



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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SCHOOL OF BIO AND CHEMICAL ENGINEERING

DEPARTMENT OF BIOINFORMATICS- 2023-2024

LIST OF ELECTIVES - UG

Sl. No.	Course code	Course title
1.	SBIA3001	Pharmacogenomics
2.	SBIA3002	Cancer Biology
3.	SCSA3016	Data Science
4.	SBIA3003	R Programing for Biologists
5.	SITA3008	Internet of Things
6.	SBIA3004	Next Generation Sequencing
7.	SBIA3005	Quantitative modelling in biology
8.	SBIA3006	Stem Cell Research
9.	SCSA3015	Deep Learning
10.	SCSA1501	Operating Systems
11.	SBIA3007	Bigdata in Health care
12.	SBIA3010	Health Informatics

SBIA3001	PHARMACOGENOMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course introduces students to the emerging fields of pharmacogenomics and personalized 'precision' medicine that are now transforming the face of modern health care.

UNIT I Introduction

9hrs

Pharmacogenomics: Past, Present, and Future - The Genetic Basis of Pharmacogenomics - Methodologies in Pharmacogenomics- The Pharmacogenetics of Drug Metabolism - Pharmacogenomics and Drug Transport/Efflux - Pharmacodynamics and Pharmacogenomics.

UNIT II Pharmacogenomics: Past, Present, and Future

9hrs

The Genetic Basis of Pharmacogenomics - Methodologies in Pharmacogenomics - The Pharmacogenetics of Drug Metabolism - Pharmacogenomics and Drug Transport/Efflux. - Pharmacodynamics and Pharmacogenomics

UNIT III Important Issues in Pharmacogenomics

9hrs

The Role of Pharmacists in Pharmacogenomics - Pharmacogenomics and Clinical Testing = Pharmacogenomics in Pharmacy Education - Ethical Considerations in Pharmacogenomics - Future Promise of Pharmacogenomics in Clinical Practice

UNIT IV Advances in pharmacogenomics

9hrs

Traditional Therapeutic Drug Monitoring and Pharmacogenomics: Are They Complementary? - Pharmacogenomics Aspect of Warfarin Therapy - Pharmacogenetics and Cancer Chemotherapy - Pharmacogenomic Considerations in Anesthesia and Pain Management - Pharmacogenomics of Immunosuppressants

UNIT V Practice and future of pharmacogenomics

9hrs

Pharmacogenomics of Cardiovascular Drugs - Pharmacogenomic Aspects of Antiretroviral Therapy - Pharmacogenetics of Psychoactive Drugs - Pharmacogenomic Aspects of Adverse Drug- Drug Interactions - Microarray Technology and Other Methods in Pharmacogenomics Testing - Pharmacogenetic Testing in the Clinical Laboratory Environment

Course outcomes

At the end of the course the students will

- CO1** –Comprehend the historical basis of pharmacogenomics along with the basics of pharmacodynamics.
- CO2** –Understand drug metabolism and its genetic basis.
- CO3** –Identify the issues in pharmacogenomics
- CO4** –Describe the pharmacogenomics of cancer and its implementation.
- CO5** –Analyse the latest advancements in pharmacogenomics
- CO6** –Discuss the futuristic aspects of pharmacogenomics and its role in systems and personalized medicine.

TEXT / REFERENCE BOOKS

1. Pharmacogenomics in Clinical Therapeutics, edited by Loralie J. Langman, and Amitava Dasgupta, John Wiley & Sons, Incorporated, 2012.
2. Zdanowicz, Martin M.. Concepts in Pharmacogenomics, ASHP, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 questions of 2 marks each - No choice**20 Marks****PART B** : 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBIA3002	CANCER BIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course will educate students on various genetic and molecular changes that normal cells undergo to turn into malignant cancer cells and also describe factors that contribute to cancer development. It presents an overview on cancer prevention and currently available therapeutic treatments.

Unit I Fundamentals Of Cancer Biology

9hrs

Definition, Hall marks of cancer, Types of Cancer, Common Symptoms. Cell signalling in carcinogenesis- Growth factors and their receptors. Genes frequently mutated in cancer - Cellular oncogenes, Tumour suppressor genes. Causes of cancer- Mutations and cancer, Viral causes of cancer, the importance of DNA repair systems

Unit II Carcinogenesis

9hrs

The main stages of carcinogenesis – an overview, Early steps characterised in cancer, Cellular principles of invasion and metastasis, Stromal microenvironment and carcinogenesis

Unit III Principles Of Carcinogenesis

9hrs

Chemical Carcinogenesis -Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis. Physical Carcinogenesis- X - Ray radiation - mechanism of radiation Carcinogenesis.

Unit IV Cancer Metastasis

9hrs

Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement Membrane disruption, Three-step theory of Invasion, Proteinases and tumour cell invasion.

Unit V Detection Of Cancer And Cancer Therapy

9hrs

Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection. Different forms of therapy, Chemotherapy, radiation therapy, and Immuno therapy: advantages and limitations. Challenges in cancer treatment.

Course outcomes

At the end of the course the students will

CO1 –Identify the six hall marks of cancer

CO2 –Analyse the mechanism of carcinogenesis and evaluate the effect of chemical carcinogens and assess the role of physical carcinogens

CO3 –Identify the ways in which the oncogenes are activated and outline the current state of knowledge about the biochemical and molecular basis of cancer

CO4 –Describe the multistage nature of cancer and be able to discuss factors which influence this process

CO5 –List out the various cancer treatment strategies and their suitability

CO6 –Discuss contemporary approaches to the development of therapies, including specific molecular alterations in cancer as therapeutic targets and prognostic factors to guide treatment.

Texts / Reference Books

1. Robert A. Weinberg The Biology of Cancer, Garland Science 2013
2. Lewis J. Kleinsmith Principles of Cancer Biology: Pearson New International Edition 2013
3. Robin Hesketh Introduction to Cancer Biology Cambridge University Press 2012
4. Lauren Pecorino Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics Oxford University Press 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 questions of 2 marks each - No choice**20 Marks****PART B** : 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SCSA3016	DATA SCIENCE	L	T	P	Credit s	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the mathematical foundations required for data science.
- To describe a flow process for data science problems.
- To introduce basic data science algorithms and data visualization.
- To learn machine tools and techniques.
- To learn the ideas and tools for data visualization.

UNIT I Linear Algebra

9 Hrs.

Algebraic view – vectors 2D, 3D and nD, matrices, product of matrix & vector, rank, null space, solution of over determined set of equations and pseudo-inverse. Geometric view - vectors, distance, projections, eigenvalue decomposition, Equations of line, plane, hyperplane, circle, sphere, Hypersphere.

UNIT II Probability And Statistics

9 Hrs.

Introduction to probability and statistics, Population and sample, Normal and Gaussian distributions, Probability Density Function, Descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates.

UNIT III Exploratory Data Analysis And The Data Science Process

9 Hrs.

Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Data Visualization - Basic principles, ideas and tools for data visualization - Examples of exciting projects- Data Visualization using Tableau.

UNIT IV Machine Learning Tools, Techniques And Applications

9 Hrs.

Supervised Learning, Unsupervised Learning, Reinforcement Learning, Dimensionality Reduction, Principal Component Analysis, Classification and Regression models, Tree and Bayesian network models, Neural Networks, Testing, Evaluation and Validation of Models.

UNIT V Introduction To Python

9 Hrs.

Data structures-Functions-Numpy-Matplotlib-Pandas- problems based on computational complexity-Simple case studies based on python (Binary search, common elements in list), Hash tables, Dictionary.

Max. 45 Hr

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the basic terms of Linear Algebra and Statistical Inference.

CO2 - Describe the Data Science process and its components interaction. CO3 - Apply EDA and the Data Science process in a case study.

CO4 - Classify Data Science problems.

CO5 - Analyse and correlate the results to the solutions. CO6 - Simulate Data Visualization in exciting projects.

TEXT / REFERENCE BOOKS

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
2. Introduction To Linear Algebra - By Gilbert Strang, Wellesley-Cambridge Press, 5th Edition.2016.
3. Applied Statistics And Probability For Engineers – By Douglas Montgomery.2016.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014.
(free online)
5. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 questions of 2 marks each - No choice**20 Marks****PART B** : 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SBIA3003	R PROGRAMMING FOR BIOLOGISTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course provides knowledge to handle biological problems in Bioinformatics and computational biology

UNIT I R Language

9hrs

Motivation of R, Attributes and some special values, Types of objects, Sequence generating and vector subsetting, Types of functions, Data Structures, Managing R session, Evaluations.

