25	75	100	2-0-0	0

4. MODE OF CURRICULUM DELIVERY

Mode of curriculum delivery includes classroom teaching, assignments, test, lab work, presentations, participation in relevant events and regularity.

5. ATTENDANCE

a. All students are supposed to attend every lecture and practical classes. However, the attendance requirement for appearing in the examination shall be a minimum of 75% of the classes held.

b. Each one-period teaching shall account for one attendance unit.

c. The concerned teacher will take a roll call in every scheduled class, maintains and consolidate the attendance record, which would be submitted to the Head of the Department at the conclusion of the semester.

d. Attendance on account of participation (with prior permission from the head of the department) in the co-curricular/extra-curricular activities can be granted by the Dean on receipt of certificates or recommendations of the respective activity issued by the Head of the Department.

e. Attendance records displayed on Notice Board from time to time, in respect of short attendance, shall be deemed to be a proper notification and no individual notice shall be sent to the students/local guardian.

f. In case a student is found to be continuously absent from the classes without information for a period of 30 days, the concerned teacher shall report it to the Head of the Department.

g. Head of the department may recommend for striking off the name of a student from rolls, after ensuring '**one month continuous absence**', from all the concerned teachers.

h. A student, whose name has been struck off on account of long absence, may apply to the Dean for readmission within 15 days of the notice of striking off the name. The readmission shall be effected on payments of prescribed readmission fees.

i. A student with less than 75% attendance, in aggregate shall not be allowed to appear in the semester examination. The Head of the Department shall recommend all such cases to the Dean of the faculty.

j. The Dean, on the recommendation of the Head of the Department, may consider the relaxation of attendance up to 10% on account of sickness and /or any other valid reason. No application for relaxation of attendance (duly certified by a

Registered Medical Practitioner/Public hospital or a competent authority) will be entertained after 15 days from the recovery from illness etc.

6. INTERNAL ASSESSMENT

a. Internal assessment, to be made by concerned teachers, will be based on unit tests, quizzes, presentation, programming test, demonstrations and assignments.

b. There will be three (3) Internal Assessment (Unit Tests) with a total of 20 marks ,and the best two (2) performances out of the three Unit tests of Internal Assessment will be counted. Other modes of assessment shall account for remaining 5 marks.

c. Dates for unit tests will be announced at the beginning of the semester, by the examination coordinator.

d. The teacher concerned shall maintain a regular record of the marks obtained by students in minor tests and display the same in due course.

e. The concerned teachers shall submit the compiled internal assessment marks to the Head of the Department, on the conclusion of teaching of the current semester.

f. The Head shall display a copy of the compiled sheet, of internal assessment marks of all the papers, before forwarding it to the Controller of Examination, i.e. at the conclusion of the semester.

g. A promoted candidate, who has to reappear in the examination of a paper, will retain internal assessment marks.

h. In the case of re-admission, the candidates shall have to go through the internal assessment process afresh and shall retain nothing of the previous year.

7. SEMESTER EXAMINATIONS

Prescriptions for conducting semester examinations of theory and lab papers, those shall be conducted after the conclusion of each of the semesters, are presented in the following table:

S.N.	Classification	Theory	Lab
1.	Mode	Written Only	Written, Demo, Programming and viva- voce etc.
2.	Duration	03 Hours	04 Hours
3.	Total Marks	75 (Seventy Five Only)	75 (Seventy Five Only)

8. DISSERTATION

a. Each student of the final semester will have to go for a Research based Dissertation work either in the industry or in the Department under the guidance of one or two faculty members.

b. Dissertation shall be based on latest research topics.

c. Students are required to get approval of their title of Dissertation by Dissertation Assessment & Evaluation committee constituted by HOD. Supervisor of respective students must be member of the above committee. Students are required to give at least three presentations for progress monitoring & assessment purpose to their respective supervisors. Viva-voce will be held only after the submission of completion report duly signed by the supervisor of the respective student. A plagiarism report duly signed by the students are mandatory to submit in compliance with UGC (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations, 2017 (or any such regulations notified time to time) by competent authority.

d. *Students are required to publish at least one article related to their work of Dissertation in UGC approved International Refereed Journal/International Conference. Before submitting the paper Student* ***MUST*** *take the consent of their respective supervisor.*

e. A supervisor will be allocated to every student for dissertation work as decided by the Dissertation Committee of the Department.

f. All the students, who are pursuing the Dissertation work, shall be continuously in touch with the internal supervisor.

g. ***There shall be three presentations by the students for evaluation of the progress*** and the internal supervisors will conduct it. However, an internal supervisor may ask the student to submit a confidential progress-report from the external supervisor *(if any).*

h. All the candidates shall submit ***Three (03***) hard copies of the project reports that are duly approved and signed by internal as well as external *(if applicable)* supervisors.

i. An external examiner, appointed for the purpose, shall evaluate the project report.

j. The Head of the Department shall fix a date and time for viva-voce examinations, on receipt of the evaluation-report of the project reports from the external examiner.

k. Head of the Department shall forward the compiled total marks (awarded in internal assessment, project Report and Viva-voce Examination), in the project-semester of each of the candidate, to the Controller of Examination.

9. EXAMINATION

a. The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/ tutorials, quizzes/ viva voce and attendance. The end semester examination shall be comprised of written papers, practical and viva voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.
b. The marks obtained in a subject shall consist of marks allotted in end semester theory paper, practical examination and sessional work.
c. The minimum pass marks in each subject including sessional marks (Theory, Practical or Project etc.) shall be 40%.

10. PROMOTION SCHEME

a. A student will be required to clear minimum **40% of his/her papers** (including Labs; excluding non-credit papers) in a semester/annual examination to be eligible **for promotion to the next semester/year**. A student may appear in the supplementary examination after each semester/annual examination and can have a choice to appear in the backlog papers in the supplementary examination or in the subsequent regular semester/annual examination with a prescribed fee. A students detained due to shortage of attendance will repeat his/her paper in the subsequent semester concerned (even/odd).

b. A **detained** Student is not allowed to re-appear in the internal assessment (Unit test). His/her old internal assessment marks will remain same.

A student who cleared all the papers of a semester/annual examination of a programme/course will be eligible for improvement examination as per university rule.

After having passed all the FOUR semesters successfully, the students shall be eligible for the award of M.Tech (Bioinformatics) degree of JAMIA HAMDARD based on their in the respective program.

11. THE GRADING SYSTEM

As per University Rule

12. CALCULATION OF SGPA AND CGPA OF A STUDENT IN A SEMESTER

As per University Rule

After having passed all the FOUR semesters successfully, the students shall be eligible for the award of M.Tech (Bioinformatics) degree of JAMIA HAMDARD based on their in the respective program.

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES

The result of successful candidates, who fulfill the criteria for the award of Master ***of Technology (Bioinformatics), M. Tech. (Bioinformatics)*** shall be classified at the end of last semester, on the basis of his/her final CGPA (to be calculated as per university rule).

DETAILED SYLLABUS

SEMESTER I

Course Code	Course Title	L	T	P	C
MTBI 101	Mathematical Foundations of Computer Science	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisites	Basic Mathematics, Discrete Mathematics.				
Objectives					
1. To understand the statistical fundamentals used in designing various bioinformatics algo. 2. To develop the understanding of the mathematical and logical basis to many modern techniques in bioinformatics like machine learning 3. To study various sampling and classification problems.					

Unit – I: Probability Functions and Distributions
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

Unit – II: Random Sample Distribution
Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood.

Unit – III: Statistical Models
Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.

Unit – IV: Graph Theory
Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

Unit – V: Bioinformatics Applications
Healthcare, Genomics, structure prediction,Data mining, Machine learning.

