



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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School of Bio and Chemical Engineering

Department of Biomedical Engineering

1.2.1 New Courses Introduced in 2023- 2024

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SBMB1101	CELL BIOLOGY AND MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To introduce extensive knowledge in cell structure, functions, cell signaling pathways and transfer across membranes in cell
- To enable students to learn about the principles of Microbiology to emphasize structure and biochemical aspects of various microorganisms
- To understand the basic principles of microscopy and sample preparation

UNIT 1 CELL STRUCTURE AND TRANSPORT ACROSS CELL MEMBRANE 9 Hrs.

Structure and functions of Eukaryotic cell, Plasma Membrane models and chemical composition, Permeases, Passive and active transports, Transport through cell membrane, Sodium - potassium pumps, co- transport, symport, antiport, Endocytosis and Exocytosis.

UNIT 2 CELL RECEPTORS AND CELL SIGNALING 9 Hrs.

Membrane bound receptors, Cytosolic and Nuclear receptors, autocrine, paracrine and endocrine signaling, signal amplification, CAMP and G-protein role in signal transduction, role of IP3, DAG and calcium in cell signaling.

UNIT 3 CELL DIVISION AND DNA REPLICATION 9 Hrs.

Cell cycle – interphase, cell cycle check points, cell cycle regulations, Cell division - Mitosis & Meiosis cell division, difference between mitosis and Meiosis cell division, DNA replication- Conservative, Semi-Conservative, & Dispersive models of DNA replication

UNIT 4 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL GROWTH 9 Hrs.

History, overview and scope of microbiology, contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, and Fleming. Structure of bacteria; (nucleoid, plasmid, ribosomes, cell wall, flagella), morphology, reproduction of bacteria. Microbial growth types of media, growth curve and pure culture, Enumeration of microorganisms -Pour plate, Spread plate, and Streak plate, preservation of pure culture.

UNIT 5 MICROSCOPY AND STAINING TECHNIQUES 9 Hrs.

Microscope - compound microscope, phase contrast microscope, fluorescent microscope, electron microscope - Transmission electron microscope, scanning electron microscope. Sterilization and disinfection methods, Staining techniques- simple staining, Gram's staining, acid fast staining, capsule and spore staining.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1** - Understanding the principles of cell structure and transport across the cell membrane.
- CO2** - Demonstrate the role of various cell receptors and the signaling between the cells.
- CO3** - Learning the process of cell division and recognize the importance of chromosome.
- CO4** - Understands the scope of microbiology, structure of microbes and their microbial growth.
- CO5** - Demonstrates the morphology of microbes using various microscopes and staining techniques.
- CO6** - Outline the problem encountered to stain the microbes and mechanism of staining reaction.

TEXT BOOK / REFERENCE BOOK

1. Thomas D. Poolard, Williams C. Earnshaw, Graham T. Johnson, Cellbiology, 3rd edition, 2017, Elsevier
2. C.B.Powar, Cell Biology, New Edition, Publisher : Himalaya Publishing House (1 January 2010) ISBN-10 9350246694 , India.
3. Pelczar, Jr E.C. S Chan and noel R.Krieg, Microbiology, 5th edition Tata McGraw Hill 2006.
4. Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 8th Edition, McGraw Hill Higher Education, 2008.
5. Tortora, Funke, and Case's Microbiology, An Introduction 13th Edition, Publisher: Pearson, ISBN-10: 0134605187, January 8, 2018

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 with internal choice, each carrying 16 marks**80 Marks**

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Skill development

S24BLH21	BIOSENSORS AND MEASUREMENTS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

- To provide the basics of measurements, knowledge on the principle and operation of different medical transducers.
- To introduce the application of sensors and transducers in the physiological parameter measuring system.

UNIT 1 MEASUREMENT SYSTEM

9 Hrs.

Measurement System – Functional elements of an instrumentation system - Static and Dynamic Characteristics - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards. Sensor for Motion and Position Measurement, GPS, INS, Doppler, SONAR.

UNIT 2 PASSIVE AND ACTIVE TRANSDUCERS

9 Hrs.

Classification of transducers and characteristics for selection of transducers - Resistive Transducers- Strain Gauge, Capacitive transducer - various arrangements, Capacitor microphone, Capacitive pressure sensor, Proximity sensor. Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics. Piezoelectric active transducer.

UNIT 3 BIO POTENTIAL ELECTRODES AND CHEMICAL SENSORS

9 Hrs.

Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non-Polarizable, Electrodes, Reference Electrode, Hydrogen Electrode, Electrode Skin-Interface and Motion Artifact. Surface Electrodes. Oxygen electrodes, CO₂ electrodes, enzyme electrode, construction, ISFET for glucose, urea etc. fiber optic sensors.

UNIT 4 SMART AND BIOSENSORS

9 Hrs.

Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, sensors for smell, sound, vision, osmolality and taste.

Biosensors: Introduction, Advantages and limitations, various components of Biosensors, Biocatalysts based biosensors, bio-affinity based biosensors & microorganisms-based biosensors, Types of membranes used in biosensor constructions, Electronic Nose. SMART SENSORS. Introduction to Smart Sensors and Semiconductor sensors, MEMS.