UNIT II Object Oriented Programming In R

9hrs

OOP in R, Basics of OOP, S3 OOP, S4 OOP, Documentation, Debugging, Managing S3 and S4 together.

UNIT III Input And Output In R

9hrs

Basic file handling, connections, File input and output, Tools for accessing files on the Internet.

UNIT IV Working With Character Data

9hrs

Built-in Capabilities, Regular Expression, Prefix, Suffix and Substrings, Biological sequences, Matching patterns.

UNIT V R Packages

9hrs

Package basics, Package Management and authoring, Initialization, Debugging and Profiling

Course outcomes

At the end of the course the students will

- CO1** –Providing general properties and unique aspects of the R language
- CO2** –To teach Object Oriented programming in R
- CO3** –To teach methods for getting of data in and out
- CO4** –To provide knowledge how to how to write own software packages
- CO5** –Use R to apply statistics to analyze and interpret data.
- CO6** –Choose appropriate analysis techniques for a variety of data types and formats.

TEXT / REFERENCES BOOKS

1. Robert G, "R programming in Bioinformatics", CRC press, Taylor and Francis Group, USA, 2008.
2. Own J, Robert. M, and Andrew R., "Introduction to Scientific programming and simulation using R", CRC Press, Taylor and Francis Group, USA, 2014.
3. Norman M. And Norman S. Matloff "The Art of R programming: A tour of statistical software Design", No Starch Press Inc, USA, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 questions of 2 marks each - No choice****20 Marks****PART B : 2 questions from each unit of internal choice; each carrying 16 marks****80 Marks**

SITA3008	INTERNET OF THINGS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Internet of Things
- To identify the various elements of an IoT System.
- To understand the various means of communication from Node / Gateway to Cloud Platforms.
- To identify types of data analytics and data visualization tools.
- To make students aware of security concerns and challenges while implementing IoT solutions.

UNIT I INTRODUCTION TO IOT

9 Hrs.

Introduction to IoT, Current technological trends and future prospects, - Evolution of IoT , Business Scope, Relation with embedded system, - Basic Architecture of an IoT, From M2M to IoT, M2M towards IoT, IoT Value Chains, An emerging industrial structure for IoT.

UNIT II ELEMENTS OF IOT

9 Hrs.

Application Sensors & Actuators - Edge Networking (WSN) – Gateways - IoT Communication Model – WPAN & LPWA, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards, Wearable Development Boards .

UNIT III COMMUNICATION AND CONNECTIVE TECHNOLOGIES

9 Hrs.

IoT Communication Model, Cloud computing in IoT, IoT in cloud architecture, Logging on to cloud, Selecting and Creating cloud service , cloud based IoT platforms - IBM Watson, Google cloud.

UNIT IV DATA ANALYTICS AND IOT PLATFORM

9 Hrs.

Big Data Analytics , Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Storm, Data Visualization, Visualization tools for IoT.

UNIT V HANDS-ON PROJECTS

9 Hrs.

Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), DIY Kits – Soil moisture monitoring, Weather monitoring, Air quality Monitoring, Movement Detection.

Max. 45 Hrs.

COURSE OUTCOMES

On Completion of the course, student will be able to

CO1 - To learn and understand the technology and current trends in Internet of things. CO2 - To understand the various elements of IoT system and hardware devices.

CO3 - To learn the programming languages and platforms for building IoT applications. CO4 - To understand the cloud computing and its relevance for developing IoT applications.

CO5 - To design and implement IoT applications that manages big data with data analytics and visualization tools. CO6 - To implement hands-on projects using an appropriate software and hardware devices in various applications.

TEXT / REFERENCE BOOKS

1. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi.
2. Architecting the Internet of Things, Springer publications. Author(s): Dieter Uckelmann, Mark Harrison, Florian Michahelles.
3. Internet of Things with Arduino Cookbook, Packt Publications. Author(s): Marco Schwatz.
4. Internet of Things and Data Analytics, Wiley Publications

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 questions of 2 marks each - No choice****20 Marks****PART B : 2 questions from each unit of internal choice; each carrying 16 marks****80 Marks**

SBIA3004	NEXT GENERATION SEQUENCING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course will provide an introduction to the technology, data analysis, tools and resources for next generation sequencing data. The content is intended to provide a broad overview of the subject areas, and to highlight key resources, approaches and methodologies.

Unit I Introduction to NGS

9hrs

NGS Platforms: Introduction to NGS, Roche/454 FLX, Illumina/Solexa Genome Analyzer, Applied Biosystems SOLiD system, Helicos Heliscope, Pacific Biosciences/single molecule real time (SMRT) sequencing.

Unit II Sequence data

9hrs

Genome assembly algorithms: Alignment of short-reads to reference genome using spaced seed (ELAND, SOAP), index- filtering algorithm (SeqMap), quality-score (RMAP), q-filter algorithm (SHRiMP), FM-index (Bowtie, BWA, SOAP2), suffix tree (MUMmer). Sequence Alignment formats: Sequence Alignment/Map (SAM) format, Binary Alignment/Map (BAM) format, Tools for conversion (SAMtools), Alignment viewers (IGV, MGAviwer).

Unit III Sequence data assembly

9hrs

De-novo assembly: Overlap-layout-consensus (OLC) approach (Arachne, Phusion), de Bruijn and Euler path approach (Euler, SOAPdenovo), string graph assembler (SGA). Scaffolding: Supercontig, contig orientation, contig ordering, contig distancing and gap closing using SOAPdenovo, ABySS, OPERA and RACA.

Unit IV Softwares in NGS analysis

9hrs

Application of R in NGS analysis: Introduction to Bioconductor, Reading of RNA-seq data (ShortRead, Rsamtools, GenomicRanges), annotation (biomaRt, genomeIntervals), reads coverage and assign counts (IRanges, GenomicFeatures), differential expression (DESeq).

Unit V Applications

9hrs

Biological applications of NGS: Whole-genome sequencing, Exome sequencing, Transcriptome sequencing, Epigenome sequencing, Interactome sequencing, methylome sequencing.

Course outcomes

At the end of the course the students will

CO1 –Describe the applications of the different NGS technologies, including the weakness and strengths of the approaches.

CO2 –Explain the steps involved in a general NGS data analysis.

CO3 –Explain key theoretical concepts of alignment and de novo assembly. **CO4** –Synthesize and formulate a project and relevant question within the field. **CO5** – Independently perform a basic NGS data analysis.

CO6 –Apply analytical and reflective skills in analyzing results from individual steps and the final project.

Text / Reference Books:

1. Next-generation DNA sequencing Informatics by Stuart M. Brown, Cold Spring Harbor Laboratory, 2013.
2. RNA-seq Data Analysis: A Practical Approach by Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, Garry Wong. Chapman & Hall/CRC, 2014.
3. Next generation sequencing: Translation to Clinical Diagnostics by Wong Lee-Jun C. (ed.), Springer, 2013.
4. Next-generation genome sequencing: Towards Personalized Medicine by Michal Janitz, WileyVCH, 2008

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 questions of 2 marks each - No choice****20 Marks****PART B : 2 questions from each unit of internal choice; each carrying 16 marks****80 Marks**

SBIA3004	NEXT GENERATION SEQUENCING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course will provide an introduction to the technology, data analysis, tools and resources for next generation sequencing data. The content is intended to provide a broad overview of the subject areas, and to highlight key resources, approaches and methodologies.

Unit I Introduction to NGS

9hrs

NGS Platforms: Introduction to NGS, Roche/454 FLX, Illumina/Solexa Genome Analyzer, Applied Biosystems SOLiD system, Helicos Heliscope, Pacific Biosciences/single molecule real time (SMRT) sequencing.