Unit – VI: Recent Trends in Various Distribution Functions

Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Text/ Reference Books:

- John Vince, Foundation Mathematics for Computer Science, Springer.
- K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
- M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and
- Probabilistic Analysis.
- Alan Tucker, Applied Combinatorics, Wiley

Outcomes
After completion of course, students would be able to:
• To understand the basic notions of discrete and continuous probability. • To understand the methods of statistical inference, and the role that sampling distributions play in those methods. • To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

Course Code	Course Title	L	T	P	C
MTBI 102	Advanced Data Structures	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisties	Basic data structure, algorithm knowledge.				
Objectives					

1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary mathematical abstraction to solve problems.
3. To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4. Introduce students to the advanced methods of designing and analyzing algorithms.
5. To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.

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Unit – I: Dictionaries & Hashing

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit – II: Skip Lists

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit – III: Trees

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit – IV: Text Processing

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit – V: Computational Geometry

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit – VI: Recent Trends in Hashing, Trees & Computational Geometry

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

REFERENCES

- E. Horowitz, S. Sahni, & S. Rajsekaran, Fundamentals of Computer Algorithms, Galgotia Publication.
- Horowitz, Sahni, Freed, Fundamentals of Data Structures in C, Silicon Press.
- Kruse R., Data Structures and Program Design in C, Pearson Education India

Outcomes
After completion of course, students would be able to:
1. Have the knowledge of data structures and algorithms that can be implemented further for developing bioinformatics software.

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI 103	Research Methodology and IPR	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisites	NIL				
Objectives					

Students will:

1. understand some basic concepts of research and its methodologies.
2. identify appropriate research topics.
3. select and define appropriate research problem and parameters .
4. prepare a project proposal (to undertake a project).
5. organize and conduct research (advanced project) in a more appropriate manner.
6. write a research report and thesis.
7. write a research proposal (grants**).**

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Unit – I: Research Problem, Scope & Objectives

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit – II: Effective Literature Studies

Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit – III: Effective Technical Writing

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit – IV: Nature of Intellectual Property

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

Unit – V: Patent Rights

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit – VI: New Developments in IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science

& engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992.
5. Niebel , "Product Design", McGraw Hill, 1974.
6. Asimov , "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Outcomes
After completion of course, students would be able to:
• Understand research problem formulation. • Analyze research related information. • Follow research ethics. • Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity. • Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. • Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

SEMESTER II

Course Code	Course Title	L	T	P	C
MTBI 201	Proteomics and Genomics	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisites	Cell and molecular biology, Introduction to bioinformatics				
Objectives					
This course provides a foundation in the following four areas; whole genome analysis; genome sequencing; annotation of genome and proteome analysis.					

Unit 1

Genomics and Metagenomics: Large scale genome sequencing strategies. Metagenomics, basic principles, application of methods to prokaryotic and eukaryotic genomes and interpretation of results. Basic concepts on identification of disease genes, role of bioinformatics-OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; identification of SNPs, SNP database (DbSNP). Role of SNP in Pharmacogenomics, SNP arrays. Basic concepts in identification of Drought stress response genes, insect resistant genes, nutrition enhancing genes.

Unit 2

Epigenetics: DNA microarray: database and basic tools, Gene Expression Omnibus (GEO), ArrayExpress, SAGE databases DNA microarray: understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation of gene expression data to biological process and computational analysis tools (especially clustering approaches).

Unit 3

Comparative genomics: Basic concepts and applications, whole genome alignments: understanding the significance; Artemis, BLAST2, MegaBlast algorithms, PipMaker, AVID, Vista, MUMmer, applications of suffix tree in comparative genomics, synteny and gene order comparisons Comparative genomics databases: COG, VOG.

Unit 4

Functional genomics: Application of sequence based and structure-based approaches to assignment of gene functions – e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases in function assignment, use of SNPs for identification of genetic traits. Gene/Protein function prediction using Machine learning tools viz. Neural network, SVM etc.

Unit 5

Proteomics: Tools for proteomics: 2D Electrophoresis, Liquid chromatography in proteomics,Protein identification – Mass spectrometry, peptide mass fingerprinting, protein sequencing, Structural proteomics- X-raycrystallography, NMR.

Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools.

Unit 6

Protein interactions and microarrays: Protein-Protein interactions, Library based methods, systematic complexanalysis by Mass spectrometry, Protein interaction maps .Functional proteomics – protein chips, detection and quantification.

Reference books:

1. Principles of Genome Analysis and Genomics (3rd Ed.) by Primrose, S.B. and Twyman, R.M., Blackwell Publishing Company, Oxford, UK. 2003

2. Introduction to Proteomics – Tools for the new biology (1st Ed.) by Liebler, D.C., Humana Press Inc., New Jersey, USA. 2002

3. Bioinformatics and Functional Genomics by Pevsner, J., John Wiley and Sons, New Jersey, USA. 2003

4. Bioinformatics: Sequence and Genome Analysis by Mount, D., Cold Spring Harbor Laboratory Press, New York. 2004

5. Discovering Genomics, Proteomics and Bioinformatics 2nd edition - by A. Malcolm Campbell and Laurie J. Heyer. by Cold Spring Harbor Laboratory Press 2006.

Outcomes
After completion of this course, students would able to:
1.Identify and describe the different components in prokaryotic and eukaryotic genomes and proteomes. 2.Use the different methodologies, techniques and tools commonly used in proteomics and interactomics and metabolomics

Course Code	Course Title	L	T	P	C
MTBI 202	Structural and System biology	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Cell and molecular biology,Proteomics and Genomics.				
Objectives					
Introducing various concepts of systems biology, requiredfor modeling and simulation of biological systems.					

Unit 1

Principles of systems biology: Systems Biology and modeling, Properties of models, Variables, parametersand constants. Model development, Data integration, Techniques involved insystems biology: Elementary experimental techniques, advancedexperimental techniques.

Unit 2

Standard models and approaches: Law ofmass action. Michaelis-Menton Kinetics, Enzyme inhibition, Elementary fluxmodels and extreme pathways, Flux balance analysis,Metabolic controlanalysis.

Unit 3

Signal transduction , biological process: Quantitative measures of properties of signalingpathway. Selected Biological process: Glycolytic oscillation, coupling ofoscillator, cell cycle, Minimal cascade model, models of budding yeast cellcycle, ageing, Evolution of ageing process, Accumulation of defectivemitochondria, Dilution of membrane damage, choice of parameters andsimulation.

Unit 4

Gene expression modeling: Modeling of Gene expression, Bayesian networks, Boolean Networks, TheModel according to Griffith, The model according to Nicolis and Prigogine.Evolution and self organization: Quasispecies and Hypercycles.

Unit 5

Evolution and self organization: The Genetic Algorithm, Spin-glass Model of Evolution, Boolean NetworkModels

Unit 6

Data integration: Basic Concepts of database integration and datamanagement, Biclustering and data integration. Applications of SystemsBiology.

References:

1. EddaKlipp, Ralf Herwig, "*Systems Biology in Practice-Concepts,Implementation and Application",* Wiley VCH, I Edition, 2005.
2. Bernhard Ø. Palsson, "*Systems Biology: Properties of reconstructednetwork",* Cambridge University Press, 2006.

Outcomes
After completion of the subject, student would be able to:
1. Do cell differentiation and specialisation; diversity and unity of cell structure, prokaryotes and eukaryotes; tissues and organs; major metabolic pathways, metabolism; enzymes. 2. Understand the Nutrient uptake, circulation, gas and fluid exchange; differences between animal and plant anatomy.

PROGRAM ELECTIVE 1

Course Code	Course Title	L	T	P	C
MTBI PE111	Introduction to Bioinformatics (techniques and algorithm)	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Knowledge of computers, biology and databases				
Objectives					
1.To launch the students into core areas of Bioinformatics like sequence alignment, phylogenetic trees, genomics, proteomics. 2. To explore the students to applied areas of Bioinformatics like drug design, metabolic pathway engineering 3. Practical exploration of tools in bioinformatics.					