UNIT 5 DISPLAY AND RECORDING DEVICES

9 Hrs.

Digital Display System and Indicators: Classification of display devices, DOT Matrix display, Digital voltmeter, Multimeter, Digital storage oscilloscope, LCD monitor, Recorders: Graphic recorders, strip chart recorders, Galvanometer type recorders and self-balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders.

Max.15 Hrs.

PRACTICE EXERCISE

1. Characteristics of Temperature Transducers.
2. Characteristics of Optical Transducer.
3. Characteristics of LVDT and Potentiometer Transducer
4. Characteristics of Strain Gauge.
5. Dead weight measurement
6. Study of Characteristics of Hall effect Transducer using Arduino.
7. Measurement of pulse and body temperature using Arduino

Max.60 Hrs

COURSE OUTCOMES

- CO1** - Understand the calibration procedure for the basic instruments involved in physiological parameter measurement.
- CO2** - Identify the characteristics of various transducers and classify transducers.
- CO3** - Attain adequate knowledge about the various sensors and measuring instruments used for measurement and detection of physical quantities.
- CO4** - Demonstrate the concepts, types, working and practical applications of important biosensors.
- CO5** - Apply the suitable design criteria for developing a medical sensor for a particular application.
- CO6** - Employ Multimeter, CRO and different types of recorders for appropriate measurement.

TEXT BOOK / REFERENCE BOOK

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai Sons, 2014
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw Hill, 2011.
3. John G. Webster, Medical Instrumentation Application and Design, 4th Edition, Wiley India Pvt. Ltd., New Delhi, 2015.
4. Richard S.C. Cobbold, Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 2004.
5. Nandini K. Jog, Electronics in Medicine and Biomedical Instrumentation, PHI, 2nd Edition 2013.
6. Harry N, Norton, Biomedical sensors – Fundamentals and Application, 2001.
7. Tatsuo Togawa, Toshiyo Tamma and P. Ake Öberg, Biomedical Transducers and Instruments, 2018. Pillai S.O., Solid state Physics, New age International Publishers, 7th Edition.

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 with internal choice, each carrying 16 marks	80 Marks

- Employability

SBMA3014	MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE FOR HEALTHCARE APPLICATION	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To understand the concepts of Machine Learning
- To get introduced to Artificial Intelligence techniques
- To apply ML in healthcare data

UNIT- I INTRODUCTION TO MACHINE LEARNING

9 Hrs

Machine Learning–Applications - Types of Machine Learning – Training, Testing, - Machine Learning process – Variance – Bias - Training Error – Testing Error - Overfitting – Underfitting – Gradient Descent – Accuracy – Precision – Recall – Confusion Matrix.

UNIT- II NEURAL NETWORKS

9 Hrs

Structure of a brain - Artificial Neural Network – Perceptron – Activation function – Sigmoid – Relu – Tanh - Multilayer perceptron – Feed forward propagation – Backpropagation - Training process in neural network-Introduction to Adaptive resonance theory and Self-organizing map.

UNIT- III SUPERVISED AND UNSUPERVISED LEARNING

9 Hrs

Supervised Learning- Regression - Linear Models for Regression – Classification – Logistic Regression - Classification Models - KNN Classification – Naïve Bayes Classification – Decision Tree Classification – Support Vector Machine – Ensemble Learning – Random Forest-Clustering - k-means clustering.

UNIT-IV INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT

9 Hrs

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem-Solving Approach to Typical AI Problems- Introduction to Knowledge Representation and Reasoning- Introduction to Decision Theory.

UNIT-V HEALTH CARE APPLICATIONS

9 Hrs

Case Studies and use cases- Disease Personalized medicine- patient monitoring- Robotic surgery- Precision medicine- Medical Imaging Diagnosis Signal Classification -Oncology research- Bio Predictive Analysis- Simple programs for classification of biosignals.

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1: Understand the basics of Machine Learning
 - CO2: Acquire knowledge of training data using Neural Networks
 - CO3: Analyze the Supervised Learning and Unsupervised learning methods
 - CO4: Explore the principles of Artificial Intelligence
 - CO5: Explore techniques for analyzing and classifying medical data.
 - CO6: Design an algorithm for anomaly detection using a machine-learning algorithm

TEXTBOOK / REFERENCE BOOK

1. Burkov, Andriy, — The Hundred-page Machine Learning Book, 2019.
2. Theobald, Oliver., — Machine Learning for Absolute Beginners: A Plain English Introduction II, Scatterplot Press, 2017. .
3. Maini, Vishal, and Sabri, Samer. Machine Learning For Humans: Introduction to Machine Learning with Python. Romania, Alanna Maldonado, 2023
4. Stephen Lucci and Danny Kopec, " Artificial Intelligence in the 21st Century, Second Edition, Mercury Learning and Information, 2015.

5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017. Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017

END-SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each - No choice

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80Marks

- Skill Development

S24BPB71	VR AND AR IN BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To understand virtual reality, and augmented reality and use them to build Biomedical engineering applications.
- To know the intricacies of these platforms to develop PDA applications with better optimality

UNIT-I INTRODUCTION

9 Hrs

Introduction to AR and VR. Difference between AR and VR. The three I 's of virtual reality-Components of AR and VR technology - Input Devices:(Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers navigation and manipulation interfaces and gesture interfaces. Output Devices: Graphics displays-sound displays

UNIT-II VR DEVELOPMENT PROCESS AND CONTENT CREATION CONSIDERATIONS FOR VR

9 Hrs

Geometric modeling-kinematics modeling-physical modeling, behavior modeling, model Management. Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system-cyber sickness effects of exposures to virtual reality environment

UNIT-III STEREOSCOPIC VISION & HAPTIC RENDERING

9 Hrs

The human optical system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Haptic rendering and parallax algorithms, Stereo pairs Synthesis, and Stereo images pipelines.