Unit II Sequence data

9hrs

Genome assembly algorithms: Alignment of short-reads to reference genome using spaced seed (ELAND, SOAP), index- filtering algorithm (SeqMap), quality-score (RMAP), q-filter algorithm (SHRiMP), FM-index (Bowtie, BWA, SOAP2), suffix tree (MUMmer). Sequence Alignment formats: Sequence Alignment/Map (SAM) format, Binary Alignment/Map (BAM) format, Tools for conversion (SAMtools), Alignment viewers (IGV, MGViewer).

Unit III Sequence data assembly

9hrs

De-novo assembly: Overlap-layout-consensus (OLC) approach (Arachne, Phusion), de Bruijn and Euler path approach (Euler, SOAPdenovo), string graph assembler (SGA). Scaffolding: Supercontig, contig orientation, contig ordering, contig distancing and gap closing using SOAPdenovo, ABySS, OPERA and RACA.

Unit IV Softwares in NGS analysis

9hrs

Application of R in NGS analysis: Introduction to Bioconductor, Reading of RNA-seq data (ShortRead, Rsamtools, GenomicRanges), annotation (biomaRt, genomeIntervals), reads coverage and assign counts (IRanges, GenomicFeatures), differential expression (DESeq).

Unit V Applications

9hrs

Biological applications of NGS: Whole-genome sequencing, Exome sequencing, Transcriptome sequencing, Epigenome sequencing, Interactome sequencing, methylome sequencing.

Course outcomes

At the end of the course the students will

CO1 –Describe the applications of the different NGS technologies, including the weakness and strengths of the approaches.

CO2 –Explain the steps involved in a general NGS data analysis.

CO3 –Explain key theoretical concepts of alignment and de novo assembly. **CO4** –Synthesize and formulate a project and relevant question within the field. **CO5** – Independently perform a basic NGS data analysis.

CO6 –Apply analytical and reflective skills in analyzing results from individual steps and the final project.

Text / Reference Books:

1. Next-generation DNA sequencing Informatics by Stuart M. Brown, Cold Spring Harbor Laboratory, 2013.
2. RNA-seq Data Analysis: A Practical Approach by Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, Garry Wong. Chapman & Hall/CRC, 2014.
3. Next generation sequencing: Translation to Clinical Diagnostics by Wong Lee-Jun C. (ed.), Springer, 2013.
4. Next-generation genome sequencing: Towards Personalized Medicine by Michal Janitz, WileyVCH, 2008

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice
Marks

20

PART B : 2 questions from each unit of internal choice; each carrying 16 marks
Marks

80

SBIA3006	STEM CELL RESEARCH	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

The objective is to make the students aware of the basics of stem cells, experimental techniques to isolate them and understand their applications.

Unit I Fundamentals of Stem Cell research

9hrs

Introduction - Properties of stem cells - Types of stem cell - Similarities and differences between embryonic and adult stem cells - pluripotency - totipotency

Unit II Isolation of stem cells

9hrs

Isolation of stem cells from embryo cultures - Invitro fertilization - blastocyst - inner cell mass - Growing ES cells in lab - laboratory tests to identify ES cells - properties of ES cells and Embryonic stem cell markers - Governance of hESC research, Ethical issues at stake, regulation in European and non - European countries.

Unit III Differentiation

9hrs

Somatic stem cells, Test for identification of adult stem cells, Adult stem cell differentiation - Trans differentiation - Plasticity - Different types of adult stem cells.

Unit IV Stem Cells and Tissue Engineering

9hrs

Tissue engineering triad, ECM components and their role in tissue development, Tissue engineering application - Production of complete organ - Kidney - Eyes - Heart - Brain.

Unit V Applications

9hrs

Gene therapy - genetically manipulated stem cells - stem cells and Animal cloning - transgenic animals and stem cells - Therapeutic applications – Parkinson's disease - Neurological disorder - limb amputation - heart disease - spinal cord injuries - diabetes -burns - HLA typing- Alzheimer's disease.

Course Outcomes

At the end of the course the students will

- CO1 –appreciate the significance of stem cells
- CO2 –the strategy associated in the governance of stem cell research in various countries. CO3 –Identify the adult stem cells.
- CO4 –Appreciate the role of stem cells in tissue engineering. CO5 – Appreciate the role of stem cells in therapy.
- CO6 – Describe the key role played by stem cells in the living system

Text / Reference Books

1. Kursad and Turksen, Embryonic Stem cells, Humana Press, 2002
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research, 12 National Academic press, 2002

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice **20**
Marks

PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80**
Marks

SCSA3015	DEEP LEARNING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To present the mathematical, statistical and computational basis of neural networks.
- To study the concepts of deep learning.
- To introduce dimensionality reduction techniques.
- To enable the students to know deep learning techniques to support real-time applications.
- To examine the case studies of deep learning techniques.

UNIT I Introduction

9 Hrs.

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT II Deep Networks

9 Hrs.

History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.

UNIT III Dimensionality Reduction

9 Hrs.

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

UNIT IV Optimization And Generalization

9 Hrs.

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V Case Study And Applications

9 Hrs.

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection- Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to CO1 - Understand basics of deep learning.

CO2 - Implement various deep learning models.

CO3 - Realign high dimensional data using reduction

techniques. CO4 - Analyze optimization and

generalization in deep learning. CO5 - Explore the deep learning applications.

CO6 - Design and creation of data models.

TEXT / REFERENCE BOOKS

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice
Marks

20

PART B : 2 questions from each unit of internal choice; each carrying 16 marks
Marks

80

SCSA1501	OPERATING SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have an overview of different types of operating systems.
- To understand the concept of process management.
- To understand the concept of storage management.
- To understand the concept of I/O and file systems.

UNIT I INTRODUCTION

9 Hrs.

Introduction - Operating system structures - System components - OS services - System calls - System structure - Resources Processes - Threads - Objects - Device management - Different approaches - Buffering device drivers.

UNIT II PROCESS MANAGEMENT

9 Hrs.

Processes - Process concepts - Process scheduling - Operations on processes - Cooperating processes - CPU scheduling - Basic concepts - Scheduling criteria - Scheduling algorithms - Pre-emptive strategies - Non-pre-emptive strategies.

UNIT III SYNCHRONIZATION AND DEADLOCKS

9 Hrs.

The critical section problem - Semaphores - Classic problems of synchronization - Critical regions - Monitors-Dead locks - Deadlock characterization - Prevention - Avoidance - Detection - Recovery.

UNIT IV MEMORY MANAGEMENT

9 Hrs.

Storage Management Strategies - Contiguous Vs. Non-Contiguous Storage Allocation - Fixed & Variable Partition Multiprogramming - Paging - Segmentation - Paging/Segmentation Systems - Page Replacement Strategies - Demand & Anticipatory Paging - File Concepts - Access Methods - Directory Structure - File Sharing - Protection - File – System Structure - Implementation.

UNIT V I/O SYSTEM, LINUX & SHELL PROGRAMMING

9 Hrs.

Mass Storage Structure - Disk Structure- Disk Scheduling - Disk Management - Swap Space Management – RAID Structure- Shell Operation Commands - File Management Operation - Internet Service - Telnet - FTP - Filters & RegularExpressions- Embedded Linux – Android Vs iOS - Unix Internals - Shell Programming - Variable, Arithmetic Operations, Control Structures, Handling Date, Time & System Information.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental components of a computer operating system and how computing resources are managed by the operating system.

CO2 - Demonstrate and understand the different memory and I/O management techniques used in Operating Systems. CO3 - Apply the concepts of CPU scheduling, synchronization and deadlocks in real computing problems.

CO4 - Have practical experience with software tools available in modern operating systems such as semaphores and monitors for process synchronization.

CO5 - Create design and construct the following OS components: System calls, Schedulers, Memory management systems, Virtual Memory and Paging systems in the modern operating system.

CO6 - Understand file system structure and implement a file system such as FAT.

TEXT / REFERENCE BOOKS

1. Abraham Silberschatz, Peter Galvin and Gagne, "Operating System Concepts", 6th Edition, Addison Wesley, 2002.
2. Harvey M.Deitel, "Operating System", 2nd Edition, Addison Wesley, 2000.
3. Gary Nutt, "Operating System, A modern perspective", 2nd Edition, Addison Wesley, 2000.
4. Richard Peterson, "Linux : The Complete Reference", 6th Edition, Tata McGraw Hills, 2007.
5. Andrew S. Tanenbaum, "Modern Operating Systems"

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice
Marks

20

PART B : 2 questions from each unit of internal choice; each carrying 16 marks
Marks

80

SBIA3007	BIGDATA IN HEALTHCARE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

The course is designed to make the students realize the role and importance of big data in genomics and its implications for research in biology and medicine.