UNIT I - BIOLOGICAL DATABASES

Biological data types, Major biological databases and its classification,sequence and structure file formats, data mining.

UNIT II –BIOLOGICAL DATA: ACQUISITION, ACCESS, RETRIEVAL AND SUBMISSION.

Form of biological information; DNA sequencing, types of DNA sequences, genomic DNA, cDNA, recombinant DNA, expressed sequence tags (ESTs), genomic survey sequences (GSSs); Protein sequencing, Protein structure determination methods; gene expression data; data access, standard search engines, data retrieval tools, entrez, DBGET and SRS; software for data building; submission of new and revised data.

UNIT III-SEQUENCE ANALYSIS

Methods of sequence alignment. Pair wise alignment- Global, local, dot plotand its applications. Words method of alignment- FASTA and its variations,BLAST- Filtered and gapped BLAST, PSIBLAST, sequence alignment – global (Needleman &Wunsch Algorithm), local (The Smith &Watermann Algorithm) , Dynamic Programming, scoring matrices and gap penalties; similarity and homology. Multiple sequencealignment- methods and Tools for MSA, Application of multiple alignments,Viewing and editing of MSA.

UNIT IV - MOLECULAR PHYLOGENY

Concepts of trees- Distance matrix methods, Character based methods.Solving UPGMA, NJ and small parsimony problems. Methods of evaluatingphylogenetic methods- boot strapping, jackknifing.

UNIT V - MACROMOLECULAR STRUCTURE ANALYSIS

Gene prediction, Conserved domain analysis, Protein visualization,Prediction of protein secondary structure, Tertiary structure prediction-Validation of the predicted structure using Ramachandran plot,steriochemical properties.

Unit VI - COMPUTER AIDED DRUG DESIGNING

Protein Function Prediction,Metabolic Pathway analysis, Computer aideddrug designing,Pharmacogenomics and Pharmacogenetics.

REFERENCES

1. Cynthia Gibas, Per Jambeck, "*Developing Bioinformatics ComputerSkills"*, O'Reilly Media,Inc., 2001.
2. David Edwards, Jason Eric Stajich, David Hansen, "*Bioinformatics:Tools and Applications"*, Springer, 2009.
3. David W Mount, "*Bioinformatics: Sequence and genome analysis"*,Cold spring harbor laboratory press, 2nd edition, 2004.
4. Stan Tsai C., "*Biomacromolecules: Introduction to Structure,Function and Informatics"*, John Wiley & Sons, 2007.
5. Attwood T K, D J Parry-Smith, "*Introduction to Bioinformatics"*,Pearson Education, 2005.
6. ParagRastogi, "*Bioinformatics Methods And Applications: GenomicsProteomics And Drug Discovery"*, PHI Learning Pvt. Ltd., 3rdedition,2008.

Outcomes
After completion of course, students would be able to:
1. Have the knowledge of bioinformatics and its respective applications. 2 .Use bioinformatics search tools on the internet for mining data, pairwise and multiple sequence alignments. 3. Design parsimony tree for developing phylogenetic relations.

Course Code	Course Title	L	T	P	C
MTBI PE112	Cell and Molecular Biology	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisites	Basic biology.				

Objectives

1. To give in-depth knowledge of our body's building blocks.
2. To impart knowledge of genetic material, its constituents and functioning.
3. To provide awareness about the various catalysts present in body.
4. enables to survey the biological world which includes topics of Genetics, Cell biology and molecular biology.

Unit 1

Molecules of life - Structural organization of prokaryotic and eukaryotic cells- Concept of a composite cell and Molecular composition of cells. Biomembranes- Structural organization- Models of a plasma membrane, Membrane permeability- Transport across cell membranes- Transmembrane signals- Artificial membranes- liposome.

Unit 2

Mitochondrial Structure and Function – Oxidative Metabolism in the Mitochondrion – The Role of Mitochondria in the formation of ATP – Translocation of Protons and the Establishment of a proton-motive force – The Machinery for ATP formation – Peroxisomes.

Unit 3

Chloroplast structure and function – An overview of photosynthetic Metabolism – The absorption of light – Photosynthetic units and reaction centers – Photophosphorylation – Carbon dioxide fixation and the synthesis of carbohydrates.

Unit 4

Cellular Components – Cytoskeleton – components of Cytoskeleton, Microtubules, Intermediate filaments – Microfilaments, Cell cycle, Endoplasmic reticulum, Golgi complex, Types of vesicles - transport and their functions, Lysosomes.

Unit 5

DNA - Structure of DNA - evidence for DNA as genetic material. Gene transfer in microorganisms – conjugation, transformation, transduction - DNA replication, Transcription – mRNA processing, Translation.

Unit 6

Protein -- Amino acids- structure and chemical nature, peptides; primary, secondary, tertiary and quarternarystructures , Ribosomes, enzymes, Protein processing.

References :

1. Genes VIII (8 th Ed.) by Lewin, B. Pearson Education International. 2004.
2. Cell and Molecular Biology by De Robertis and De Robertis. Saunders College, Philadelphia, USA. 2002
3. Cell and Molecular Biology – Concepts and Experiments by Gerald Karp. Wiley International Student Version. 2008

Outcomes
After completion of this course, students would able to:
1.Understand literature in general biological sciences. 2. Exhibit knowledge in genetics, cell and molecular biology. 3.Represent and illustrate the structural organization of genes and the control of gene expression 4.Conceptualize and describe protein structure, folding and sorting 5. Explain the structure of membranes and intracellular compartments and relate these to function. 6. Summarize the processes of energy transduction in cells and explain their significance. 7.Relate how cell movement and cell-cell communication occur and discuss mechanisms of signal transduction 8. Outline the processes that control eukaryotic cell cycle and cell death.

Course Code	Course Title	L	T	P	C
MTBI PE113	Physics and Chemistry Relevant to Bioinformatics	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisties	Basic understanding of concepts related to physics and chemistry.				
Objectives					
1. Providing the knowledge of 2D and 3D molecular structures 2. To teach importance of structural descriptors 3. To explain the importance of physics and chemistry in biology.					

Unit 1: Classical Mechanics

Classical Mechanics: Types of Motion**:-**Uniform, projectile, circular and relative motions, Newton's Laws of Motion, Law of Gravitation, **Work and energy**:- work energy theorem, conservative / non-conservative forces, energy conservation, power, Linear momentum and collisions (elastic and inelastic), impulse, momentum theorem, **Rigid body rotation**:- angular velocity and acceleration, rotational kinetic energy, inertia, torque, dynamics of rotation, **Angular Momentum**:- conservation of angular momentum, translation and rotation, Statics Oscillatory motion

Unit 2: Quantum Mechanics

Black body radiation, photoelectric effect, Bohr's Model of Hydrogen atom, De Broglie's Hypothesis, Harmonic wave function, wave packets, Heisenberg uncertainty principle, Eigen states and eigen values, Pauli Exclusion Principle, Schrodinger equation.

Unit 3: Thermodynamics

Continuum Model, System (closed, isolated), State functions & variables, Adiabatic &diathermal boundary walls, Equilibrium, Process, equation of state. Heat, Zeroth Law of Thermodynamics, Heat Conduction Equation, The First Law of Thermodynamics, Work, Entropy, The Second Law of Thermodynamics:- reversibility and irreversibility, free and isothermal expansions, Heat Capacity, Isothermal and reversible-adiabatic expansion of an Ideal Gas , Enthalpy, Change of state, Latent heat and Enthalpy, Carnot cycle, Gibbs and Helmholtz free energy, Young's Modulus, The Third Law of Thermodynamics.