UNIT-IV SOFTWARES FOR AR AND VR

9 Hrs

AR software, Camera parameters and calibration, AR based on markers, and AR Toolkit. JS-pros and cons-building blocks (WebVR, WebGL), Three.js, device orientation events) frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT-V APPLICATIONS

9 Hrs

Medical applications-military applications-robotics applications-Advanced Realtime Tracking of other applications-games, movies, simulations, therapy

COURSE OUTCOMES

45 Hrs

On completion of the course, students will be able to

- CO1-Understands the system or process to meet given specifications with realistic engineering constraints
- CO2-Identify problem statements and function as a member of an engineering design team.
- CO3-Examine the Stereoscopic vision and haptic rendering
- CO4-Explore the various software used for the development of AR and VR
- CO5-Apply the concepts of AR and VR to medical and industrial applications
- CO6-Design various medical applications based on augmented reality.

TEXTBOOK / REFERENCE BOOK

1. C. Burdea & Philippe Coiffet, Virtual Reality Technology, Second Edition, Gregory, John Wiley & Sons, Inc., 2008
2. Jason Jerald, 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, 2015.
3. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media, 1 edition, 2015.
5. Vasanth Mohan, Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing, Shroff/O'Reilly, 2019

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 with internal choice, each carrying 16 marks **80 Marks**

- Skill Development

S24BPB72	AI FOR HEALTH CARE					Total Marks
	L	T	P	EL	C	100
	2	0	2	0	3	

UNIT-I INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT 9 Hrs

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem-Solving Approach to Typical AI Problems.

UNIT-II INFORMED SEARCH ALGORITHMS 9 Hrs

Informed Search - Introduction to Heuristics – Greedy Breadth First Search, A* - Local Search Optimization Algorithms - Hill Climbing, Simulated Annealing.

UNIT-III OPTIMAL SEARCH ALGORITHMS 9 Hrs

Global optimization algorithms - Genetic Algorithms, Particle Swarm Optimization Algorithm, Ant Colony Optimization, Gravitational Search Algorithm - Games – Optimal Decisions in Games - Minimax Algorithm, Alpha-Beta Pruning Algorithm.

UNIT-IV KNOWLEDGE REPRESENTATION AND REASONING 9 Hrs

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

UNIT-V DECISION THEORY AND PLANNING 9 Hrs

Basics of utility theory, decision theory, sequential decision problems, decision networks, elementary game theory, Planning: planning as search, partial order planning, construction and use of planning graph.

COURSE OUTCOMES 45 Hrs

On completion of the course, students will be able to

- CO1: Demonstrate a fundamental understanding of the evaluation of Artificial Intelligence (AI) and its foundations.
- CO2: Elucidate the basic knowledge representation, problem-solving, and learning methods of Artificial Intelligence
- CO3: Apply basic principles of AI in solutions that require problem-solving through Optimal Search Algorithms
- CO4: Demonstrate working knowledge of reasoning in the presence of uncertain information and show how search algorithms are essential for problem-solving
- CO5: Illustrate the importance of artificial intelligence and planning in solving real-world problems
- CO6: Design applications for healthcare that use Artificial Intelligence

TEXT BOOK / REFERENCE BOOK

- Russell S and Norvig P, Artificial Intelligence – A Modern Approach, 3rd Edition, Prentice Hall, 2015.
- Elaine Rich, Kevin Knight, Shivashankar B Nair., "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2017.
- Wolfgang Ertel, "Introduction to Artificial Intelligence", Second Edition, Springer, 2017.
- Stephen Lucci and Danny Kopec, "Artificial Intelligence in the 21st Century, Second Edition, Mercury Learning and Information, 2015.
- David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017.
- SarojKaushik, "Logic & Prolog Programming", New Age International, 1st edition, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 Questions of 2 marks each - No choice

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

- Skill Development

S24BPB73	MACHINE LEARNING	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

To focus on the construction and study of algorithms that can learn from data.

- To emphasize the logical, knowledge-based approach.
- To introduce students to the basic concepts and techniques of Machine Learning.
- To develop skills in using recent machine learning software for solving practical problems.
- To gain experience in doing independent study and research.

UNIT-I INTRODUCTION TO MACHINE LEARNING 9

Hrs

Machine learning - examples of machine learning applications - Learning associations - Classification -Regression - Unsupervised learning - Supervised Learning - Learning class from examples - PAC learning -Noise, model selection, and generalization - Dimension of the supervised machine learning algorithm.

UNIT-II MULTILAYER PERCEPTRONS 9

Hrs

Structure of brain - Neural networks as parallel processing - Perceptron - Multilayer perceptron - Backpropagation - Training procedures - Tuning the network size - Learning time.

UNIT-III SOM AND ART 9

Hrs

Counter propagation network -Training of Kohonen and Grossberg Layer-feature mapping, self-organizing feature maps, Adaptive Resonance theory (ART) Network- ART1 and ART 2 Architecture, Evolving Support Vector Machine.