UNIT I Introduction

9hrs

Big Data - Big Data in Medicine? - The Three Vs of Big Data - Can Medicine Learn from Other Industries? - Big Data Framework in Medicine - Fields of Action in Medicine - It is Time for Big Data - The Example of Google Flu Trends - Big Data Adoption Model in Medicine - Big Data in the Context of Health - The Difference to Classic Clinical Analysis (Old Wine in New Bottles?) - Are Hospitals Prepared for Big Data? - Personalized Medicine and Big Data - The (Genetic) Human in Numbers - Big Data, "Personalized Medicine" and IT

UNIT II Data Management and Data Mining Approaches

9hrs

Data Management and Data Mining Approaches - Introduction Challenges of Managing and Mining Big Biomedical Data - Data Management Framework - Data Management Platforms - Data Mining in Translational Medicine - Data Mining Techniques and Methods - Big Data and Data Mining - Applications of Data Mining in Translational Medicine

UNIT III Information Management for Systems Medicine

9hrs

New Data Volumes - The Digitalization of the Knowledge Cycle - Consolidation of the Digital Medical Care and Research Systems - Integration and Differentiation - Good and Bad Data = Digital Expert Systems - Human Beings are More Than the Sum of Their Data - Medicine of the Person is Made More Difficult

UNIT IV Medical Big Data

9hrs

Medical Big Data - Data Protection Expectations - Legal Biological Principles - Data Sources - Health-Specific Use of Data - Risks - Data Protection Mechanisms - Data Economy in Particular Transparency

UNIT V Big Data and Business

9hrs

Big Data in Healthcare from a Business perspective - Data as a Basis for Decisions - Strategy and Data Big Data as a Part of Digitalization - Consulting as a Decision Support = The Path to an Informed Decision The Transformation of Big Data to Smart Data New Technologies in the Area of Big Data – Benefits to the patient.

Course Outcomes

- CO1 –To understand the concept and nature of bigdata.
CO2 –To understand the basics of data management and mining approaches of genomic big data. CO3 –To appreciate the role of bigdata in genomic medicine.
CO4 –Ethical use of medical bigdata.
CO5 –Use of genomic bigdata in entrepreneurship.
CO6 –Appreciate the enormous data available and the means to handle the data

Text /Reference books

1. Big Data in Medical Science and Healthcare Management : Diagnosis, Therapy, Side Effects, edited by Peter Langkafel, De Gruyter, Inc., 2015.
2. Translational Medicine : Tools and Techniques, edited by Aamir Shahzad, Elsevier Science & Technology, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice
Marks

20

PART B : 2 questions from each unit of internal choice; each carrying 16 marks
Marks

80

SBIA3010	HEALTH INFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To Introduce the students the problems and challenges that confront the field of health informatics.
- To Introduce the students about the research avenues and salient features in the practice of health informatics.
- To Provide the students with the basic skills and knowledge in health informatics to apply in a career related to health care.
- To Lead students in the discussion around ethical and diversity issues in health informatics.
- To Provide additional direction to those interested towards the study in the field.

UNIT I Introduction & Overview: Health Information Technology & Health Informatics 9 Hrs.

Define information management, information technology and informatics - Various ways in which HIT has evolved to improve quality or enhance patient safety - Informatics drivers and trends - Standards development organizations: Health Level 7 (HL-7), Healthcare Information Technology Standards Panel (HITSP), and Office of the National Coordinator for Health Information Technology (ONC) Health IT Standards Committee-Health informatics – Needs, objectives and limitations - Medical Terminology for Health Informatics Professionals.

UNIT II Clinical Decision Support Systems (CDSS) And Workflow 9 Hrs.

Fundamental requirements of an effective Clinical Decision Support System-principles of health care data exchange and health care data standards relate to patient care, productivity and data analysis- common controlled vocabularies in use today: ICD, CPT, NDC, RxNorm, LOINC and SNOMED CT-advantages and disadvantages (unintended consequences) of Clinical Decision Support Systems (CDSS) in terms of cognitive support.

UNIT III Healthcare Database Management System 9 Hrs.

Health information systems – design, architecture and interoperability - Electronic health records (EHRs) - Electronic medical record (EMR) with electronic health record (EHR)- emergence of Personal Health Records and their implications for patients, health care providers and Decision Aids and health systems- EHR access agreement.

UNIT IV Computer Applications In Health Care And Biomedicine 9 Hrs.

The language of biomedical informatics: data, information & knowledge; standards and vocabularies - Evidence based practice (EBP) and clinical practice guidelines (CPG) - Evaluation methods for health informatics - Machine learning for extraction of medical knowledge - MATLAB programming for health informatics.

UNIT V Case Studies And Ethical Issues

9 Hrs.

Modelling, simulation and visualisation in health informatics - Ethical Issues in Health Informatics - Fundamentals of data science in medicine - Genomic and Systems Medicine - Advanced data analysis in medicine - Data driven decision making and evaluation in medicine - Legal Aspects of Health Information Systems - E-Healthcare & Ethics - E-Medicine Business Models - Case Studies in Health Information Management.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Develop knowledge about problems and challenges that health addressed by informatics and apply the knowledge to the research and practice in health informatics.
- CO2 - Demonstrate basic skills and knowledge in health informatics for application in future health-related careers. CO3 - Demonstrate ability to ask, search for information and answer health-related questions.
- CO4 - To identify genomic variants associated with a disease phenotype and communicate this association.
- CO5 - Perform visualization and simple analysis of a data set to assess difficulty of predicting disease (cardiovascular and other) risk in a synthetic patient dataset.
- CO6 - Apply communication skills through an interview with an informatics professional and development of a written summary and analyse ethical and diversity issues in health informatics.

TEXT / REFERENCE BOOKS

1. Hoyt, RE and Yoshihashi, A, Eds. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, 6th Edition. Pensacola, FL, Lulu.com.
2. Wager KA, Lee FW, Glaser JP. Health Care Information Systems: A Practical Approach for Health Care Management. San Francisco, California: Jossey-Bass 2009.
3. Shortliffe EH, Cimino JJ. Biomedical Informatics: Computer Applications in Health Care and Biomedicine, 4th Edition. New York, New York: Springer Science +Business Media, LLC 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100
Hrs.

Exam Duration : 3

PART A : 10 questions of 2 marks each - No choice
Marks

20

PART B : 2 questions from each unit of internal choice; each carrying 16 marks
Marks

80



SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
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SCHOOL OF BIO AND CHEMICAL ENGINEERING
DEPARTMENT OF BIOINFORMATICS

LIST OF ELECTIVES – PG

SL. NO.	COURSE CODE	COURSE TITLE
1	SBIA7401	Cell and Molecular Genetics
2	SBIA7402	Phylogenetic analysis
3	SBIA7403	Cheminformatics
4	SBIA7404	Pharmacoinformatics
5	SBIA7405	Structural Biology
6	SBIA7406	Data mining in bioinformatics
7	SBIA7407	Medicinal chemistry
8	SBIA7408	Next generation sequence data analysis
9	SBIA7409	Health Informatics
10	SBIA7412	Nanotechnology and Advanced Drug Delivery System
11	SCSA7023	Cloud Computing
12	SCSA7014	Mathematical Foundations for Computer Science

SBIA7401	CELL BIOLOGY AND MOLECULAR GENETICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

Enable the students to acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells

UNIT I CELLS AND ORGANELLES

Prokaryotic and Eukaryotic cells. Structure and functions of cell organelles - Mitochondria, ER, Ribosome, Golgi bodies, Nucleus. Organization of Plasma membrane, Membrane models. Cell division-Mitosis & Meiosis, Cell cycle and its Regulation

UNIT II CELL SIGNALLING

Cell-cell interactions. Basic concepts of signal transduction: Autocrine, paracrine and endocrine signalling, Intracellular and cell surface receptors, Signalling via G-protein linked receptors, Enzyme-linked receptor signalling.