Unit4: Introduction to inorganic chemistry

Introduction to inorganic chemistry: Atomic Structure - Elements and compounds, atoms and molecules-definition, Classical atomic models - J. J. Thomson, E. Rutherford, N. Bohr. Electronic configuration - aufbau principle - Pauli exclusion principle - Hund's rule- Modern periodic table, periodicity. Chemical bonds - ionic bonding - covalent bonding - Coordinate covalent bonding. Overlap of σ and π orbitals – hybridization, resonance, Bond properties, Molecular geometry.

Unit 5: Introduction to organic chemistry

Introduction to Organic chemistry: Carbon and its compounds, Position of Carbon in periodic table, tetra covalency of carbon, functional groups.
Stereochemistry: Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirallity, enantiomers, stereogeniccentres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, distereoisomers, mesocompounds, resolution of enantiomers. Relative and absolute configurations, sequence rules, D &L , R & S systems of nomenclature.
Heteroaromatics: Five / six membered hetero aromatics and analogues, Nucleic acid bases, Structure, electron rich electron deficient heterocycles.

UNIT 6: applications
Applications of chemistry and physics in biology.

Reference Books:
1. Physics for Scientists and Engineers by Paul A. Tipler, Gene P. Mosca. Freeman Company. 2007
2. Fundamentals of Physics by Resnick, Halliday and Walker. 200
3. *Chemistry, The Central Science*, 10th edition, Theodore L. Brown; H. Eugene LeMay, Jr.; and Bruce E. Bursten
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G. D. Tuli and R.D. Madan
5. Chemistry3 Introducing inorganic, organic and physical chemistry, Andrew Burrows, John Holman, Andrew Parsons, Gwen Pilling, Gareth
6. Organic Chemistry by Paula YurkanisBruice, Prentice Hall. 2010
7. Heterocyclic chemistry at a glance, John A. Joule and Keith Mills
8. Physics for Scientists and Engineers (6th Ed.) by Raymond A. Serway, John W. Jewett, Thomson Brooks/Cole. 2004
9. Fundamental Principles of Physical Chemistry (Prutton, Carl F.; Maron, Samuel H.)
10. Organic Chemistry by Morrison and Boyd Sixth Edition

Outcomes
After completion of this course, students would able to:
1.Demonstrate the application of chemistry and physics in biological world. 2.Experiment and analyse easily on biological data.

PROGRAM ELECTIVE 2

Course Code	Course Title	L	T	P	C
MTBI PE121	Metabolic Engineering	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Knowledge of basic biological pathways, chemistry.				
Objectives					

1. Metabolome and its study.
2. Applications of Metabolomics
3. Metabolic flux analysis and its applications
4. Comprehensive models cellular reactions.

UNIT I -METABOLOMICS

Overview- Background and definitions of Metabolomics- importance of Metabolomics.

UNIT II -TECHNOLOGIES IN METABOLOMICS

Technologies-Mass spectrometry: principles, definitions, nomenclature, Metabolite isolation andanalysis by Mass Spectrometry, metabolite library, HPLC- capillaryelectrophoresis coupled with Mass spectrometry

UNIT III -APPLICATIONS

Applications of Metabolomics to biology:examples and case studies,Metabolome informatics, data integration and mining.

UNIT IV- METABOLIC ENGINEERING

Metabolic engineering: introduction, mass balance, black box, metabolic flux analysis,stochiometry, Principles of metabolic engineering

UNIT V- FLUX BALANCE ANALYSIS

Flux balance analysis, flux balance methods, group based flux balance, metabolic control analysis: overview, control coefficients, methods of measuring control. Flux analysis of networks- top down approach, bottom up approach.

UNIT VI-SUCCESSFUL EXAMPLES OF METABOLIC ENGINEERING

Product over production examples: amino acids, polyhydroxyalkanoic acids, By-product minimization of acetate in recombinant E. coli, Extension of substrate utilization range for organisms such as S. cerevisae and Z. mobilis for ethanol production, Improvement of cellular properties, Altering transport of nutrients including carbon and nitrogen and xenobiotic degradation.

Reference Books:

1. Tomita M., T. Nishioka, “Metabolomics:The Frontier of Systems Biology”, Springer, 2003.
2.Gregory N. Stephanopoulos, “Metabolic Engineering: Principles and Methodologies”,Academic press, First Edition, 1998.
3. Wolfram Weckwerth, “Metabolomics: Methods and Protocols”, Humana Press, 2007.
4. Sang Yup Lee, E. Terry Papoutsakis, “Metabolic engineering”, CRC Press, 1999.
5. William J. Griffiths, “Metabolomics, metabonomics and metabolite profiling”, RoyalSociety of Chemistry, 2008.

Outcomes
After completion of this course, students would able to:
1.Understand how various methabolic pathways work and visualize them easily.

Course Code	Course Title	L	T	P	C
MTBI PE122	Algorithms for Bioinformatics	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisties	Knowledge of basic Graph theory, algorithm design.				

Objectives

1. Introduction to algorithms and dynamic programming.
2. Description of graph algorithms and their applications sequencing.
3. Description of pattern matching and clustering with reference to bioinformatics.
4. Description of evolutionary trees and phylogeny related algorithms.
5. Description Hidden Markov Models and randomized algorithms.

UNIT I

DYNAMIC PROGRAMMING ALGORITHMS: Introduction to Algorithms, Dynamic Programming, Sequence Alignment: Edit distance, LCS. PAM and BLOSUM Scoring Matrices. Global alignments: Needleman Wunsch Algorithm, Local Alignments: Smith Waterman Algorithm, Gap Penalties.

UNIT II

GRAPH ALGORITHMS: Graph Algorithms, SBH and Eulerian Paths, De-novo Peptide Sequencing: Longest Paths and Space Efficient Alignment Algorithms. Fast LCS using Table Lookup.

UNIT III

PATTERN MATCHING AND CLUSTERING : Exact Pattern Matching: KMP Algorithm, Keyword Trees, Aho-Corasick Algorithm. Clustering Basics: Hierarchical Clustering, Multiple Sequence Alignment: CLUSTAL, Center-based Clustering, Clustering via Cliques.

UNIT IV

EVOLUTIONARY TRESS AND PHYLOGENY : Evolutionary Trees and Ultrametrics, Additive distance trees, Perfect Phylogeny Problem, Small Parsimony Problem, Nearest Neighbor Interchange.

UNIT V

HIDDEN MARKOV MODELS: Basics, Forward and Backward (Viterbi) Algorithms.

UNIT VI

RANDOMIZED ALGORITHMS: Randomized algorithms and their applications.

REFERENCES

1. Neil C. Jones and Pavel A. Pevzner, “An Introduction to Bioinformatics Algorithms”, MIT Press, 2005.
2. Gusfields D, “Algorithms on strings, trees and sequences: Computer Science and Computational Biology”, Cambridge University Press, 1997.
3. Steffen Schulze-Kremer, “Molecular Bioinformatics: Algorithms and Applications”, Walter de Gruyter, 1996.
4. Gary Benson, Roderic Page (Eds.), “Algorithms in Bioinformatics”, Springer International Edition, 2004.
5. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison. “Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acid”, Cambridge University Press, 1999.

Outcomes
After completion of the subject, student would be able to:
1. Understand the algorithms based on which different bioinformatics tools and softwaresare made.

Course Code	Course Title	L	T	P	C
MTBI PE123	Machine learning	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisties	Data Structure and algorithms ,Soft computing ,RDBMS and data mining.				
Objectives					
1 To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language. 2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs. 3. To learn various approaches in machine learning.					

Unit 1

Foundation of Machine learning: Turing Machine, Concepts of John von Neumann, computation ofamount of learning of a machine.

Unit 2

Concept of supervised and unsupervised learning, concept of clusters and classes, concept of trainingand testing.