UNIT-IV DECISION THEORY 9

Hrs

Bayesian Decision Theory- Introduction- Classification - Discriminant function-Bayesian Networks-Association rule - Parametric Methods - Introduction - Estimation -Multivariate methods-Data Parameter estimation-Dimensionality Reduction- PCA-Linear discriminant analysis.

UNIT-V CLUSTERING & REGRESSION 9

Hrs

Clustering - Mixture densities - k-means clustering - Supervised Learning after clustering - Hierarchical clustering - Nonparametric Methods - Density estimation - Generalization of multivariate data - Smoothing models -Decision Trees - Univariate trees - Multivariate trees - Learning rules from data - Linear Discrimination-Gradient Descent.

COURSE OUTCOMES 45

Hrs

On completion of the course, students will be able to

CO1 -Understand the complexity of Machine Learning algorithms and their limitations;

CO2 -Understand modern notions in data analysis-oriented computing;

CO3 -Be capable of confidently applying common Machine Learning algorithms in practice

CO4 -Be capable of performing distributed computations;

CO5 -Can demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

CO6 -Gain the ability to apply knowledge representation, reasoning, and machine-learning techniques to real-world problems

TEXT BOOK / REFERENCE BOOK

1. EthemAlpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
3. ShaiShalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
4. James A. Freeman & David M.Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education 1991.
5. S.Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education (Asia) Pvt. Ltd., Prentice Hall of India, 2003.

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

- Skill Development

S24BPB74	DEEP LEARNING FOR BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To gain knowledge on the concepts of deep learning
- To provide insight into recent CNN architectures and deep models
- To enable the students to know deep learning techniques to support real-time applications

UNIT-I FOUNDATION OF NEURAL NETWORKS AND DEEP LEARNING**9 Hrs**

Neural Networks-Training neural networks, Activation Functions, Loss functions, Hyperparameters, Fundamentals of Deep Networks-Defining Deep Learning, Common Architectural Principles of Deep Networks, Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters.

UNIT-II CONVOLUTION NEURAL NETWORKS**9 Hrs**

Architectural Overview – Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.

UNIT-III RECURRENT AND RECURSIVE NETS - SEQUENCE MODELLING**9 Hrs**

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks

UNIT-IV AUTO ENCODERS AND DEEP GENERATIVE MODELS**9 Hrs**

Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for e-health applications

UNIT-V RECENT TRENDS IN DEEP LEARNING**9 Hrs**

Recent Models of Deep Learning, Genomics, Predictive Medicine, Clinical Imaging, Lip Reading, Visual Reasoning

COURSE OUTCOMES**45 Hrs**

On completion of the course, students will be able to

- CO1: Ability to differentiate the concept of machine learning with deep learning techniques
- CO2: understand and visualize Convolutional Neural Networks for real-world applications
- CO3: demonstrate the use of Recurrent Neural Networks and Transformer based for time series prediction
- CO4: Illustrate autoencoder and deep generative models to solve problems with high dimensional data
- CO5: design and develop an application-specific deep-learning model
- CO6: Analyse the latest trends in deep learning

TEXT BOOK / REFERENCE BOOK

6. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
7. Wei Di, AnuraghBharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
8. Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O'Reilly Media, 2017.
9. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
10. SurajSawant. "Deep Learning", IGI Global, 2018.
11. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" A press, 2018.

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

- Skill Development

S24BPB75	PYTHON FOR SIGNAL AND IMAGE APPLICATIONS					Total Marks
	L	T	P	E L	C	
	2	0	2	0	3	100

COURSE OBJECTIVE

- To gain the knowledge necessary to launch a biomedical start-up
- To implement the concepts into practice and copyright the Inventions
- To understand the significance of sales and marketing

UNIT I INTRODUCTION TO PYTHON, DATA TYPES, EXPRESSIONS, LOOPS

9 Hrs.

Introduction to Python Programming - Running Code in the Interactive Shell, Input, Processing and Output, Editing, Saving and Running a Script - Data Types, String Literals, Escape Sequences, String Concatenation, Variables, and the Assignment Statement - Numeric Data Types Module, The Main Module, Program Format, and Structure and Running a Script from a Terminal Command Prompt, Conditional loops, and iterations.

UNIT II STRINGS AND TEXT FILES

9 Hrs.

Strings - Accessing Characters and Substrings in Strings, Data Encryption, Strings and Number Systems and String Methods - Text Files - Text Files and Their Format, Writing Text to a File, Writing Numbers to a File, Reading Text from a File, Reading Numbers from a File and Accessing and Manipulating Files and Directories on Disk.

UNIT III LISTS AND DICTIONARIES

9 Hrs.

Lists - List Literals and Basic Operators, Replacing an Element in a List, List Methods for Inserting and Removing Elements, Searching and Sorting a List, Mutator Methods and the Value None, Aliasing and Side Effects, Equality, and Tuples - Defining Simple Functions - Syntax, Parameters and Arguments, return Statement, Boolean Functions, and main function, DICTIONARIES - Dictionary Literals, Adding Keys and Replacing Values, Accessing Values, Removing Keys and Traversing a Dictionary.

UNIT IV DESIGN WITH FUNCTIONS AND DESIGN WITH CLASSES

9 Hrs.

Design with Functions and Design with Classes - Functions as Abstraction Mechanisms, Problem Solving with Top-Down Design, Design with Recursive Functions and Managing a Program's Namespace -DESIGN WITH CLASSES - Objects and Classes, Data Modeling and Structuring Classes with Inheritance and Polymorphism.

UNIT V Case Studies in Biomedical Engineering

9 Hrs.

Medical Imaging, Speech Recognition, Genomics, Drug Discovery, Patient Health Monitoring, Virtual Assistance, and Predictive Analytics in Healthcare.

COURSE OUTCOMES**45 Hrs**

On completion of the course, students will be able to

CO1: Understand the overview of NLP and modeling of Language

CO2: Describe various word-level analysis

CO3: Analyse Grammar and NLP Models

CO4: Explore various methods of speech processing and Discourse analysis

CO5: Apply the principles of NLP in Biomedicine

CO6: Develop NLP for biomedical application

TEXT BOOK / REFERENCE BOOK

1. Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
2. NitinIndurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
3. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech, Pearson Publication, 2014
4. Doan S, Conway M, Phuong TM, Ohno-Machado L. Natural language processing in biomedicine: a unified system architecture overview. *Methods Mol Biol.* 2014; 1168:275-94. doi: 10.1007/978-1-4939-0847-9_16. PMID: 24870142.

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 with internal choice, each carrying 16 marks**80 Marks**

- Skill Development

S24BPB76	MEDICAL BIG DATA ANALYTICS					Total Marks
	L	T	P	EL	C	
	2	0	2	0	3	100

COURSE OBJECTIVE

- To understand the underlying concepts of Big Data.
- To study the various tools used for Big Data Analytics
- To apply Big Data in the field of health care systems and Biomedical Data

UNIT-I INTRODUCTION

9 Hrs

Introduction to Big Data – Issues and Challenges in the traditional systems - Evolution of Big Data – Four V's of Big Data – Big Data Use Cases and Characteristics – Intelligent Data Analysis – Data Analytic Tools – Big Data Storage Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error – Random Sampling.

UNIT II HADOOP AND NoSQL

9 Hrs

Introduction to Hadoop – Hadoop Distributed File System – Analyzing data with Hadoop – Scaling – Streaming – Clustering: Single Node and Multi-Node – Working with Hadoop Commands – Working with Apache Oozie- Introduction to NoSQL- NoSQL business drivers-; NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores - Variations of NoSQL architectural patterns; Big data NoSQL solution- Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer.

UNIT III BIG DATA TOOLS AND MAP REDUCE

9 Hrs

Big Data Applications using Pig and Hive – Fundamentals of HBase and ZooKeeper – IBM Infosphere Big Insights – Introduction to FLUME – KAFKA. Algorithms using map-reduce - Matrix-Vector – Multiplication – Word Count - Understanding inputs and outputs of MapReduce, Data Serialization – Introduction to YARN – MapReduceVs YARN – YARN Architecture – Scheduling in YARN – Fair Scheduler – Capacity Scheduler.

UNIT IV Mining Data Stream AND FRAMEWORKS

9 Hrs

Mining Data Stream: Introduction to 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, Real-time Analytics Platform (RTAP) applications, - Using Graph Analytics for Big Data: Graph Analytics.

UNIT V Sources and Techniques for Big Data in Healthcare

9 Hrs

Motivation for Big data analytics in Health care-Structured EHR Data – Unstructured Clinical Notes – Medical Imaging Data – Genetic Data – Epidemiology & Behavioral data analysis.

COURSE OUTCOMES

45 HrsOn

completion of the course, students will be able to

CO1: Understand the fundamentals of Big Data

CO2 Analyze the usage of HADOOP and NoSQL in Big data

CO3: Familiarize tools used for Big Data

CO4: Comprehend the data mining concepts and Frameworks.

CO5: Apply the concepts of Big Data in the field of healthcare

CO6: Develop Big data solutions for healthcare applications

TEXT BOOK / REFERENCE BOOK

1. Chris Eaton, Dirk deroo et al., "Understanding Big data", McGraw Hill, 2012.
2. Tom White, "HADOOP: The Definitive Guide", O Reilly 2012.
3. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing 2013.
4. Jimeng Sun, Chandan K. Reddy, Big Data Analytics for Healthcare, IBM Wayne State, <http://dmkd.cs.wayne.edu/TUTORIAL/Healthcare>.

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

S1SB9101	RESEARCH METHODOLOGY & IPR					Total Marks
	L	T	P	EL	C	
	3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the concepts of research.
- To provide an insight into the techniques of research. To learn the requisites of writing a research report.
- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection

UNIT-I RESEARCH PREPARATION AND PLANNING

9 Hrs

Objectives of research – Understanding research and its goals, Critical thinking, Techniques for generating research topics. Topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – Formulation of hypotheses and testing of the same – Development of a research proposal

UNIT-II RESEARCH RESOURCES

9 Hrs

Sources of information. Literature search. World Wide Web, Online data bases – search tools. Citation in dices – Principles underlying impact factor – Literature review – Case studies, review articles and Meta analysis – Role of the librarian. Ethical and moral issues in Research, Plagiarism, tools to avoid plagiarism

UNIT-III ACADEMIC WRITING AND PRESENTATION

9 Hrs

Proposal submission for funding agencies, Elements of Style. Organization of proposals, Basic knowledge of funding agencies, Research report writing, Communication skills, Tailoring the presentation to the target audience – Oral presentations, Poster preparations, Submission of research articles for Publication in Reputed journal, Thesis writing and Research report writing. Elements of excellent presentation: preparation, visual and delivery, oral communication skills and oral defense.

UNIT-IV DATA COLLECTION, ANALYSIS AND INFERENCE

9 Hrs

Basic statistical distributions and their applications. Sample size determination and sampling techniques. Large sample tests and small sample tests.

UNIT-V INTELLECTUAL PROPERTY RIGHTS

9 Hrs

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT. Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

COURSE OUTCOMES

45 Hrs

On completion of the course, students will be able to

CO1: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO2: Understand research problem formulation & Analyze research related information and Follow research ethics

CO3: Correlate the results of any research article with other published results. Write a review article in the field of engineering.

CO4: Appreciate the importance of IPR and protect their intellectual property. 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

TEXT BOOK / REFERENCE BOOK

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.

4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5. James C. Van Horne, Stanford University, Financial Management and Policy, Prentice Hall,
6. James R. McGuigan, R. Charles Moyer, Frederick H. deB. Harris, Managerial economics – applications, strategy and Tactics, Cengage learning,
7. Philip Kotler, Marketing management Pearson Education, India
8. Modern Production / Operations Management, Elwood S. Buffa & Rakesh Sarin, Wiley India
9. Ronald R. Sims, Organizational success through effective human resources Management, Quorum books, London
10. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam

Duration: 3 Hrs.

PART A: 6 Questions of 5 marks each - No choice **30 Marks**

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

70 Marks



- Employability

S44BPB21	INDUSTRY VERSION 5.0	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To have an in-depth knowledge of advancements in Industries
- To differentiate Industry version 4.0 and version 5.0.
- To acquire knowledge on Internet of Medical things and its security threats and challenges

UNIT I INTRODUCTION TO INDUSTRY 5.0

9Hrs.

Industry 4.0- difference between industry 4.0 and industry 5.0, Society 5.0, Human Centric Approach, Advantages of Industry 5.0, Implementation of Industry 5.0.-Challenges-Human Centric solution

UNIT II FEATURES OF INDUSTRY 5.0

9Hrs.

Smart additive manufacturing- Predictive maintenance- Hyper customization- Cyber Physical Cognitive systems- Supply chain management-Collaborative Robots-6G communication-Big data Analytics

UNIT III INDUSTRY 5.0 IN BIOMEDICINE

9Hrs.

Smart hospitals- Smart Sensors- 4D CT and MRI scans-Holography in medicine-AI in medicine-Robotic Surgery-Smart materials and 4D printing

UNIT IV INTERNET OF MEDICAL THINGS

9Hrs.

Introduction and system architecture: Introduction, IoMT Devices-On-Body Devices, In Home Devices, Community Devices, In-Clinic Devices, In Hospital Devices, IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer.

UNIT V INTERNET OF MEDICAL THINGS SECURITY

9Hrs.

Threats, Security Challenges and Potential Solutions: IoMT Attack Types, Challenges in IoMT Security Schemes, Current Security Plans for IoMT, Potential Solutions for Security Vulnerabilities.

COURSE OUTCOMES

45 Hrs

On completion of the course the students will be able to

CO1: Differentiate Industry 4.0 and Industry 5.0

CO2: Evaluate features of Industry 5.0

CO3: Analyse Industry 5.0 in biomedical field.

CO4: Analyse the aspects of Internet of Medical things

CO5: Examine the security challenges and threats in Internet of medical things

CO6: Explore avenues of IoMT in Industry 5.0

TEXT BOOK / REFERENCE BOOK

1. Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018.
2. D. Jude Hemanth and J. Anitha George A. Tsihrintzis- Internet of Medical Things Remote Healthcare Systems and Applications, Springer, 2021
3. UthayanElangovan, Industry 5.0: The Future of the Industrial Economy, 2021
4. Srivastava J, Routray S, Ahmad S, Waris MM. Internet of Medical Things (IoMT)-Based Smart Healthcare System: Trends and Progress. ComputIntellNeurosci. 2022

SBMB7004	E-HEALTH AND TELEMEDICINE					Total Marks
	L	T	P	EL	C	100

COURSE OBJECTIVE

- To introduce the concepts of eHealth
- To assess the advantages of eHealth care
- To design and develop applications for eHealth care
- To explore the advancements of Telemedicine technology

UNIT-I INTRODUCTION TO eHEALTH CARE

9 Hrs

Overview and introduction to eHealth and flow of health information- International regulations in eHealth-Advantages, Challenges and future of eHealth.

UNIT-II MEDICAL DATA ANALYTICS AND WEARABLE DEVICES

9 Hrs

Health care data and Electronic Health Records (EHR) systems- Medical data bases –Wearable Devices-Data collection from wearable devices-Clinical use of personal health data-big data in the field of Medicine.

UNIT-III DIGITAL HEALTH

9 Hrs

Introduction to health care digital transformation- Digital health: Tools, Strategies of digital health-Technologies in digital health-Implementation of Digital health- Advantages and challenges of Digital health.

UNIT-IV APPLICATION DEVELOPMENT FOR e HEALTH

9 Hrs

Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for e-health applications

UNIT-V TELEMEDICINE

9 Hrs

Usage scenarios and operation modes- Telemedicine systems technologies- Standards and best-practices - Telemedicine in developed and developing countries - Telemedicine generations in IndiaTelemedicine for management of Cancer, Stroke cardiology and Diabetes

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

CO1: Acquire knowledge on basics of e-health care and its regulations

CO2: Explore medical data analytics and records

CO3: Apply digital transformation in the field of medicine

CO4: Apply Android Application development and its accessing tools for eHealth care

CO5: Evaluate the development of telemedicine in India and abroad

CO6: Develop an android App for telemedicine application

TEXT BOOK / REFERENCE BOOK

1. Shortliffe, Edward H and Cimino James J. Biomedical Informatics, Computer Applications in Health Care and Biomedicine, Springer-Verlag London 2014

2. ICMR- National Centre for Disease Informatics and Research. Framework for Telemedicine use in Management of Cancer, Diabetes, Cardiovascular Disease and Stroke in India.

Bengaluru: ICMR-National Centre for Disease Informatics and Research; 2021

3. Lavis, JN (ed). Ontario's Health System: Key Insights for Engaged Citizens, Professionals and Policymakers. 2016.

4. Hoyt RE, Yoshihashi A, Bailey N. Health informatics: Practical guide for healthcare and information technology professionals. Lulu Press. 2014 Seventh edition.

5. Gaddi A, Capello F, Manca M. eHealth, Care and Quality of Life. 2014 electronic library holding in the Health Science Library

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 6 Questions of 5 marks each – No choice **30 Marks****PART B:** 2 Questions from each unit with internal choice, each carrying 14 marks**70 Marks** - Employability

SBMB7006	MEMS AND NANOTECHNOLOGY IN HEALTH CARE	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand Various MEMS fabrication techniques
- Application of MEMS in different field of medicine.
- To know the underlying concept in engineering and implement in nano centric applications

UNIT-I MEMS & FABRICATION

9 Hrs

MEMS and Microsystems, Materials for MEMS-Active Substrate Materials Silicon and Its Compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz Polymers Lithography Etching and Its Types, Wafer Bonding, Micromachining –Bulk, Surface Micromachining, LIGA Process.

UNIT II MICROFLUIDIC SYSTEMS

9 Hrs

Fluid Dynamics, Continuity, Momentum Equation, Equation of Motion Laminar air Flow In- Circular, Circular Conducts, Flow in Micro conducts in Sub micro meter and Nanoscale. Microscale Fluid Expression for Liquid Flow In A Channel, Fluid Methods Actuation, Dielectrophoresis, Microfluid Dispenser, Microneedle, Micropump, Continuous flow System, Micro mixers.

UNIT III APPLICATIONS OF MEMS IN MEDICINE

9 Hrs

CAD for MEMS Biological MEMS Materials Polymers Based Gas Sensor Microbial Analysis Systems Detection and Measurement Methods Microsystems Approaches To PCR, DNA Sensor Drug Delivery Types of Reservoirs CARDIOMEMS Case Study Design of Sensor in Health Care Introduction To 3D Printing.

UNIT IV OVERVIEW OF NANOPARTICLES

9 Hrs

Nanotechnology from medical perspective Different Types of Nano biomaterials And Nanostructure Interactions Synthesis and Characterization of Smart Nano materials Surface Modification Biofunctionalization of Nano materials.

UNIT V NANOTECHNOLOGY IN HEALTH CARE

9 Hrs

Nano shells, Nanopores, Carbon Nanotubes, Synthesis and Monitoring of Antigen Antibody Reactions. Nanowires, Quantum Dots and Biomedical Applications Nanorobots in Surgery Nano oncology Nano neurology, Nano cardiology, Nanoorthopedies and Nano Ophthalmology.

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

CO1: Understand the Mems Fabrication Processes and Characterization of Various Mems Materials

CO2: Applying the Concepts to The Design of Different Types of Microsystems.

CO3: Design the Procedure Adopted for Mems Device Towards Health Care Applications.

CO4: Interpret the Latest Scientific Development and Discoveries in The Field of Nanomedicine.

CO5: Examine the New Findings and Implement the Perspective in The Field of Nanoscience.

CO6: Create New Approaches in Nanotechnology That Can Be Used in Biomedical Therapies.

TEXT BOOK / REFERENCE BOOK

1. Nano: The Essentials: T. Pradeep. McGraw – Hill education, First edition, 2017.
2. Carola Leuschner, Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. 2005, Wiley – VCH.
3. Kewal K. Jain, The Handbook of Nanomedicine. Humana Press, (2008).
4. Wanjun Wang, Stephen A. Soper, Bio MEMS: Technologies and applications, CRC Press, New York, 2007
5. Marc J. Madou, Fundamentals of micro fabrication: the science of miniaturization, CRC Press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 6 Questions of 5 marks each - No choice **30 Marks****PART B:** 2 Questions from each unit with internal choice, each carrying 14 marks**70 Marks****- Skill Development**

SBMB7010	3D PRINTING TECHNOLOGY AND ITS BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To provides opportunities for training and research in all aspects of 3D printing
- To educate the students in the development of high quality of printing technology to provide a satisfactory environment to the manufacturing sector
- To implement 3 D printing in health care industry for future betterment to the society

UNIT- I DIGITAL MANUFACTURING FOR 3D PRINTNG

9 Hrs

Introduction- Definition of 3D Printing, Terminologies, Types additive manufacturing operations- Stereolithography (SLA), Digital Light Processing (DLP), Fused Deposition Modeling (FDM), Selective laser sintering (SLS), Selective Laser Melting (SLM), Electron Beam Melting (EBM), Details of Laminated Object Manufacturing (LOM); Granular Materials Binding, 3D innovative printers and application.

UNIT II DIGITAL DESIGN FOR 3D PRINTING

9 Hrs.

Transferring prototyping to 3D printing, STL file for 3D printing, Rapid prototyping, Classification of 3D printing technologies, Design criteria, Design consideration, Types of fast filament fusion support, Top-Down support structures, designing for selective Laser Sintering, Designing for material Jetting, OBJ-VRML files, CAD-STL files, Rules for STL format.

UNIT III 3D PRINTING

9 Hrs.

Introduction, Development of physical goods, Nomenclature; milestones of 3D systems, Nontraditional manufacturing innovative technique, shorter lead time and design freedom, 3D printing possibilities, the digital model, CAD software- 3D scanners process, 3D printing pen, 3D printing geometry restrictions, STL file, Professional and home 3D printers, 3D printersimprovements, Phases of rapid prototyping to home fabrication.

UNIT IV ADDITIVE MANUFACTURING

9 Hrs.

Limited prototyping, Hazards of printing materials, 3D printing state and federal laws, Steps towards AM cybersecurity, 3D printing in forensic science, ethics and legality of 3D printing, Intricacy of 3D printing, Impact of 3D printing, 3D printing impact on global manufacturing, Revolutionizing mass manufacturing, Advance perception of additive manufacturing.

UNIT V 3D PRINTING IN HEALTH CARE

9 Hrs.

Bone reconstructive surgery, living tissues- Bioprinting 2D and 3D tissues Bioink components, Hydrogels for Bioprinting; Implants of printed organs- Human Ear, Kidneys artificial liver, Bioprinting skin, Bioprinting nerves, 3D printed ovaries, obstacles to bio printing organs, 3D Bio-Printing, 3D Printing for implant and medical device- Hearing Aid, sensor arm, Knee replacement, Aorta, dental implants, obstacles to bioprinting organs, 3D print future medical implants.

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

- CO1: Understands the basic principles of 3D printing.
- CO2: Outline the problem encountered during design for 3D printing.
- CO3: Recognize the importance and future scope of 3D printing and evolving.
- CO4: Demonstrate the types of additive manufacturing in 3D printing technology.
- CO5: Application of 3D printing in health care system.
- CO6: Identify the importance of 3D printing in health care systems.

TEXT BOOK / REFERENCE BOOK

1. Sabrie Soloman, 3D printing and design, Khanna Book Publishing Co., (P) Ltd., 2020.
2. Ad van Wijk and Iris van Wijk, 3D Printing with Biomaterials Towards a Sustainable and Circular Economy, Published by IOS Press, under the imprint Delft University Press. 2020.
3. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition. 2015.

4. Andreas Gebhardt, Julia Kessler and Laura Thurn, 3D Printing Understanding Additive Manufacturing, Second Edition, Science Direct, 2019.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions of 5 marks each – NO choice **30 Marks**

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

70 Marks



- Skill Development

SBMB7011	DEEP LEARNING FOR BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To gain knowledge on the concepts of deep learning
- To provide insight into recent CNN architectures and deep models
- To enable the students to know deep learning techniques to support real-time applications

UNIT-I FOUNDATION OF NEURAL NETWORKS AND DEEP LEARNING

9 Hrs

Neural Networks-Training neural networks, Activation Functions, Loss functions, Hyperparameters, Fundamentals of Deep Networks-Defining Deep Learning, Common Architectural Principles of Deep Networks, Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters.

UNIT-II CONVOLUTION NEURAL NETWORKS

9 Hrs

Architectural Overview – Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.

UNIT-III RECURRENT AND RECURSIVE NETS - SEQUENCE MODELLING

9 Hrs

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks

UNIT-IV AUTO ENCODERS AND DEEP GENERATIVE MODELS

9 Hrs

.Under complete Autoencoders – Regularized Autoencoders – stochastic Encoders and Decoders – Contractive Encoders. Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine - Generative Adversarial Networks.

UNIT-V RECENT TRENDS IN DEEP LEARNING

9 Hrs

Recent Models of Deep Learning, Genomics, Predictive Medicine, Clinical Imaging, Lip Reading, Visual Reasoning

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

- CO1: Ability to differentiate the concept of machine learning with deep learning techniques
 CO2: understand and visualize Convolutional Neural Network for real-world applications
 CO3: demonstrate the use of Recurrent Neural Networks and Transformer based for time series prediction
 CO4: Illustrate autoencoder and deep generative models to solve problems with high dimensional data
 CO5: design and develop an application-specific deep learning model
 CO6: Analyse the latest trends in deep learning

TEXT BOOK / REFERENCE BOOK

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Wei Di, AnuraghBharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
3. Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O Reilly Media, 2017.
4. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
5. SurajSawant. "Deep Learning", IGI Global, 2018.
6. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions of 5 marks each - No choice 30 Marks

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

70 Marks



- Skill Development