UNIT III BIOMOLECULES

Organisation of prokaryotic and Eukaryotic genome. Structure of Nucleic acids and Proteins. Central dogma. Gene expression: Overview of Replication, Transcription and Translation. Gene Regulation – Operon Concept

UNIT IV BIOMOLECULAR CHARACTERIZATION

Purification and Separation of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis.

UNIT V GENETIC ENGINEERING

Amplification of DNA –PCR, construction of gene libraries – cDNA libraries. Gene Cloning – steps, recombinant DNA technology

COURSE OUTCOMES

At the end of the course the students will be able to

- CO 1-** Elucidate the differences between eukaryote and prokaryote cells.
- CO 2-** How cells divide and communicate.
- CO 3-** Realize how genetic traits are transferred from parents to offspring and how the process is regulated. DNA technology
- CO 4-** To understand the informatics connection.
- CO 5-** To use novel informatics tools in genetic engineering
- CO 6-** To propose novel protocols that connect experimental biology and computational techniques.

TEXT / REFERENCE BOOKS

1. Friefelder, David. "Molecular Biology." Narosa Publications, 1999.
2. Weaver, Robert F. "Molecular Biology" 2nd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald "Cell and Molecular Biology : Concepts and Experiments" 4th Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" 2nd Edition, Panima Publishing, 1993.
5. Lewin's GENES XI, Published by Jones & Bartlett Learning; 11 edition (January 15, 2013).
6. Tropp, Burton E. "Molecular Biology : Genes to Proteins". 3rd Edition. Jones and Bartlett, 2008.
7. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology : Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010

**END SEMESTER EXAM QUESTION
PAPER PATTERN**

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice
: 2 Questions from each unit with internal choice, each carrying 14 marks

30 Marks
PART B
70 Marks

SBIA7402	PHYLOGENETIC ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

Students will understand the concept of reconstructing the evolutionary relationship between species.

UNIT I MOLECULAR BASIS OF EVOLUTION

Molecular basis of evolution - Evolutionary tree of life - Mechanisms of evolution - Mutation and codon age. Evolutionary changes in amino acid sequences - Differences and proportion - Amino acid substitution matrix - Mutation rate and substitution rate. Evolutionary changes in DNA sequences - Nucleotide differences - Estimation of number of nucleotide substitutions - Gamma distances - Numerical estimation - alignment - Handling of sequence gaps in the estimation of evolutionary distances. Software tools for Sequence alignment - ClustalW, BioEdit, Hmmer, T-coffee, MAFFT, MultiAlign.

UNIT II PHYLOGENETIC TREES

Synonymous and Non-Synonymous Nucleotide substitutions - Evolutionary pathway methods - Methods based on Kimura's 2 - Jones-Taylor-Thornton (JTT) model, Parameter Models - Nucleotide substitutions at different codon positions - Likelihood methods with codon substitution models. Phylogenetic trees - Types of phylogenetic trees - Topological differences - Tree building methods. Horizontal gene transfer.

UNIT III PHYLOGENETIC TREE BUILDING METHODS

Phylogenetic Inference - Tree building methods - Distance methods - UPGMA - Minimum Evolution method - Neighbor Joining method - Distance measures to be used for phylogenetic reconstruction - Maximum Parsimony methods - Finding MP trees - Strategies for searching - Consensus trees - Estimation of branch lengths - Weighted parsimony - Maximum Likelihood methods - Computational procedure - Models - Protein likelihood - Theoretical foundation - Parameter estimation

UNIT IV OPTIMIZATION PRINCIPLES

Accuracies and Statistical tests - Optimization principle and topological errors - Interior branch tests - Bootstrapping and Jack-knifing. Advantages and disadvantages of different tree building methods - Molecular clocks - Hypothesis - Relative rate tests - Linearized trees - Ancestral nucleotide and amino acid sequences - Bayesian approach - convergent and parallel evolution.

UNIT V APPLICATIONS IN PHYLOGENETICS

Genetic Polymorphism and Evolution - Evolutionary significance - analysis of allele frequency data - DNA polymorphism - Statistical tests - Population trees from genetic markers - Analysis of RAPD data - Software Tools - TreeView - MrBayes, PAUP, PHYLIP, Spectronet, HYPHY, Dendroscope, FigTree, ModelTest, Mesquite and MEGA.

COURSE OUTCOMES

At the end of the course the students will be able to

- CO 1- Describe evolutionary process at the molecular level
- CO 2- Apply molecular methods to study genetic variation within and between species
- CO 3- Explain and justify different models of sequence evolution
- CO 4- Explain and evaluate different phylogenetic optimality criteria, and select adequate criterion to solve a given problem
- CO 5- Sketch and apply the process to do and evaluate a phylogenetic analysis, and explain the different steps
- CO 6- Select and apply, for the problem area, existing software on a given biological problem

TEXT / REFERENCE BOOKS

1. Joseph Felsenstein, Inferring Phylogenies, 1st edition Sinauer Associates Inc, 2004
2. Baxevanis and Oulette, Bioinformatics Practical guide, Wiley, 2005
3. Durbin, Biological sequence Analysis, 1st Edition, 1998
4. David Mount, Bioinformatics: Sequence and Genome Analysis, 2nd Edition, CSHL press 2004
5. Masatoshi Nei, Molecular Evolution and Phylogenetics, Oxford University press, 200

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions for 5 Marks each –without choice **30 Marks** **PART B:** 2 Questions from each unit with internal choice, each c

SBIA7403	CHEMINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To impart the students with a well-advanced course, to enable them to know the role of the pharmacophores and henceforth to design new molecules.

UNIT I INTRODUCTION TO CHEMINFORMATICS

Introduction to Cheminformatics - History and evolution of Cheminformatics - Chemical representation - Sequence, 2D, 3D structure, Types of chemical representation - linear notation, tabular storage, graphical representation - Chemical data management - Chemical mark up languages.

UNIT II CHEMICAL DATABASES

Chemical Databases - CHEMDB, KEGG LIGAND, CSD, CAS REGISTRY, BIOMETA DB, National Cancer Institute Database (NCI) - Chemical searching methods - exact searching, sub structure searching, similarity searching, reaction searching.

UNIT III COMBINATORIAL CHEMISTRY

Combinatorial chemistry: Introduction, Liquid Phase synthesis, Solid phase synthesis, Designing Combinatorial Synthesis, High through put screening.

UNIT IV COMBINATORIAL LIBRARY DESIGN

Combinatorial library design - Rational principles of compound selection for combinatorial library design and optimization approach, Descriptor Analysis, Modeling toxicity, Computer Assisted Synthesis design and structure-based library design.

UNIT V APPLICATION OF CHEMINFORMATICS

Application of cheminformatics - QSPR Drug design - Target identification and Validation, lead finding and optimization - Pharmacophore-Based Drug Design - Structure-Based Drug design - Application of Cheminformatics in Drug Design.

COURSE OUTCOMES

At the end of the course the students will be able to

- CO 1-** Learn the basics of cheminformatics.
- CO 2-** Understand the various databases for cheminformatics.
- CO 3-** Appreciate the role of Combinatorial chemistry.
- CO 4-** Analyse the various descriptors used in cheminformatics.
- CO 5-** Work on pharmacophore-based drug design and SBDD.
- CO 6-** To develop novel techniques in the area

TEXT / REFERENCES BOOKS

1. Andrew R. Leach & Valerie J. Gillet, "An Introduction to Cheminformatics", Revised Edition, Springer Publication, 2007.
2. Johann Gasteiger, Dr. Thomas Engel, "Cheminformatics", Wiley-VCH Press, 2003.
3. Jurgen Bajorath, "Cheminformatics: Concepts, Methods and Tools for Drug Discovery", Humana Press, 2004.
4. Tudor. L. Oprea, "Cheminformatics in Drug Discovery", Wiley-VCH Press, 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice **30**

Marks PART B : 2 Questions from each unit with internal choice, each carrying 14 marks **70**
Marks

SBIA7404	PHARMACOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

The students will be able to understand the basics aspects of drug metabolism and delve into their kinetics and dynamicsthat are crucial in the functioning of the drugs.