Unit 3

Statistical Machine Learning: Design of rule based expert system, knowledge engineering, forward chaining and backwardchaining inference techniques, Application to discriminate intron from exon within eukaryoticDNA. Application of rule based system to discover knowledge from data, concept of clustering,condition to find best clusters. Various clustering techniques.Important components of a classifier, Probabilistic classifier, Bayesian classifier, Nearest
Neighbor Classifier, Discriminant Function Analysis (Linear and non-linear) as precursor to Artificial Neural Network.

Unit 4

Hidden Markov Models and applications, Applications to discriminate Exon from Intron, to predict secondary structures of proteins,discover group of genes having similar up-regulation or down-regulation pattern frommicro-array data.

Unit 5

Soft computing introduction, Soft Computing Constituents, From Conventional AI to Computational Intelligence.

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making

Unit 6

Soft computing method based machine learning, Artificial Neural Network for clustering and classification, local optimization ofANN weights, Back propagation network, Hopfield network. Genetic algorithm for optimizing parameters of classifiers.Support Vector Machine foundation, constrained local optimization using Lagrange Multiplier,application on 2 and more than 2 classes.Over fitting and Cross validation.

Application on the above said topics.

Reference Books:

1. Pattern recognition and image analysis by Earl Gose.
2. Pattern Classification by Duda, Richard and David Stork.
3. Machine Learning by Mitchell and Tom

Outcomes
After completion of the subject, student would be able to:
1. Explain how machine learning enables capabilities that are beyond conventional technology. 2. Ability to apply various machine learning and soft computing techniques for problem solving.

PROGRAM ELECTIVE 3

Course Code	Course Title	L	T	P	C
MTBI PE231	Object Oriented programming using JAVA	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Knowledge of basic programming. Basics of object oriented subject				
Objectives					
1. Introducing various concepts of object oriented programming. 2. To make aware how Java can be used to develop different applications in the area if program development.					

Unit 1

Introduction to Java: what is object oriented programming and its features, importance.Compilation of java programs – Java Development kit – virtual machine – byte code – data types (int, long, char, and Boolean) – operators (arithmetic, relational, bitwise and assignment) – arrays – operator precedence – type conversion – control statements and loops.

Unit 2

Working with java classes: Declaring classes – super and sub classes – constructors – instances of classes – inheritance (simple, multiple and multilevel) – overriding and overloading – exception handling – file handling.

Unit 3

Multi-thread programming: Life cycle of a thread – creating a thread (extension of thread class and implementing runnable) – thread priorities – synchronization – deadlock.

Unit 4

Event handling and applets: Event handling mechanisms – delegation event model – event classes – event listener interfaces – mouse and keyboard events – adapter classes and inner classes. Applet basics – passing parameters to applets – applet display methods – drawing lines, ovals, rectangles and polygons – threads and animation.

Unit 5

Biojava : Installing BioJava, Symbols, Basic Sequence Manipulation (DNA to RNA, Reverse Complement, motif as regular expression), Translation (DNA to Protein, Codon to amino acid, Six frame translation), Proteomics (Calculate the mass and pI of a peptide), Sequence I/O (File Formats conversions), Locations and Features (PointLocation, RangeLocation, Feature modifications), BLAST and FASTA (Blast and FastA Parser, extract information from parsed results), Counts and Distributions, Weight Matrices and Dynamic Programming, User Interfaces.

Unit 6

Applications in java.

Reference Books:

1. Java:The completer Reference. (7th Ed.) by Herbert Schildt, TMH. 2012

Outcomes
After completion of this course, students would able to:
1.Understand how to model real world scenario using JAVA programming. 2. Implement relationships between classes. 3. Create, debug and test application designed using JAVA on biological data.

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE232	RDBMS and Data Mining	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Mathematical foundation of computer science, Advanced data structures.				
Objectives					

1.Introduce the Database management architecture and languages
2. Description of Database models using ER diagram and mining the data into these database.

Unit 1:
Introduction to database: Database models, Flat model, Hierarchical model, & Network model, Profile& Block, Secondary and Tertiary sequence databases, Relational model, Codd's rule with explanation,1st, 2nd and 3rd level normalization, Relational operations, Dimensional model and Object databasemodels.

Unit 2:
Entity relationship model: ER Model: Objects, Attributes and its Types, Entity and Entity Set, Relationship & Relationship Set. Design Issues in choosing attributes orentity set or relationship set: Constraints, Super Key, Candidate Keys,Primary Key, ER Diagram Notations.
Structured query language : Overview, the Form of Basic SQL Query, UNION, INTERSECT, andEXCEPT- Nested Queries- Aggregate Functions- Null Values.

Unit 3:
Knowledge Discovery in Databases: Analysis of Data Using Large Database,. Challenges in DataCleaning, Data Integration, Data WarehousingFeature Selection and Extraction Strategies , Over fitting, Data Transformation, Attributes Featuresand Relevance, Dataset/Distribution, Feature Selection, Reduction, Techniques for MS Data Analysis,Data Pre-processing, Association: Apriori, FP growth tree.

Unit 4:
Clustering Techniques: Expressions for Co expressed Genes, Implementation of k-Means,Hierarchical Clustering, Microarray Data, Self-Organizing Maps Clustering, Hierarchical Clusteringfor Representation of Genes, Expectation Maximization Algorithm.
Unit 5:
Advanced Clustering Techniques: Graph-Based Clustering, Measures for Identifying Clusters, Graph-Based Algorithms, Graph Process, Kernel-Based Clustering, Identifying Stable and Tight Patterns,Problem in k-Means Clustering.

Unit 6:
Classification Techniques in Bioinformatics: Support Vector Machines (SVMs) , BayesianApproaches, Bayesian Networks, Expression Analysis, Decision Trees, Ensemble Approaches,
Classifiers, Challenges of Supervised Learning, Validation and Benchmarking, Performance Evaluation Techniques, Classifier Validation, Performance Measures, Cluster Validation Techniques.

Reference Books:
1. Data Mining for Bioinformatics (Text) SumeetDua, Pradeep ChowriappaCRC Press
2. Data Mining: Practical Machine Learning Tools and Techniques (Ed 3) (Ref)Ian Witten, Eibe Frank, Mark Hall, Morgan Kaufmann Publishers

Outcomes
After completion of this course, students would able to:
1. Master the basic concepts and appreciate the applications of database systems. 2. Master sound design principles for logical design of databases, including the E-R method and normalization approach. 3. Master the basics of query evaluation techniques and and query optimization 4. Apply acquired knowledge for understanding data and select suitable methods for data analysis. 5. Evaluate the performance of different data-mining algorithms 6. Propose data-mining solutions for different applications

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE233	Big Data Analytics	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisties	RDBMS and data mining , machine learning and soft computing.				
Objectives					

1. This course help students to work on huge datasets and perform analysis of them.
2.Learners will be able to realistically assess the application of big data analytics technologies for different usage scenarios.

UNIT 1

Introduction to Big Data Platform – Challenges of conventional systems – Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting – Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT 2

Data analysis: Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction – Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT 3

Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Realtime Analytics Platform(RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

UNIT 4

Itemsets and clustering : Mining Frequent itemsets – Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT 5

Framework and visualization: MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques; Systems and applications:

UNIT 6

Databases and Data Warehouses : databases, polygot persistence and their related introductory knowledge. Some live examples of big data.

Reference books:

1.Hadoop: a definitive guide, 2015, Tom white.
2.Big data and Analytics: SeemaArcharya, Subhashinichellappan.
3. Big data analytics 2ed.,RadhaShankarmani, M. Vijayalakshmi.

Outcomes
After completion of subject, students would be able to:
1.Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues. 2.Formulate and use appropriate models of data analysis to solve hidden solutions to biological related challenges.

PROGRAM ELECTIVE 4

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE241	Sequence Analysis	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisties	Advanced Algorithm, Proteomics and genomics				

Objectives
1.Provide students with skills to use biological molecule sequence database and analysis tools. 2.Help students to access the tool quality for analysis various sequences.

Unit 1

Structure of Biomolecules– Biomolecules, structure and techniques used to determine the structure of biomolecules; methods for single crystal X-ray diffraction of macromolecules; molecular replacement method and direct methods, fiber diffraction; analysis of structures and correctness of structures; submission of data to PDB, atomic coordinates and electron density maps.Ramachandran Plot, secondary structures of proteins, motifs, domains, tertiary and quaternary protein structure; Rossman fold, Immunoglobulin fold; anatomy of DNA, A, B, and Z-DNA; structure of RNA, secondary and tertiary structures.

Unit 2

X-ray crystallography and spectroscopy – Elementary description of crystallography; crystal growth; data collection; structure solution; refinement and interpretation; concept of resolution, Fluorescence spectroscopy; NMR spectroscopy chemical shift; Fourier transform, NMR spectroscopy; protein structure determination using NMR

Unit 3

Methods for prediction of protein structure and comparison of 3D structures – Knowledge-based structure prediction, fold recognition, *ab initio* methods for structure prediction, comparative protein modeling, methods for comparison of 3D structures of proteins; methods to predict three dimensional structures of nucleic acid, rRNA; electrostatic energy surface generation.

Unit 4

Systems biology – objectives, elements, robustness, redundancy, modularity, control, strategies relating to *in silico* modeling of biological processes, Drug target identification, metabolic networks, metabolome, signal transduction pathways; gene expression patterns; E-cell and V-cell simulations and applications. Characterization of network structure and algorithms for reconstructing the network from biological data. Develop mathematical models to represent the system, Predict how different perturbations will affect the system, test prediction for validity, Refine models and repeat.

Unit 5

File formats, sequence patterns and profiles: Sequence file formats – GenBank, FASTA, ALN/ClustalW2, PIR; Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations viz. consensus, regular expression (Prosite-type) and sequence profiles; Sequence similarity based search engines (BLAST and FASTA); Pattern based search using MeMe and PRATT); Motif-based search using ScanProsite and eMOTIF; Structure similarity based search using VAST and DALI; Profile-based database searches using PSI-BLAST and HMMer.

Unit 6

Sequence Analysis and predictions: Nucleic acid sequence analysis- Reading frames; Codon Usage analysis; Translational and transcriptional signals, Splice site identification, Gene

prediction methods and RNA fold analysis; Protein sequence analysis-Compositional analysis, Hydrophobicity profiles, Amphiphilicity detection, Moment analysis, Transmembrane prediction methods, Secondary structure prediction methods.

Reference Books:

1.Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

3. Introduction to Bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Outcomes
After completion of the subject, student would be able to:
1.Use tools for comparision and characterization of sequence. 2.Identify functional domains and predict the structure of molecules. 3.Analyze the gene expression using database of expression profiles.

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE242	Molecular Modeling and Drug Designing	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Mathematical Foundations of Computer Science, Physics and				

	chemistry relevant to bioinformatics, Sequence analysis.
Objectives	
1 To familiarize students with some common techniques for molecular modelling, 2. To draw drug structures in 3D using softwares. 3. To study active sites on receptors for drug to bing. 4. To make students able to propose and design suitable drug for given target enzyme or receptor.	

UNIT 1

Introduction, History of Drug Development, Basic pharmacodynamics and pharmacokinetics, Strategies for drug designing and drug development, Lead generation and Lead optimization Analogue and structure based methods, File format, conversion, Coordinate systems.

UNIT 2

Identifying Cavities and Surface Matching, Shape Complementarity, Solvent-Accessible Surface,Connolly Surface, Lenhoff "Surface", Nussinov and Wolfson Method, Alpha Shapes.

UNIT 3

Introduction to Molecular Dynamics, Density Functional Theory, Linear Scaling Techniques, Ab initio Methods, Hartree-Fock Approximation, Mùller-Plesset Perturbation Theory, Quantum Monte Carlo Methods, Natural Orbitals and Monte Carlo Simulations.

Introduction to Molecular Geometry, Coordinate Space for Optimization of Algorithm of Molecular Geometry, Z-Matrix, Molecular Vibrations, Electrostatic Charges, Electrostatic Charges, Multipole Moments, Fermi Contact Density, Electronic Spatial Extent and Molecular Volume, Electron Affinity and Ionization Potential, Hyperfine Coupling, Dielectric Constant, Force Field Customization.

UNIT 4

Docking and scoring methods for proteins-ligands, protein-protein, protein-DNA, DNA-ligand,Geometric Hashing, Generating a Coordinate System, Kuntz System, Clique detection, DockingSearch and its Dimensionality, Evolutionary Algorithms (EA), Tabu Search (TS), Hybrid Global-Local Search,Lamarckian GA (LGA).

UNIT 5

Docking Software: Dock, AutoDock, Flexx, GOLD, Optimization Technique: Gradient Descent Approach, Simulated Annealing, Metropolis Algorithm, Genetic Algorithm, Receptor mapping andactive site finding.

UNIT 6

Introduction, Pharmacophore Modeling, Structure Based Drug Designing (SBDD), Ligand BasedDrug Designing (LBDD), Pharmacophore Generation, Hypogen Theory, HipHop Theory, Softwares Ex: Catalyst etc.

Reference Books:

1. Drug Design: Structure and ligand-based approaches: Kenneth M.Merz, Dagmar Ringe, Charles.Reynolds.

2. Bioinformatics-from genomes to drugs (Vol.2- Applications Lengauer, Thomas (ed.).
3. Burger`s medicinal chemistry & drug discovery; Vol.-2(Drug discovery and drug development)Abraham, Donald J. (ed.)
4. Drug design : structure and ligand-based approaches: edited by Kenneth M. Merz, Dagmar Ringe,Charles H. Reynolds
5. Chemoinformatics; (Vol.-275 - Methods in molecular biology) : concepts, methods and tools fordrug discovery : Bajorath, Jurgen (ed.)

Outcomes
After completion of the subject, student would be able to:
1. Identify various molecular modeling tools and techniques for drug design and discovery 2.Explain how quantum mechanics can contribute to the understanding of reaction mechanisms in organic chemistry and catalysis. 3.Evaluate the accuracy of performed calculations. 4.Understand how a drug is developed for a disease.

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE243	Python for bioinformatics	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Advanced data structures (MTB 102) Object oriented programming using JAVA (MTB PE121)				
Objectives					

1.To apply Python for bioinformatics applications.
2. To describe Object oriented programming in Python and differentmodules.
3. To help students analyze biological sequences using Python.
4. To describe advanced analysis techniques using Python.
5. To describe expression analysis using Python.

UNIT 1
Python fundamentals: Running programs, types and operations, Functions, modules, classes, Exceptions,

UNIT 2
Object Oriented Programming: Threads, process, synchronization, databases and persistence, NumPy, SciPy, image manipulation, Akando and Dancermodules.

UNIT 3
Biopython: Parsing DNA data files, Sequence Alignment, Dynamicprogramming, Hidden Markov Model, Genetic algorithms, MultipleSequence Alignment, gapped alignment.

UNIT 4
Advanced analysis techniques: Trees, text mining, clustering, Self Organizing Map, Principal ComponentAnalysis, Fourier transforms, Numerical Sequence Alignment.

UNIT 5
Gene expression array analysis: Spot finding and Measurement, SpreadsheetArrays and Data Displays, Applications with Expression Arrays.

UNIT 6
Designing few applications using Python.