UNIT I INTRODUCTION

Basics of pharmacoinformatics: Definition, branches, Scope and applications. Concepts of drugs: Classification, Major sources, Common filters for drugs design. Molecular descriptors, Structure activity relationship. Pharmacogenomics

UNIT II DRUG TARGETS

Classification of drug targets. Targets of drug design: Proteins, Nucleus and Genes as target, coding and noncoding RNA, membranes. Drug databases and tools used in pharmacoinformatics

UNIT III DRUG DESIGN

Drug development and drug design. Types of drug design: Strucure based, ligand based, fragment based, metabolites and their importance in drug design; Pharmacophore concept. Molecular modeling in drug design: Quantum mechanics and Molecular mechanics. QSAR and molecular docking. Tools to perform docking

UNIT IV PHARMACOKINETICS

One-compartment model, Two-compartment model, Multi-compartment models, Pharmacokinetic parameters, Absorption, Distribution, Metabolism, Excretion, Multiple doses, Salt factor, Bioavailability, Analysis. Tools to study the ADME properties.

UNIT V PHARMACODYNAMICS

Drug receptor action, Direct physiological action, Drug-drug interaction, Polymorphism and drug metabolism, Drug potency and efficacy, Agonists and antagonists, Receptor effector coupling, Spare receptors, Therapeutic index.

COURSE OUTCOMES

At the end of the course the students will be able to

- CO 1-** Explain the basics of pharmacoinformatics and its application in medicine.
- CO 2-** Summarize the various biomolecules as drug targets
- CO 3-** Retrieve data from the drug databases
- CO 4-** Select the right approach to design molecules for a particular disease
- CO 5-** Study the properties of drug metabolism in silico
- CO 6-** Understand the mechanism of action of drugs

TEXTS/ REFERENCE BOOKS

1. DuraiAnandaElementary Pharmacoinformatics BSP 2014
2. Tagelsir Mohamed Gasmelseid Pharmacoinformatics and Drug Discovery Technologies: Theories and Applications: Idea Group,U.S.; 1 edition 2012
3. Sara E. Rosenbaum Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer SimulationsWiley; 1 edition 2011
4. Thomas N. TozerPharmD, Malcolm Rowland Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy 1st Edition LWW; 1 edition 2006

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice	30
Marks PART B : 2 Questions from each unit with internal choice, each carrying 14 marks	70
Marks	

SBIA7405	STRUCTURAL BIOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

To know the importance of XRD and NMR in structure elucidation of a macromolecule and to appreciate the application of computational tools in structural biology.

Unit I STRUCTURE

Fundamentals of protein structure- Basic building blocks - unique nature of peptide bond - torsion angles - cis and trans configurations; Structural Hierarchy: Primary, Secondary, Tertiary, Quaternary structures; Motifs and Domains: alpha - domain structures, beta - domain structures; Fundamentals of nucleic acid structure: Interactions stabilising the base pairs - Watson and Crick's base-pairs - Types of DNA - their structures - DNA polymorphism.

Unit II STRUCTURE DETERMINATION

Structure determination of macromolecules: XRD - Bragg's law - lattices and unit cells; Miller indices - crystal systems, Bravais lattices NMR - Symmetry elements: - Crystal symmetry - rotation axis, mirror planes and center of inversion, proper/ improper axes of rotation, translational symmetry- screw axis and glide planes; Seven crystal systems - Application of XRD - Calculating electron density and Patterson maps (Fourier transform and Structure factors, convolutions), phases - Criteria for NMR sensitivity - Shielding and deshielding effects - NOIE effect - Chemical shifts - coupling constants - spin - spin splitting -Carbon-13 NMR - Instrumentation - Application of NMR to biology.

Unit III CHROMATOGRAPHY

Chromatography – Principles, Types – Thin Layer Chromatography, Column chromatography, Molecular sieving chromatography, Affinity chromatography, HPLC, GC - Radioactive Techniques-Liquid scintillation counting- Applications of chromatography.

Unit IV STRUCTURE PREDICTION

Annotation of structure - Sequences Sequence alignments - BLAST- sequence search tools - Sequence databases - MSA / Phylogenetic trees / file types Annotation, names, ontology Structural alignment and Classification: Classification methods - necessity to compare proteins - similar sequence / function / structure.

Unit V PROTEIN FOLDING

Principles of protein folding and methods to study protein folding - Macromolecular interactions - Protein – Protein - Protein –Nucleic acids - Protein – carbohydrates

COURSE OUTCOMES

At the end of the course the students will be able to

CO1- Explain the relationship between protein sequence and protein structure.

CO2- Describe how structure translates into function within different biological fields such as catalysis, transport and regulation.

CO3- Estimate the validity of information in macromolecular structure databases, and use computer programs to visualise and analyse macromolecular structures from a functional perspective.

CO4- Use bioinformatics tools for sequence alignment, sequence motif identification and prediction of secondary and tertiary structures.

C05- Account for the purpose, theoretical background, ethical aspects and limitations of the above-mentioned bioinformatics methods and use this knowledge to interpret relevant results.

C06- Assess the important features and aspects of protein folding and its significance

TEXT/REFERENCES BOOKS:

1. Forbes Burkowski. Structural bioinformatics: An algorithmic approach.
Publisher: CRC Press, 2009. ISBN: 9781584886839.
2. Li-ling Ooi, (2010), Principles of x-ray crystallography, Oxford University Press
3. Liljas, A., Liljas, L., Piskur, J., Lindblom, G. Nissen, P. Kjeldgaard, M. (2009)
"Textbook of structural biology"; Hackensack, N.J.: World Scientific.
4. Principles of Protein Structure by G. E. Schulz., Springer 2009
5. Structural Bioinformatics, Philip E. Bourne, Helge Weissig, Wiley publications.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice

30 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 14 marks

SBIA7406	DATA MINING IN BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles, used, architectures, applications, design and implementation of data mining and data ware housing concepts

UNIT I INTRODUCTION

Introduction, Importance of Data Mining, Relational Databases, Data Warehouses, Transactional Databases, Advance Database Systems and Applications, Data Mining Functionalities, Classification of Data Mining Systems, Major issues in Data Mining.

UNIT II PRIMITIVES AND SYSTEM ARCHITECTURES

Data Mining Primitives, Data Mining Query Language, Designing Graphical User, Interfaces Based on a Data Mining Query Language, Architectures of Data Mining Systems.

UNIT III CONCEPT DESCRIPTION AND ASSOCIATION RULES

Concept Description, Characterization and comparison, Data Generalization and Summarization-Based Characterization, Analytical Characterization, Mining Class Comparisons, Mining Association Rules in Large Databases, Association Rule Mining, Mining Single Dimensional Boolean Association Rules from Transactional Databases.

UNIT IV CLASSIFICATION AND PREDICTION

Classification and Prediction, Issues: Data preparation for classification and Prediction, Comparing classification Methods, Classification by Decision Tree Induction: Decision Trees and Decision Tree induction

UNIT V CLUSTERING METHODS

Clustering Analysis, Types data in clustering analysis: Scaled variable, Binary variables, Variables of Mixed Types, Partitioning Methods: K-means and K-Medoids, Model-Based Methods, Data Mining Applications: Data mining for Biomedical and DNA Data Analysis

COURSE OUTCOMES

- CO1-** Be familiar with mathematical foundations of data mining tools..
- CO2-** Understand and implement classical models and algorithms in data warehouses and data mining
- CO3-** Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
- CO4-** Master data mining techniques in various applications like social, scientific and environmental context.
- CO5-** Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

TEXT/ REFERENCES BOOKS

1. Data Mining Concepts and Techniques – Jiawei Hen, Micheline Kambler, Academic Press Morgan Kaufman Publishers.2006
2. Data Mining: Practical machine learning tools Techniques with java implementation by Ian H.Witten, Eibe Frank, 2005.
3. Machine Learning and data mining in pattern recognition in third International conference MLDM, by Petra Perner andAzriel Rosenfield, Springer.2003

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice	30
MarksPART B : 2 Questions from each unit with internal choice, each carrying 14 marks	70
Marks	

SBIA7407	MEDICINAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course will provide an in-depth look at how novel and pharmacologically active molecules are designed to treat human diseases and understand the mechanism of action of various classes of drugs.

UNIT I BASIC PRINCIPLES

Basic Principles of Medicinal Chemistry: Physico-chemical aspects of drug molecules and biological action, Drug-receptor interaction including transduction mechanisms. Principles of Drug Design- Traditional, analog (QSAR) and mechanismbased approaches

UNIT II MODE OF ACTION

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physicochemical properties of the following classes of drugs: Drugs acting at Synaptic and neuro-effector junction sites, Autocoids, Drugs affecting uterine motility Oxytocics

UNIT III MODE OF ACTION I

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of the following classes of drugs -Steroids and related drugs, Drugs acting on the Central Nervous System, Diuretics, Cardiovascular drugs, Anticoagulant and Antiplatelet drugs.

UNIT IV MODE OF ACTION II

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship of the following classes of drugs – Antimetabolites, Chemotherapeutic agents, Antineoplastic agents, Anti-viral, Immunosuppressives and immunostimulants

UNIT V MODE OF ACTION III

Amino acids, peptide, nucleotides and related drugs a. Thyroid and Anti thyroid drugs b. Insulin and oral hypoglycaemic agents. c. Peptidomimetics and nucleotidomimetics. vi. Diagnostic agents. vii. Pharmaceutical Aids.

COURSE OUTCOMES

The students will be able to

- CO 1- Understand the basics of medicinal chemistry
- CO 2- Evaluate the role of physic chemical aspects of drugs
- CO 3- Understand the necessity of insilico approach in drug design
- CO 4- Comprehend the mode of action of drugs acting on central nervous system and neural drugs
- CO 5- Explain the role other classes of drugs
- CO 6- Explain the role of another class of drugs that are derived from peptides and nucleic acids

TEXT/ REFERENCE BOOKS

1. AshutoshKar Medicinal Chemistry New Age International Publishers; Seventh edition 2018.
2. Graham L. PatrickAn Introduction to Medicinal ChemistryOxford University Press 2009
3. V AlagarsamyTextbook of Medicinal Chemistry Vol IElsevier India 2009
4. David A. Williams Foye's Principles of Medicinal Chemistry Seventh, North American EditionLWW 2012

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

**PART A : 6 Questions for 5 Marks each –without choice
Marks**

30

**PART B : 2 Questions from each unit with internal choice, each carrying 14 marks
Marks**

70

SBIA7408	NEXT GENERATION SEQUENCE DATA ANALYSIS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- NGS bioinformatics workflow steps following sequence generation
- NGS for transcriptomics; QC, mapping, visualisation tools
- NGS for genomics; assembly, alignment, QC and variant calling tools
- Exploring EMBL-EBI resources

UNIT I DNA SEQUENCING

DNA Sequencing, first generation DNA sequences, Drawbacks of the first generation sequencing method- Emergence of Next generation sequencing -Platform overview- Biological applications- Basic concepts- Recent scientific breakthroughs using NGS technology

UNIT II OVERVIEW OF NGS TECHNOLOGY

Pyro-sequencing, Illumina Genome Analyzer, Applied Biosystems Sequencing, Ion Torrent Sequencing, Polonator Technology, Nanopore Sequencing, Single Molecule Real Time DNA sequencing- Comparison of Next generation sequencing techniques, & applications- Drawbacks of NGS, NGS File formats- FASTA, FASTQ, FNA, CSFASTA, GFF, SAM and BAM

UNIT III NGS DATABASES AND ANALYSIS OF NGS DATA

NGS databases, Sequence Analysis: Pairwise and multiple sequence alignment methods and tools- Sample data processing with annotation

UNIT IV ALIGNMENT AND ANALYSIS

Genome alignment and analysis tools- BWA (Burrows-Wheeler Aligner), SAMtools, GATK (The Genome Analysis Toolkit), IGV (Integrative Genomics Viewer), HISAT, StringTie, Cuffcompare, Velvet, Oases, Trinity

UNIT V TRANSCRIPTOMICS ANALYSIS

Transcriptome (RNA) sequencing, Exome sequencing, Genome Annotation, Using NGS to detect sequence variants, ChIP- sequence, Biological theories on ChIP-sequence analysis, Understanding the non – coding genome, Disease gene identification, DNA fragment evaluation, Peak identification, Two condition comparison, Saturation analysis, Motif finding and related theories

COURSE OUTCOMES

After this course the students will be able to

- CO 1:** Discuss a variety of applications and workflow approaches for NGS technologies
- CO 2:** Use a range of bioinformatics software and tools to undertake basic analysis of NGS data
- CO 3:** Understand the advantages and limitations of NGS analyses
- CO 4:** Submit, browse and access a range of NGS data available in public repositories using EBI resources
- CO 5:** Comprehend the different areas of NGS analysis utility
- CO 6:** Apply the knowledge of NGS technology in transcriptome data analysis

TEXT BOOKS /REFERENCES

1. Ali Masoudi-Nejad, Zahra Narimani, Nazanin Hosseinkhan; "Next Generation Sequencing and Sequence Assembly", Methodologies and Algorithms, Springer; 2013.
2. Stuart M. Brown, "Next-Generation DNA Sequencing Informatics", Cold Spring Harbor Laboratory Press, 2013.
3. Mark I. Rees, "Challenges and Opportunities of Next-generation Sequencing for Biomedical Research", Academic Press, 2012.

**END SEMESTER EXAM QUESTION PAPER
PATTERN**

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice

30 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 14 marks

70 Marks

SBIA7409	HEALTH INFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course provides an insight into the fundamental aspects and applications of health informatics.

UNIT I INTRODUCTION

An Introduction to Structural Equation Modeling - Privacy and Data Protection in Healthcare - Biomedical Technology – Case - Allergic Severity Under Conjunctival Provocation - Texture Analysis of Heterogeneous MRI Data for Diagnostic Classification of Childhood Brain Tumours - Establishing a National Medical Device Registry

UNIT II CLINICAL INFORMATICS

Endoscopy Information System (EIS) - Remote Patient Monitoring System Implementation at a Cardiac Care Centre - Vagal Nerve Stimulation (VNS) Therapy System Implementation - Improving Emergency Room Performance - Automation of Fugl-Meyer Assessment Scale for Neurorehabilitation - Extensible Neuroimaging e - Repository for Clinical Trials of Tumours -Query Tool Enabling Clinicians and Researchers to Explore Patient Cohorts

UNIT III INTELLIGENT SYSTEMS

Clinical Decision Support Knowledge Management - Prediction of 5-Year Survival with Data Mining Algorithms - Abstractive Summarization of Drug Dosage Regimens - Exploitation of Medical Crisp Database for Fuzzy Systems - Spatial Epidemiology - **E-Learning and Education** - Role for Education - Proactive Support of Internet Browsing - Biomedical Informatics Education Programs and Ecosystems - e-Learning Approach to Hospital Information Systems

UNIT IV FORMALISATION AND INFORMATICS

Formalisation of Knowledge, Ontologies, Clinical Guidelines and Standards of Healthcare Clinical Pathways: Identifying Development, Implementation and Evaluation Challenges - “HoPRO” - Data Warehouse Design - Innovative Information Systems in Intensive Care Unit - A Framework to Enrich EHR System - e ENERCA) - Based Stroke Rehabilitation - Greek Public Hospitals’ Websites

UNIT V ADVANCES

Health Information Management - Emergency Physician Productivity - Taming Big Data: An Information Extraction Strategy for Large Clinical Text Corpora - Institutional Repository of Digital Health Information Content - Healthcare IT - Neural Network in Healthcare - Healthcare Management - Public Health Informatics - Social Media and Health - Telemedicine

COURSE OUTCOMES

The students will be able to

- CO 1-** Understand the basics concepts of health informatics.
- CO 2-** To understand the intricacies of clinical informatics.
- CO 3-** To elaborate on the understanding of decision support systems in a hospital.
- CO 4-** Comprehend clinical documentation in the real world.
- CO 5-** To ponder and on the various aspects of telemedicine, healthcare, and social networks in the practice of medicine
- CO 6-**

TEXT BOOKS / REFERENCES

1. Enabling Health Informatics Applications, edited by J. Mantas, et al., IOS Press, 2011.
2. Sullivan, Frank, and Jeremy Wyatt. ABC of Health Informatics, John Wiley & Sons, Incorporated, 2006.
3. Health Informatics : Improving Patient Care, edited by The Chartered Institute for IT BCS, BCS Learning & Development Limited, 2012.
4. International Perspectives in Health Informatics, edited by E.M. Borycki, et al., IOS Press, 2011.
5. Brender, Jytte. Handbook of Evaluation Methods for Health Informatics, Elsevier Science & Technology, 2006.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice **30**

Marks PART B : 2 Questions from each unit with internal choice, each carrying 14 marks **70**

Marks

SBIA7412	NANOTECHNOLOGY AND ADVANCED DRUG DELIVERY SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course provides an insight into the various nanomaterials their fabrication and characterisation with a focus on using them as drug delivery agents.

UNIT 1 INTRODUCTION

Definition, concepts and principles, types of approaches, four generations, self-assembly, properties and application of nanotechnology and nanobiotechnology

UNIT 2 SYNTHESIS OF NANOMATERIALS

Physical, Chemical, Biological Methods, Principles- Application, Fabrication Technology, Characterization

UNIT 3 CHARACTERIZATION OF NANOMATERIALS

UV - Vis- NIR - absorption and reflectance Spectroscopy, X- Ray Diffraction studies - Bragg's law – particle size - Scherrer's equation - Photoluminescence (PL) studies -Fourier Transform Infrared Spectroscopy (FTIR) – FT Raman studies -Surface Enhanced Infrared spectroscopy, Resonance Raman Spectroscopy

UNIT 4 NANOTECHNOLOGY IN DRUG DELIVERY

Nanotechnology and Drug Delivery- Fundamentals, Drug carriers, Drug encapsulation, Administration routes

UNIT 5 APPLICATIONS

Nanotechnology in gene therapy. Nanoimmunotechnology - nanoimmunoassay and nano-immunosensors. Nanotechnology based medical diagnostics - improved diagnosis by in vivo imaging. Prosthetic and medical implants, nano-bioconjugates and their significance

COURSE OUTCOMES

At the end of the course the students will be able to

- CO1-** Understand the basics concepts of nanotechnology **CO2-** Classify the various ways of synthesising nanomaterials **CO3-** Articulate over the various characterisation methods **CO4-** Comprehend the basics of drug delivery **CO5-** Ponder on the various nano carriers **CO6-** Understand their significance in various fields of medicine

TEXT/ REFERENCE BOOKS

1. de Villiers, Melgardt M., Aramwit, Pornanong, Kwon, Glen S. Nanotechnology in Drug Delivery Springer 2009
2. Vasant V. Ranade, John B. Cannon Drug Delivery Systems 3rd Edition CRC Press 2011
3. Alexandru Mihai Grumezescu Nano- and Microscale Drug Delivery Systems Design and Fabrication Elsevier 2017
4. W Mark Saltzman Drug Delivery: Engineering Principles for Drug Therapy Oxford University Press 2001

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice 30 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 14 marks 70 Marks

SBIA7412	CLOUD COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ❑ To gain knowledge in basics of Cloud computing.
- ❑ To understand Cloud Computing architecture and industry frameworks such as Map Reduce.
- ❑ To discuss practical applications of cloud computing.

UNIT I UNDERSTANDING CLOUD COMPUTING

History of Cloud computing -Cloud Computing Reference Model – NIST Architectural Framework - Types of Clouds- pros and cons of cloud computing –difference between web 2.0 and cloud - key challenges in cloud computing - Major Cloud players - Cloud Deployment Models - Virtualization in Cloud Computing- types of virtualization – web services – key concepts.

UNIT II CLOUD SERVICE MODELS

Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS)- Service Oriented Architecture (SoA) - Elastic Computing - On Demand Computing - Parallelization in Cloud Computing – cloud resource management – dynamic resource allocation- Optimal allocation of cloud models.

UNIT III CLOUD DEPLOYMENT MODELS

Deployment models: Public cloud – Private Cloud –Hybrid cloud – Community cloud - Deployment of applications on the cloud - Hypervisor -Case studies- Xen, Hyper V, Virtual Box, Eucalyptus, Amazon Cloud Computing - Amazon S3 - Amazon EC2-, Windows Azure – creating deploying cloud services, Working with Google Appengine, Disaster Recovery.

UNIT IV VIRTUALIZATION

Cloud data centers – Energy efficiency in data centre – Mobile cloud computing service models– Need for virtualization – Types of Virtualization – Virtualization OS – VMNware, KVM – System VM – Process VM - Virtual Machine Monitor – Properties – Interpretation and Binary Translation – HLL VM.

UNIT V CLOUD SECURITY

Cloud security – Security threats and solutions in clouds – Auditing protocols – dynamic auditing – storage security –Privacy preserving — Fully Homomorphic Encryption – Big data security- Cloud availability- DoS attacks – Fault tolerance management in cloud computing- Cloud computing in India.

COURSE OUTCOMES

At the end of the course the students will be able to

- CO1-** Understand the basic concepts of cloud computing.
- CO2-** Use cloud service models as infrastructure.
- CO3-** Deploy cloud models in a real – time environment
- CO4-** To efficiently use data centres.
- CO5-** Grasp virtualization.
- CO6-** To comprehend security issues involved.

TEXT / REFERENCE BOOKS

1. Cloud computing a practical approach - Anthony T.Velte, Toby J. Velte Robert Elsenpeter TATA McGraw- Hill , New Delhi, 2010.
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller – Que, 2008.
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
4. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011.
5. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice	30
Marks PART B : 2 Questions from each unit with internal choice, each carrying 14 marks	70
Marks	

SCSA7014	MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ☐ To understand the significance of number theory.
- ☐ To introduce Automata Theory and Regular Languages.
- ☐ To understand Context Free languages and recognizers for different languages.
- ☐ To design Turing Machines for various languages.

UNIT I PRELIMINARIES AND INDUCTION

Set Theory basic concepts-Relations and ordering- Functions, Recursion and its use in theorem proving- Alphabets, Strings and Languages and Grammars- Functions and Infinite sets – Paring Functions – Contor's proof- Mathematical Induction – proofs- the principle of mathematical induction – Recursive definitions – Structural Induction.

UNIT II FINITE AUTOMATA

Finite Automata and Regular Languages - Regular Languages and regular expressions, Finite Automata- Distinguishing one string from another, union, intersections, and complements- Non- determinism and kleene's theorem-Non-deterministic finite automata and NFA with transition-Kleene's theorem.

UNIT III REGULAR LANGUAGES AND CONTEXT-FREE LANGUAGES

Regular and Non-regular Languages- A criterion for regularity-Minimal finite automata-The pumping lemma- Decision problems, Regular languages and computers. Context-free Grammars- Definition- More examples-Including some familiar languages- Union-Concatenations, and *'s of CFLs.

UNIT IV DERIVATION TREES AND PUSHDOWN AUTOMATA

Derivation Trees and Ambiguity- Unambiguous CFG for Algebraic Expressions-Simplified forms and Normal forms. Pushdown Automata - Introduction-Definition-Deterministic Pushdown automaton-PDA corresponding to a given Context- free Grammar- Context-free Grammar corresponding to PDA.

UNIT V TURING MACHINES AND THEIR LANGUAGES

Turing Machines – Models of computation and the Turing thesis-Definition of TM and TMs as Language Acceptor- Computing a partial Function with a TM, variations of TM-Non-deterministic TM- Universal Turing Machine. Recursively Enumerable and Recursive languages – Recursively Enumerable and recursive sets- Enumerating a Language-Not all Languages are recursively enumerable-Language not Recursively enumerable.

COURSE OUTCOMES

At the end of the course the students will be able to

C01- Understand the basic concepts behind languages, grammar and mathematical induction.

C02- Understand finite automata and regular languages

C03- Grasp context free

languages. **C04-** To understand

derivation trees. **C05-** To understand

pushdown automata

C06- To comprehend turing machines and their languages.

TEXT / REFERENCE BOOKS

1. John C. Martin, "Theory of Computation", Tata McGraw Hill, 3rd Edition.
2. Bernard M. Moret, "The Theory of Computation", Addison Wesley, 2002 Reprint.
3. Tremblay.P. and Manohar. R, "Discrete Mathematical Structures with applications to computer science" Tata McGraw Hill.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 6 Questions for 5 Marks each –without choice

30 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 14 marks

70 Marks

REGULATIONS 2019

BSC BIONFORMATICS AND DATA SCIENCE

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REGULATIONS 2019