Reference books:

1. Jason Kinser, "*Python for Bioinformatics"*, Jones & BartlettPublishers, 2008.
2. Mark Lutz, "*Learning Python"*, 3rd edition, O'Reilly, 2007.
3. Alex Martelli, David Ascher, "*Python cookbook"*, O'Reilly, 2002.
4. http://www.biopython.org

Outcomes
After completion of the subject, student would be able to:
1. Create applications using python programming. 2. Implement database using SQLite. 3. Access database using python programming. 4. Develop and analyze algorithms for biological sequences using python programming

PROGRAM ELECTIVE 5

Course Code	Course Title	L	T	P	C
MTBI PE351	Digital Image Analysis and Image Processing	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Molecular modeling and drug designing.				
Objectives					

To aware students about need of image analysis in bioinformatics.

To introduce various techniques used for analyzing image.

Unit 1
The Image, its Representations and Properties: Image representations, Image digitalization, Digital image Properties, Color (overview), Cameras (overview).

Unit 2
Data Structures for Image Analysis: 1 Levels of Image Data Representation, Traditional Image Data Structures, Hierarchical Data Structures, Other Pyramidal Structures.

Unit 3
Image Pre-Processing: Pixel Brightness Transformations,, Geometric Transformations, Local Pre-Processing.

Unit 4
Segmentation: Thresholding, Edge-based Segmentation, Region-based Segmentation, Matching, Evaluation Issues in Segmentation.

Unit 5
The Image, its Mathematical and Physical Background: Overview, Linear Integral Transforms.

Unit 6
Image Data Compression: Image Data Properties, Discrete Image Transforms in Image Data Compression.

Reference books:
1. Digital image processing and analysis, B. Chanda, D. Majumder.
2. Fundamentals of Digital Image Processing 1st Edition, S. Annadurai.

Outcomes					
After completion of this subject, students would be able to:					
Familirize with the main theoretical and practical tools that are necessary for image processing (from image acquisition to image rendering), including both natural and medical images.					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE352	Molecular Structure Prediction and Visualization	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-requisites	Advanced algorithm ,Molecular modeling and drug designing, Structural biology and System biology.				
Objectives					

1. To make students recognize different approaches to structure prediction 2. To understand some aspects of the limitations of computer-based methods

UNIT 1

Basic structural principles: Building blocks of life, Chemical properties of polypeptides & PDBDatabase, Intermolecular forces: Types of intermolecular forces, Entropy and temperature, Proteinfolding &Levinthal Paradox

UNIT 2

Levels of protein structure: Primary structure, Secondary structure, Tertiary structure & Quaternarystructure, Motifs of protein structure: Hydrophobic and hydrophilic regions, Ramachandran plotAlpha-helix, Beta sheets, Loops, Topology diagrams &various structural motifs.

UNIT 3

X-Ray crystallography and NMR: Structure determination methods & Structure evaluation methods.

UNIT 4

Protein structure prediction: Impediments, Secondary/fold recognition, Threading/tertiary structures,Sequence considerations, Structural considerations, Energy consideration, Energy landscape &Validation.

UNIT 5

Structure prediction of small proteins using ab initio stochastic models: Lattice simulation, Randomwalkmodel, Self-avoiding model & HP-models, Structure prediction of small proteins using ab initiodeterministic models Ergodic hypothesis, Use of Newtonian equations of motion , Optimizationtechniques: Steepest descent, GA, simulated annealing & Force fields (Amber, CHARMM)

UNIT 6

Nucleic acid structures: DNA structures, RNA structures & Secondary structure prediction in RNA,Useful Tools: Visualization using VMD, PROCHECK, WHATIF & Simulation using Amber.

Reference Books:

1. Molecular Modelling: Principles and Applications (2nd Edition): Andrew R. Leach (Prentice Hall)
2. Introduction to Protein Structure: Carl Branden, John Tooze (Garland)
3. Proteins: Structures and Molecular Properties: Thomas E. Creighton (Freeman)
4. Principles of Nucleic Acid Structure Stephen Neidle (Academic Press)

Outcomes
After completion of this subject, students would be able to:
1. Develop practical skills in computational approaches to analyze, predict, and engineer biomolecules and biomolecular systems.

2. Gain knowledge about fundamental concepts, pressing challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare 3.Apply and to strengthen engineering principles and algorithmic thinking to the emerging applications of structural bioinformatics and other fields

Course Code	**Course Title**	**L**	**T**	**P**	**C**
MTBI PE353	Data Analysis for Microarrays	**3**	**0**	**0**	**3**
Total Contact hours	40				
Pre-Requisites	Big data analytics, Sequence analysis.				
Objectives					
1. To make students aware of DNA microarray techniques and its statistical analysis. 2. To make students understand the various RNA analysis techniques available.					

UNIT 1

DNA microarray: The Technical Foundations, Why are MicroArrayImportant?,What is a DNA MicroArray?, Designing a MicroArray Experiment-The Basic steps, Types of MicroArray.

UNIT 2

Microarray database: NCBI and MicroArray Data Management, GEO (Gene Expression Omnibus), MAML, The benefits of GEO and MAML, The Promise of MicroArray Technology in Treating Disease

UNIT 3

Microarray data normalization: MicroArrayDataPreprocessing, Data-Data normalization, MeasuringDissimilarity of Expression Pattern-Distance Motifs and Dissimilarity measures, Visualizing MicroArray Data-Principal Component Analysis,MicroArray Data.

UNIT 4

Microarray data analysis:KMeans Clustering, Hierarchical Clustering, Self Organization Maps (SOM), Identifying Genes: Expressed usually in a sample- Expressed significantly in population-Expressed differently in two populations, Classifying Samples from two populations using Multilayer Perceptron, Support Vector Machinesand their applications, Using genetic algorithm and Perceptron for feature selection and supervised classification.

UNIT 5

Microarray applications: Gene Ontology and pathway analysis, Promoter analysis and gene regulatory network, Coexpression analysis, CGH & Genotyping chips, Chromosome aberration and polymorphism via genome-wide scanning, Future direction of microarray approach, Pharmacogenomics, Toxicogenomics, Data mining..

UNIT 6

Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

REFERENCE BOOKS:

1. ArunJogota*, "Microarray Data Analysis and Visualization"*, the Bay Press, 2001.
2. Ernst Wit and John McClure*, "Statistics for Microarrays Design, Analysis and Inference"*,John Wiley & Sons, 2004.
3. Steen Knudsen, "*Guide to analysis of DNA Microarray data",* John Wiley & Sons, 2004.
4. DovStekel, "*Microarray Bioinformatics"*, Cambridge University Press, 2003.

Outcomes
After completion of this subject, students would be able to:
1. Differerntiate between microarray analysis and data analysis. 2. Implement various microarray techniques to DNA, RNA and protein sequences. 3. Perform statistical analysis of microarray data.

OPEN ELECTIVES

Business Analytics

Course Code: MTBI OE311
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite: Optimization, Data Mining
Course Objective:

- Understand the role of business analytics within an organization.

- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate an solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Manage business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit wise Syllabus

Unit – I: Business Analytics

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit – II: Trendiness & Regression Analysis

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytic Technology.

Unit – III: Business Analytics

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit – IV: Forecasting Techniques

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit – V: Decision Analysis

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit – VI: Recent Trends

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Course Outcome:

- Students will demonstrate knowledge of data analytics.

- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

Text/ Reference Books:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

Industrial Safety

Course Code: MTBI OE312
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite: NIL
Course Objective:

To impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings.

Unitwise Syllabus

Unit – I: Industrial Safety

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit – II: Maintenance Engineering

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit – III: Wear & Corrosion

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit – IV: Fault Tracing

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit – V: Periodic & Preventive Maintenance

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Unit – VI: Accident investigation and Analysis Accident Investigation, Control Chart Analysis, Accident Data Analysis: Regression, Classification Tree.

Course Outcome:

- Students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics,
- Understand design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability.

Text/ Reference Books:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research

Course Code: MTBI OE313
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite: NIL
Course Objective

At the end of the course, the student should be able to

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

Unit wise Syllabus

Unit – I: Optimization Techniques

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit – II: Formulation of LPP

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit – III: Nonlinear Programming Problem

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit – IV: Scheduling & Sequencing

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit – V: Competitive Models

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Unit – VI: Transportation Problem

Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution, Moving Towards Optimality.

Course Outcome:

On finishing the course students will be able to

- Define and formulate linear programming problems and appreciate their limitations.
- Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
- Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
- Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.

Text/ Reference Books:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010

- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects

Course Code: MTBI OE314
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite: NIL
Course Objective

- To teach students the techniques relating to managing engineering activities.
- To help engineer's transition into management, engineering managerial functions.
- To motivate individual and group behavior, productivity assessment/improvement.

Unit wise Syllabus

Unit-I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents.

Unit-III

Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit-IV

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Unit-V

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-VI

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Course Outcome:

- Identify and use the tools of project management.
- Effectively use project reporting tools and techniques.
- Understand and appraise the changing business climate and how the changes have impacted project management
- Understand the importance of risk, cost, schedule and resource control and management of a project
- Understand the need for effective project management skills, training and the specific training needs of project managers.
- Demonstrate an understanding of the role of Project Management vs. Functional Management.
- Write clear goal and objective statements and establish measurable criteria for project success.

Text/ Reference Books:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials

Course Code: MTBI OE315
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite:

Course Objective

- The course covers the properties of fibre-reinforced polymer composites and the mechanical performance of laminated composites, including failure behaviour.

- Students will be able to model, simulate and optimise the performance of composite structures as well as develop practical skills in one or more common manufacturing techniques.
- Students will be taught how to use and apply classical laminate theory to intelligently design laminates with tailored mechanical responses in commercial composite analysis software.
- The course will also include a design exercise for a composite component or structure.

Unit wise Syllabus

Unit – I: Introduction

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit – II: Reinforcements

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit – III: Manufacturing of Metal Matrix Composites

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic
Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit – IV: Manufacturing of Polymer Matrix Composites

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method Compression moulding – Reaction injection moulding. Properties and applications.

Unit – V: Strength

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Unit – VI: PROMAL for Windows Software Package: A User's Guide

To set up PROMAL on a personal computer Show how to use PROMAL for matrix algebra such as multiplication of matrices, solving a set of equations and finding inverse of a matrix, developing and maintaining a database for properties of unidirectional laminas, conducting macromechanics of a lamina, conducting micromechanics of a lamina, conducting macromechanics of a laminate Show by examples how to use each of the above programs

Course Outcome:
Students will have the skills and knowledge to

- Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
- Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
- Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites
- Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project
- Critique and synthesise literature and apply the knowledge gained from the course in the design and application of fibre-reinforced composites.

Text/ Reference Books:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
- Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy

Course Code: MTBI OE316
L-T-P: 3-0-0
Total Teaching Hours: 48 hours
Course Prerequisite: Basics of Chemistry and Biology

Course Objective:

To impart the knowledge of

production of energy from different types of wastes through thermal, biological and chemical routes.

Unit wise Syllabus

Unit – I: Introduction to Energy from Waste

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit – II: Biomass Pyrolysis

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit – III: Biomass Gasification

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit – IV: Biomass Combustion

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit – V: Biogas

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion –

Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

Unit – VI: Energy production

Energy production from waste plastics, gas cleanup. Energy production from organic wastes through anaerobic digestion and fermentation, introduction to microbial fuel cells. Energy production from wastes through fermentation and transesterification. Cultivation of algal biomass from wastewater and energy production from algae.

Course Outcome:

- The course will upgrade students knowledge with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

Text/ Reference Books:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT COURSE

ENGLISH FOR RESEARCH PAPER WRITING

Course Code: MTBI AC111

L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite: Basics of English Language

Course Objective:

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Understand the skills needed when writing a title ensure the good quality of paper at very first-time submission

Unit wise Syllabus

Unit – I: Planning and Preparation

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit – II: Plagiarism

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit – III: Review Study

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit – IV: Writing Skill

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit – V: Writing Skill-II

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit – VI: Quality Assurance

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Course Outcome:

Students will be able to write good quality research paper.

Text/ Reference Books:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
- Sahni, PardeepEt. Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi

DISASTER MANAGEMENT

Course Code: MTBI AC112
L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite: None

Course Objective:

Students will be able to:

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Unit wise Syllabus

Unit – I: Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit – II: Repercussions of Disasters and Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit – III: Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post Disaster Diseases And Epidemics

Unit – IV: Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit – V: Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit – VI: Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Course Outcome: After completion of the course student will

- Understand repercussions of hazards and disasters.
- Get familiar with disaster management theory (cycle, phases)

- have knowledge of Technological innovations in Disaster Risk Reduction: Advantages and problems
- Understand disaster mitigation

Text/ Reference Books:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
- Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

PEDAGOGY STUDIES

Course Code: MTBI AC113

L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite: None

Course Objective:

The course imparts knowledge of pedagogical practices being used by teachers in formal and informal classrooms.

Unit wise Syllabus

Unit – I: Introduction and Methodology

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions**.** Overview of methodology and Searching.

Unit – II: Thematic Overview

Thematic overview: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.Curriculum, Teacher education.

Unit – III: Pedagogical Practices

Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

Unit – IV: Professional Development

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Unit – V: Future Directions

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Course Outcome:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy

Text/ Reference Books:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basimaths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.
- Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

CONSTITUTION OF INDIA

Course Code: MTBI AC221

L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite: None

Course Objective:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit wise Syllabus

Unit – I: History of Making of the Indian Constitution

History, Drafting Committee, (Composition & Working)

Unit – II: Philosophy of the Indian Constitution

Preamble, Salient Features

Unit – III: Contours of Constitutional Rights & Duties

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Unit – IV: Organs of Governance

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Unit – V: Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit – VI: Election Commission

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Course Outcome:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Text/ Reference Books:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

VALUE EDUCATION

Course Code: MTBI AC222

L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite:

Course Objective: The course will be able to

- Help student understand value of education and self- development
- Imbibe good values in students.
- Help students know about the importance of character

Unit wise Syllabus

Unit – I: Value & Self Development

Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles.
Value judgements

Unit – II: Cultivation of Values

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit – III: Personality &Behaviour Development

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self- estructive habits. Association and Cooperation, Doing best for saving nature

Unit – IV: Character & Competence

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.
All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Unit – V: Value Education towards National and Global Development

Constitutional Values: Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity, Social Values: Pity and Probity, Self-Control, Universal Brotherhood. Professional Values: Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith.

Unit – VI: Religious, Moral Values, and Aesthetic Values::

Tolerance, Wisdom, character. Love and Appreciation of literature, fine arts and respect for the same.

Course Outcome:

Students will

- Have knowledge of self-development
- Learn the importance of Human values
- Develop the overall personality

Text/ Reference Books:

- Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Code: MTBI AC223

L-T-P: 2-0-0

Total Teaching Hours: 48 hours

Course Prerequisite: None

Course Objective:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Unit wise Syllabus

Unit-I: Introduction to Personality Development

The concept of personality - Dimensions of personality – Theories of Freud & Erickson- Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis.

Unit-II: Attitude

Motivation Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation.

Unit-III: Stages of development

Freudian stages of development, Erik Erickson's stages of development. Maslow's hierarchy of needs.

Unit – IV: Neetisatakam

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses-29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses-71,73,75,78 (do's)

Unit – V: Approach to day to day work and duties

Approach to day to day work and duties, Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Unit – VI: Statements of basic knowledge

Statements of basic knowledge, Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Course Outcome:

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity

- Study of Neetishatakam will help in developing versatile personality of students.

Text/ Reference Books:

- Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi
- “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication
- Department), Kolkata
- Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi.