INTRODUCTION TO EMBEDDED SYSTEMS	
ECE 421(a)	**Credits:3**
Instruction: 3 Periods & 1 Tut/week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Prerequisites: Nil

Course Outcomes:

By the end of the course, the student will be able to:	
1.	learn about the general principles of computer architecture
2.	learn about the working of a simple embedded system and embedded system applications
3.	learn the hardware aspects of embedded systems
4.	understand the sensors, ADCs and actuators used in embedded systems
5.	understand the real world examples of embedded systems

Mapping of Course Outcomes with Program Outcomes:

		PO											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO	**1**	2	-	-	-	-	-	-	-	-	-	-	1
	2	2	-	-	-	-	-	-	-	-	-	-	1
	3	2	-	-	-	-	-	-	-	-	-	-	1
	4	2	1	-	-	-	-	-	-	-	-	-	2
	5	3	2	-	-	-	-	-	-	-	-	-	2

SYLLABUS

UNIT I: **8 Periods**

Basics of computer architecture and the binary number system

Basics of computer architecture, computer languages, RISC and CISC architectures, number systems, number format conversions, computer arithmetic, units of memory capacity

UNIT II: **8 Periods**

Introduction to embedded systems

Application domain of embedded systems, desirable features and general characteristics of embedded systems, model of an embedded system, microprocessor Vs microcontroller, example of a simple embedded system, figure of merit for an embedded system, classification of MCUs: 4/8/16/32 bits, history of embedded systems, current trends

UNIT III: **10 Periods**

Embedded systems-The hardware point of view

Microcontroller unit(MCU), a popular 8-bit MCU, memory for embedded systems, low power design, pull up and pull down resistors

UNIT IV: **12 Periods**

Sensors, ADCs and Actuators

Sensors: Temperature Sensor, Light Sensor, Proximity/range Sensor; Analog to digital converters: ADC Interfacing; Actuators Displays, Motors, Opto couplers/Opto isolators, relays.

UNIT V: **12 Periods**

Examples of embedded systems

Mobile phone, automotive electronics, radio frequency identification (RFID), wireless sensor networks(WISENET), robotics, biomedical applications, brain machine interface

Text Books:

1. Lyla B Das, *Embedded systems: An Integrated Approach*, 1st Ed., Pearson, 2013

Reference Books:

1. Shibu, K.V., *Introduction to Embedded Systems*, 1st Ed., TMH, 2009
2. Kanta Rao B, *Embedded Systems*, 1st Ed., PHI
3. Frank Vahid & Tony Givargis, *Embedded System Design*, 2nd Edition, John Wiley,

INTRODUCTION TO INTERNET OF THINGS (IoT)	
ECE421(b)	**Credits:3**
Instruction: 4 Periods week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Prerequisites: Nil

COURSE OBJECTIVES

- Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value.
- Bring the IoT perspective in thinking and building solutions.
- Introduce the tools and techniques that enable IoT solution and Security aspects.

COURSE OUTCOMES

After undergoing the course, students will be able to	
1.	Describe internet of Things and its hardware and software components
2.	Interpret Design Principles for connected devices
3.	Interface I/O devices, sensors & communication modules
4.	Remotely monitor data and control devices
5.	Develop real life IoT based projects

SYLLABUS

UNIT I [10 Periods]

Overview of Internet of Things:

Internet of Things, IoT Conceptual Framework, IoT Architectural view, Technology Behind IoT, Source of IoT, M2M communication, Examples of IoT

UNIT II [10 Periods]

Design Principles for connected devices

Introduction, IoT/M2M systems layers and Design standardization, Communication technologies, Data enhancement, Data consolidation and Device management at Gateway, Ease of designing and affordability.

UNIT III [10 Periods]

Sensors, Participatory Sensing, RFIDs and Wireless Sensor Networks

Introduction, Sensor technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuators, Sensor Data Communication Protocols, RFID technology, WSN Technology.

UNIT IV [10 Periods]

Prototyping the Embedded Devices for IoT and M2M

Introduction, Embedded Computing basics, Embedded Platforms for prototyping, Things always connected to the Internet/Cloud.

UNIT V [10 periods]

IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Text Books:

1. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
2. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, “A Hands on Approach”, University Press.

2. Hakima Chaouchi, “ The Internet of Things Connecting Objects to the Web” ISBN : 978-1-84821-140-7, Willy Publications.

Open Elective-III

INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES

(Except EEE)

EEE 413	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Course Outcomes: At the end of the course the student will be able to:

CO	BL	CO Statement
CO1	BL-3	**Associate** with the history of hybrid vehicles and physics involved in the conventional vehicle movement to **Calculate** the total tractive force required for vehicle motion.
CO2	BL-3	**Classify** various types of hybrid vehicle configurations to **interpret** their compatibility in specific applications.
CO3	BL-4	**Identify** specific configuration of electric vehicle, electric drive machine and power converter as per the requirement to **Analyse** the performance of system design.
CO4	BL-3	**Distinguish** the features and suitability of energy storage devices to **Relate** them as per the requirement.

CO	Bloom's Level
CO1	Action Verb from Blooms Taxonomy-**Calculate**/ Cognitive level- Application (BL-3)
CO2	Action Verb from Blooms Taxonomy-**Interpret**/ Cognitive level- Application (BL-3)
CO3	Action Verb from Blooms Taxonomy-**Analyze**/Cognitive level- Analysis (BL-4)
CO4	Action Verb from Blooms Taxonomy-**Relate**/Cognitive level- Analysis (BL-3)

Program Matrix

COs	Program Outcomes (POs)												PSOs	
	Domain Specific POs					Domain Independent POs								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	-	-
CO3	2	3	2	-	2	-	-	-	-	-	-	1	-	2
CO4	2	3	1	-	2	-	-	-	-	-	-	1	-	1

SYLLABUS

UNIT-I [CO1] [BL3] [PI 1.4.1] [12 Periods]

INTRODUCTION OF CONVENTIONAL VEHICLES

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance

UNIT-II [CO1] [BL3] [PI 1.4.1] [12 Periods]

INTRODUCTION OF HYBRID AND ELECTRIC VEHICLES

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies

UNIT-III [CO2] [BL3] [PI 2.4.1] [12 Periods]

HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT-IV [CO3] [BL4] [PI 2.4.2] [10 Periods]

ELECTRIC DRIVE-TRAINS

Basic concept of electric traction, various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT-V [CO4] [BL3] [PI 12.4.1] [14 Periods]

ELECTRIC PROPULSION AND ENERGY STORAGE

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, configuration and control of Permanent Magnet Motor drives.

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Alternatives for energy storage, Hybridization of different energy storage devices.

TEXT BOOKS

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

INTRODUCTION TO DATA ANALYTICS	
Course Code:	**Credits: 3**
Instruction: 3 Periods /Week	**Sessional Marks: 40**
End Exam: 3 Hours	**End Exam Marks: 60**

Prerequisites:

- Basics on Probability and statistics.
- Fundaments of Python programming.

Course Objectives:

- To familiarize with basics data analytics and data analytics in Python.
- Equip the students with core statistical models and visualization techniques to perform exploratory data analysis using Python.
- Exploring the importance of analysis of variance implement in Python with different kinds of data sets.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Understand the basic principles of data analytics for performing basic data analysis on real world data
2.	Comprehend the data visualization types in Python for exploratory data analysis.
3.	Apply Simple Statistical Techniques for Univariate and Bivariate Analyses
4.	Demonstrate the nature and logic of the analysis of variance.
5.	Apply linear and multi linear regression models for various applications

CO-PO Mapping:

S. No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1	2	2			1			1				1	2	
CO 2	1	2		1	3	1		1				1	1	2
CO 3	2	1	1	1	3	2		1				1	2	1
CO 4	2	2	1	1	3							1	2	3
CO5	2	2	1	1	3	2						1		2

SYLLABUS

UNIT-1 **10 periods**

Introduction and Overview of Applied Statistics: How Statistical Inference Works, Statistics and Decision-Making, Data Analysis, Data Science, Machine Learning, Big Data. Building a Data frame in Python: Computing Some Statistical Functions, Loading Data into Python, Exploring Mathematics in Python, Statistical Analysis in Python.

UNIT-2

12 periods

Visualization and Linear Statistical Models: Visualization in Python- Aim for Simplicity and Clarity in Tables and Graphs, What Do the Numbers Tell Us? Clues to Substantive Theory, The Scatter plot, Correlograms, Histograms and Bar Graphs, Heatmaps, Line Charts.

UNIT-3 **12 periods**

Simple Statistical Techniques for Univariate and Bivariate Analyses: Pearson Product-Moment Correlation, Computing Correlation in Python, Binomial Test, Poisson distribution, The Chi-Squared Distribution.

UNIT-4 **10 periods**

Analysis of Variance (ANOVA): T-Tests for Means as a Special Case of ANOVA, Analysis of Variance (one-way classification), ANOVA in Python.

UNIT-5 **10 periods**

Simple and Multi Linear Regression: Regression, Why we use regression, Regression in Python, The Least-Squares Principle. Multi linear regression.

Text Book:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.
2. Research Methodology, C.R. Kothari, New Age International Publishers, Second Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

1. https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

BUILDING MATERIALS AND CONSTRUCTION

(For IV B.Tech. I Sem All except Civil Engineering students)

CIV 411 **Credits : 3**

Instruction : 3 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Prerequisite:

Nil

Course Objective:

1. Learn about various building materials that are used in construction
2. Learn about the various components of a building.
3. Understand about importance about construction.

Course Outcomes:

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

1. Learn about stone and bricks and its uses in Civil Engineering
2. Learn about timber and metals and its uses in Civil Engineering
3. Understand about various building components and Masonry .
4. Know about floors, roof, doors and windows.
5. Know about surface finishes and Understand about construction safety.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO	**1**	2												2		
	2	2												2		
	3	2												2		
	4	2												2		
	5	2												2		

SYLLABUS

UNIT – I 12 Periods

Stones: Quarrying & dressing of stones; Characteristics of good building stones, Common building stones, Uses in Civil Engineering.

Clay Bricks: Ingredients of good brick earth; Manufacture of bricks; Characteristics of good bricks; Classification of bricks; defects of bricks; Uses of bricks.

UNIT – II 12 Periods

Timber: Characteristics of good timber; defects in timber, Decay of timber, Seasoning and preservation, properties, uses of timber; Commercial forms of timber products in Civil Engineering.

Metals: Ferrous metals: Properties & uses of different types of iron; non-ferrous metals: Aluminium & Lead, properties, uses in civil engineering

UNIT – III 12 Periods

Residential Buildings : Different types of Residential Buildings Selection of Site for Residential Building, Components of building, bye-laws and regulations, Orientation of Buildings

Masonry: Definitions of terms used in masonry, Materials used, Stone masonry, Brick masonry, Different bonds used for brick masonry.

UNIT – IV 12 Periods

Floors and Roofs: Components of a floor, materials used for floor construction, Different types of flooring, Ground floor and upper floors, Types of roofs, Basic roofing elements and Roof coverings, Damp proof course

Doors and Windows: Location of roofs and windows, Definition of technical terms, Size of doors and windows, Door frames, Types of doors and windows, Ventilators, Fixtures and fastenings.

UNIT – V 12 Periods

Surface Finishes: Plastering - Pointing - Paints: Characteristics of good paint; Ingredients of oil-borne paint; Types of paints; Defects in painting;

Construction safety: safety in construction - general requirements - common hazards during excavation; common hazards during walling; roofing; additional safety requirements for erection of concrete framed structures - additional safety requirements for erection of structural steel work - general requirements; safety in demolition of buildings

REFERENCES

1. Rangwala, Engineering Materials, 41st Edition: 2014, Charotar Publishing House Pvt. Ltd.
2. The Text Book Of Building Construction by S.P. Arora, S.P. Bindra, Dhanpatrai Publications.
3. Building Construction by B.C. Punmia, Laxmi Publications (p) Ltd.

Note: As the subject is an Open elective taken by non-civil engineering students, the student is expected to gain only elementary knowledge of the subject.

PROJECT PLANNING & MANAGEMENT

(ForIVB.Tech.ISemAllBranches)

CIV 411 - OE **Credits: 3**

Instruction : 3 Lectures & 1 Tutorial / week Sessional Marks: 40

End Exam : 3 Hours End Exam Marks: 60

Course Objectives:

From this course students will learn the

1. Roles and responsibilities of a project manager
2. Importance of project management in civil engineering projects
3. Management of resources in construction project
4. Understand labour problems and legislation in India

Course Outcomes:

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

1. Prepare the schedule of actives and Estimate Project completion time by conventional techniques in a construction project
2. Estimate project completion time using various network techniques namely CPM and PERT
3. Analyse the project network for Optimization of cost, crash duration and assess for updating by considering project delays
4. Classify different types of contracts and able to identify the prerequisite of tendering process
5. Identify scientific management techniques and fundamentals of labour management

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO	**1**	3	3									3		3		
	2	3	3	2		3						3		3		
	3	3	3	2		3						3		3		
	4	3					2					3		2		
	5	3										2		2		

SYLLABUS

UNIT – I 12 Periods

Planning and Scheduling: Introduction, Project management,Steps involved in planning; Objectives; Principles; Advantages; Limitations; Stages of planning; Scheduling, Preparation of construction schedules; Methods of scheduling; Bar charts; Mile stone charts; Controlling; Job layout; Factors affecting job layout; Project work break down; Activities involved; Assessing activity duration.

Project Management Through Networks: Objectives of network techniques; Fundamentals of network analysis; Events; Activities; Dummies; Types of networks; Choice of network type; Advantages of network techniques over conventional techniques.

UNIT – II 12 Periods

Program Evaluation and Review Technique (PERT): Introduction; Time estimates; Earliest expected time; Latest allowable occurrence time; Slack; Critical path; Probability of completion time for a project.

Critical Path Method (CPM): Introduction; Difference between CPM and PERT; Earliest event time; Latest event time; Activity time; Float; Critical activities and critical path.

UNIT – III 10 Periods

Cost analysis: Direct and indirect costs, operation time, Normal and crash points, optimising project cost, crash limit, Free float limit, Optimisation.
Updating – Process of updating; when to update

Resource scheduling – Resource smoothening, Resource levelling, circle notation and arrow notation.

UNIT – IV 10 Periods

Contracts: Definition, Conditions of contract, Contract document, Piece work Agreement form, work order; Types of contracts – Lumpsum contract; Lumpsum and schedule contract, Item rate contract, sub-contracts, joint ventures. Contract system with tenders – Definitions –Contractor, Quotation, Earnest money, Security money, Tender, Tender notice, Tender form.

UNIT – V 12 Periods

Management – Scope of the Construction Management, Significance of Construction management, Concept of Scientific Management, Qualities of Manager.
Organisation – Authority, Policy, Recruitment process and Training Development of Personnel Department, Labour problems, Labour legislation in India.

TEXT BOOKS

1. Punmia. B.C. and Khandelwal, K.K. (2016) "Project Planning and Control with PERT and CPM ", Laxmi Publications Ltd., New Delhi, 4th Edition.
2. Sengupta. B, Guha. H (2004), "Construction Management and Planning"; Tata McGraw Hill Publishing Company Ltd., New Delhi. 1st Edition

ROBOTICS								
Code	Category	Periods			Sessional Marks	End Exam Marks	Total Marks	Credits
		L	T	P				
MEC 411(B)	OE	2	1	0	40	60	100	3

Prerequisite: Basic Engineering Mathematics, Kinematics of Machinery, Basic Electrical and electronics engineering

Course Objectives: The objective of this course is to impart knowledge about robots for their control and design in various industrial and general applications .

Course Outcomes: At the end of the course the student will be able to:	
CO-1	Develop a deep understanding of robotics, including its history, components, workspaces, robot types, end effector functions, and principles of actuation and drive systems.
CO-2	Apply kinematics, DH parameters, obstacle-aware trajectory planning, and control systems for accurate, adaptable, and safe robot motion.
CO-3	Describe various sensors, feedback systems and image processing techniques in robot.
CO-4	Apply programming languages to develop robotic systems and control their behavior.
CO-5	Comprehend AI and ML concepts in robotics: intelligent behavior, practical applications, perception, decision-making, adaptability.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	1							2	2		2
CO-2	3	3	2						2	2		2
CO-3	2								2	2		2
CO-4	3	2	2		2				2	2		2
CO-5	2	2							2	2		2

Course Outcomes	PSO1	PSO2
CO-1		
CO-2	3	
CO-3		
CO-4	2	2
CO-5	2	

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS	
UNIT - I	**Periods: 6L+3T=8**
Basics of Robotics	
Definition and scope of robotics, Historical overview of robotics, Overview of robotic systems and components, Robot workspaces and configurations, Types of industrial robots and their applications, End effectors and grippers for different tasks. Actuation and drive systems in robot. (For Internal Evaluation) Introduction to Robot Analyzer Software	
UNIT - II	**Periods: 8L+4T=13**
Kinematics, Dynamics, and Control of Robot	
Robot joint types and mechanisms, Forward kinematics and inverse kinematics, Denavit Hartenberg (DH) parameters, Trajectory planning and path generation for robot motion and control. PID control, adaptive control, Force control and control compliance in robotic systems. (For Internal Evaluation) Perform the Forward kinematics of a 2-DOF planar robot, 3-DOF anthropomorphic arm & a 3-DOF wrist and KUKA KR5 Arc Robot.	
UNIT - III	**Periods: 6L+3T=9**
Sensors and Computer Vision in Robot	
Feedback System: Open and closed loop feedback systems. Robot sensor types and principles. Sensor types and characteristics (Range, proximity, vision, force and torque), Sensor fusion and filtering techniques. **Computer Vision in Robotics:** Image processing and feature extraction, Object detection, tracking, and recognition, Visual servoing and robot vision applications. (For Internal Evaluation) Creating Robot Joint Trajectories	
UNIT - IV	**Periods: 6L+3T=9**
Robotic Programming and simulation	
Programming languages for robotics (e.g., C++, Python, ROS), Robot operating systems (ROS) and middleware, Behavior-based programming and robot architectures, Robot simulation and visualization tools. (For Internal Evaluation) Programming of Mobile Robot	
UNIT - V	**Periods: 6L+3T=9**

AI Powered Robotics	
AI and Machine Learning for Robotics: Reinforcement learning for robot control, Deep learning in perception and decision-making, **Advanced Topics in Robotics**: Human-robot interaction and collaboration, Mobile robots and navigation, Swarm robotics and multi-robot systems. (For Internal Evaluation) Case study on AI robot.	
TEXT BOOKS:	
1.	Groover M P ,*Industrial Robotics*, Pearson Edu.
2.	Mittal R K & Nagrath I J , *Robotics and Control*, TMH.
3.	Asada and Slow time, *Robot Analysis and Intelligence*, Wiley Inter-Science.
4.	Francis X. Govers, *Artificial Intelligence for Robotics: Build intelligent robots that*
5.	Peter Norvig & Stuart Russell, *Artificial Intelligence: A Modern Approach*,
6.	Kevin Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 201
REFERENCE BOOKS:	
1.	Fu K S, *Robotics*, McGraw Hill.
2.	Robert J. Schilling, *Fundamentals of Robotics Analysis and Control*, PHI Learning,
3.	Rich and Knight, *Artificial Intelligence*, 3rd Edition, Tata McGraw Hill, 2014.
4.	Groover, *Industrial Robotics, Technology, Programming and Applications,* Tata
WEB RESOURCES:	
1.	http://ecoursesonline.iasri.res.in/course/view.php?id=82
2.	https://www.robotplatform.com/knowledge/sensors/types_of_robot_sensors.html
3.	https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_robotics.ht
4.	https://www.iiitdmj.ac.in/ict.iiitdmj.ac.in/summer-courses-2020/R-AI/
5.	https://ocw.snu.ac.kr/sites/default/files/NOTE/Chap12_Robot%20programming%20lan
6.	https://www.plyrotech.com/blog/artificial-intelligence-machine-learning-and-

Introduction to Deep Learning	
Code: 411(B)	**Credits: 3**
Instruction: 3 Periods/week	**Sessional Marks: 40**
End Exam: 3 Hours	**End Exam Marks: 60**

Pre-requisites: Linear Algebra, Calculus, Statistics, General Programming Concepts

Course Objectives:

- Explore the concepts of neural networks and deep learning
- Examine the usage of neural networks
- Describe the data needs of deep learning
- Apply the working knowledge of neural networks and deep learning
- Explore the parameters for different neural networks

Course Outcomes (CO):

By the end of the course, the student will be able to:	
1	Compare the Artificial Neural Network & Biological Neural Network and identify the need for Activation functions.
2	Identify the need of functional units and differentiate Feed Forward Neural Network and Feedback Neural Network
3	Demonstrate the concept of Deep Neural Network and Analyze the optimization & regularization of Deep Neural Network
4	Identify the need for convolutional neural network and Examine the Various Architectures of Convolution Neural Network
5	Examine the Various Architectures of Recurrent Neural Networks

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	-	-	-	-	-	-	-	3	-	-	-	3
2	3	3	3	-	-	-	-	-	3	3	-	-	-	3
3	3	3	3	-	-	-	-	-	3	3	-	-	-	3
4	3	3	3	3	3	-	-	-	3	3	3	3	-	3
5	3	3	3	3	3	-	-	-	3	3	3	3	-	3

SYLLABUS

UNIT-I: 10 Periods

Introduction:

Characteristics of Neural Networks: Features of Biological Neural Networks, Biological Neural Networks, Comparison of Artificial Neural Network and Biological Neural Network, Historical Development of Neural Network Principles.

Artificial Neural Networks: Terminology, Models of Neuron, Basic Learning Laws, Applications of ANN, Pros and Cons of ANN, Activation Functions: Binary Step Function, Linear Activation, Non Linear Activation Functions.

Learning Outcomes: At the end of this unit, Student will be able to

- Describe the concepts of neural networks.
- Apply activation functions for different scenarios.

UNIT-II: 10 Periods

Functional Units of ANN for Pattern Recognition Tasks: Pattern Recognition Problem, Basic Functional Units.

Feed forward Neural Networks: Pattern Classification Network: Perceptron, Linear Inseparability: Hard Problems, Multilayer Feed forward neural network: Generalized Delta Rule- Back propagation learning

Feedback Neural Networks: Analysis of Linear Auto associative FF Networks, Hetero-Associative Neural Network, Hopfield Network, Bidirectional Associative Neural Models (BAM).

Learning Outcomes: At the end of this Unit the student will be able to:

- Identify the need of Functional Units for Pattern Recognition Tasks.
- Explore the concepts of Feedforward and Feedback Neural Network.

UNIT-III: 10 Periods

Deep neural networks (DNNs): Perspectives and Issues of Deep Learning, Difficulty of training DNNs, Greedy layer wise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization)

Learning Outcomes: At the end of this Unit the student will be able to:

- Describe the concepts of Deep Neural Networks
- Analyze the optimization and regularization methods of neural networks

UNIT-IV: 10 Periods

Convolution Neural Networks: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Inputs and Outputs Channels, Pooling, Different Deep Convolutional Neural Network Architectures-LeNet, VGG

.**Learning Outcomes**: At the end of this Unit the student will be able to:

- Describe the basic structure of convolutional neural network.
- Analyze the Different CNN Architectures

UNIT-V: **10 Periods**

Recurrent Neural Networks:

Sequence Models, RNN, Back propagation Through Time.

Modern Recurrent Neural Network: GRU, LSTM, Bidirectional RNN, Encoder-Decoder Learning,

Generative Models: Boltzmann Machine, Restricted Boltzmann Machine, Generative Adversarial Network

Learning Outcomes: At the end of this Unit the student will be able to:

- Describe the architecture of recurrent neural network.
- Explore the concepts of Generative Models

TEXTBOOKS:

1. Yegnanarayana, B., "Artificial Neural Networks" PHI Learning Pvt. Ltd, 2009.(UNIT-I, UNIT-II)
2. Goodfellow, I., Bengio,Y., and Courville, A., "Deep Learning", MIT Press, 2016.(UNIT-III)
3. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", 2021(UNIT-IV,UNIT-V)

REFERENCE BOOKS:

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, 2004.
2. Simon Haykin, "Neural Networks-A comprehensive Foundation" Second edition(UNIT-I)
3. Charu C. Aggarwal, "Neural Networks and Deep Learning-A Textbook", Springer, 2018.

Fundamentals of IoT

Code:411(A)	**Credits: 3**
Instruction: 3 Periods/week	**Sessional Marks: 40**
EndExam:3 Hours	**EndExam Marks:60**

CourseOutcomes (CO):

Bythe end of thecourse,thestudent will be able to:	
1	Develop a comprehensive understanding of the Internet of Things (IOT) ecosystem, including its definition, characteristics, and the various components involved.
2	Examine various sensors and hardware components commonly used in IOT applications, as well as the protocols required for efficient communication and data management in IOT systems
3	Develop a comprehensive understanding of data analytics techniques and tools specific to IoT, including machine learning, big data analytics, edge streaming analytics, network analytics, and securing IoT data.
4	Acquire a deep understanding of IoT cloud platforms and their role in data collection, storage, and computing for IoT applications/services, along with the knowledge of cloud service models and IoT cloud-based services using platforms like Xively (Pachube/COSM) and Nimbits.
5	Develop a comprehensive understanding of various IoT applications through the analysis of real-world case studies in domains such as Smart City, Smart Water, Smart Agriculture, Smart Energy, Smart Healthcare, Smart Transportation, Smart Retail, and Smart Waste Management.

MappingofCourseOutcomeswithProgramOutcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		3			3	3		3	3		3		3
2	3		3		3				3			3		3
3	3	3	3	3	3	3			3	3	3	3		3
4	3		3	3		3	3			3	3			3
5	3	3	3	3		3	3			3	3	3		3

SYLLABUS

Unit 1

Introduction to loT -loT definition - Characteristics - Things in loT - loT Complete Architectural Stack - loT enabling Technologies - loT Challenges - loT Levels

IoT Physical Devices –Micro Controllers :

Arduino UNO: Introduction to Arduino, Installation, Fundamentals of Arduino Programming.
ESP8266: Introduction, Installation, Python Programming with ESP8266 using sensors.
Raspberry Pi: Introduction, Hardware and Software Layout, Configuration, Basic Raspberry Pi Programming with Python.

Unit 2

Sensors and Hardware for loT- Accelerometer, Proximity Sensor, lR sensor, Gas Sensor, Temperature Sensor, Chemical Sensor, Motion Detection Sensor.

Protocols for loT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (WiFi, LiFi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage.

Unit 3

Data and Analytics for IoT-An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT.

Unit 4

IoT Cloud Platform: Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/Services, Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits.

Unit 5

Case studies with architectural analysis:loT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail -Smart waste management.

Text books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743) .

2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)

3. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

4. Bahga A, Madisetti V. Internet of Things: A hands-on approach; 2014.

Data Visualization Analytics using Open Source Tools	
Code:411(C)	**Credits: 3**
Instruction: 3 Periods/week	**Sessional Marks: 40**
EndExam:3 Hours	**EndExam Marks:60**

CourseOutcomes (CO):

Bythe end of thecourse,thestudent will be able to:	
1	Develop a foundational understanding of data and statistics, including the types of data, data preprocessing techniques, similarity and dissimilarity measures, inferential statistics, and probability distributions.
2	Apply data wrangling techniques and tools, including the importance of data cleanup, formatting, handling outliers and duplicates, and normalizing and standardizing data.
3	Develop proficiency in using NumPy and Pandas libraries for efficient data manipulation and analysis.
4	Demonstrate proficiency in using Matplotlib and Seaborn libraries to create a wide range of data visualizations, including line plots, scatter plots, bar plots, box plots, histograms, pie charts, and subplots.
5	Demonstrate the ability to build effective data visualizations using a variety of 2D and 3D plots, including crosstab, scatter plot, bubble chart, bullet graph, box plot, tree map/heat map, bump chart, Gantt chart, histograms, motion charts, waterfall charts, waffle charts, and geospatial data using choropleth maps.

MappingofCourseOutcomeswithProgramOutcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	3	3	3	3			3		3	3		3
2	2	3	3	3	3	3			3		3	3		3
3	2	3	3	3	3	3			3		3	3		3
4	2	3	3	3	3	3			3		3	3		3
5	2	3	3	3	3	3			3		3	3		3

SYLLABUS

Unit-1

Introduction to Data: Data vs Information, Types of Data, Data preprocessing, Similarity and Dissimilarity measures

Introduction to Statistics: Difference between inferential statistics and descriptive statistics, Inferential Statistics- Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions

Unit-2

Data Wrangling: Introduction, Need of data cleanup, data clean up basics.

Tasks of Data Wrangling: Data wrangling tools with – formatting, outliers, duplicates, Normalizing and standardizing data. Importance of analytics and visualization in the era of data abundance.

Unit-3

Numpy : Creating ndarray, data types, array attributes, indexing,slicing.

Pandas : Series, data frame, how to read write CSV and Excel files, indexing, adding columns, aggregations, handling missing data, groupby and merging.

Unit-4

Matplotlib: working with axes, working with legends, line plot,scatter plot, bar plot, box plot, histogram, pie chart and subplots.

Introduction to Seaborn: using seaborn with matplotlib, customizing seaborn plots, color palette, multiple plots.

Unit-5

Data visualization using 2D & 3D plots: Crosstab, scatter plot, bubble chart ,bullet graph, box plot,tree map/heat map ,bump chart, Ganttchart histograms, motion charts ,waterfall charts, waffle charts, geospatial data using choropleth maps.

To demonstrate building a dashboard with tables and charts for any business applications

Text books:

1. Introduction to Data mining by Vipinkumar
2. AshutoshNandeshwar, Tableau Data Visualization Cookbook, 1e, Packt Publishing.
3. Introduction to statistics by PkGiri and Banerjee, Acaemic publishers
4. Python for Data Analysis by Wes McKinney, 2nd Edition, O'REILLY

Reference books:

1. Fabio Nelli, Python Data Analytics, 1e, A Press.
2. Data Wrangling with Python: Tips and Tools to Make Your Life Easier, Jacqueline Kazil and Katharine Jarmul, O'Reilly
3. Interactive Data Visualization: Foundations, Techniques, and Applications, Ward, Grinstein Keim, Natick A. K. Peters Ltd.

Open Elective-II

Bioinformatics

Course Code – Category: CHE 321 (B) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Basic Biology, Basic knowledge in computer programming

Course Objectives:

- Use of computational tools to understand the biological data
- Understand the design of novel drugs using computational tools
- To predict new sequences using the existing sequences in databases
- Student will be able to know the various sources of information

Course Outcomes:

By the end of the course, student will be able to

1. Apply the basics of bioinformatics.
2. Identify the types of databases and retrieve the protein sequence.
3. Apply aligning methods to analyze biological data.
4. Identify different strategy to predict biomolecules
5. Design novel drugs

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
	2														
	3														
	4														
	5														

SYLLABUS

UNIT I **9L + 3T**

History, Scope and Importance:

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics- HTML - introduction to NCBI data model- various file formats for biological sequences

Learning Outcomes:

At the end of this unit, student will be able to

- Tasks of bioinformatics.
- Apply the internet basics to retrieve data.

UNIT II **9L + 3T**

Databases -Tools and Their Uses:

Importance of databases - Biological databases-primary sequence databases- composite sequence databases- secondary databases- nucleic acid sequence databases - protein sequence data bases - structure databases - bibliographic databases - specialized genomic resources- analysis packages

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the biological databases.
- Apply the analysis packages

UNIT III **9L + 3T**

Sequence Alignment Methods:

Sequence analysis of biological data-significance of sequence alignment- pairwise sequence alignment methods- use of scoring matrices and gap penalties in sequence alignments- multiple sequence alignment methods - tools and application of multiple sequence alignment.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply pair wise sequence alignment methods
- Apply multiple sequence alignment methods

UNIT IV **9L + 3T**

Predictive Methods Using DNA and Protein Sequences:

Gene predictions strategies - protein prediction strategies - molecular visualization tools- phylogenetic analysis: concept of trees- phylogenetic trees and multiple alignments..

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the different strategies to predict DNA.
- Apply phylogenetic analysis.

UNIT V **9L + 3T**

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify and optimize the lead compound.
- Apply chemical libraries.

Text books:

1. T K Attwood, D J parry-Smith, *Introduction to Bioinformatics*, Pearson Education, 1st Edition, 11th Reprint 2005.
2. S.C. Rastogi, *Bioinformatics- Concepts, Skills, and Applications*, CBS Publishing, 2003.

Reference Books:

1. David W.Mount, *Bioinformatics sequence and genome analysis*", Cold spring harbor laboratory press, 2004.
2. S. Ignacimuthu, S.J., *Basic Bioinformatics*, Narosa Publishing House, 1995.

CHARACTERIZATION OF MATERIALS	
CHY 311 (B)	**Credits: 3**
Instruction: 3 periods & 1 tutorial/week	**Sessional marks: 40**
End exam: 3 Hours	**End exam marks: 60**

Course relevance

The content of this course gives knowledge and understanding over Nano & bulk materials used in various engineering& industrial applications.

Target group: Chemical Engineering, Mechanical Engineering, Electrical and Electronics Engineering, Electronics and Communication Engineering.
Prerequisites: Basics of chemistry and physics.
Course Objectives

- To provide basic knowledge on synthesis and fabrication of materials.
- To understand the surface characteristics of materials.
- To create awareness on morphology of materials by electron microscopy.
- To understand the principles of X-ray diffraction.
- To acquire knowledge on thermal studies of materials.

Course outcomes

By the end of the course, student will be able to:	
1	Select an appropriate method of synthesis based on the basic knowledge about synthesis of material.
2	Apply the suitable adsorption isotherms to determine the surface area, pore size and pore volume of materials.
3	Analyze the surface morphology of the samples from SEM and TEM images.
4	Interpret the XRD patterns for phase identification, lattice parameter and crystallite size determination.
5	Understand the principle of thermo gravimetric analysis, Differential scanning calorimetry and its applications.

SYLLABUS

Unit-I Introduction to material synthesis and fabrication **14** Periods

Synthesis of bulk phase materials-Solid state reaction route, introduction to precipitation & co-precipitation, sol-gel technique, hydrothermal; Semi Conducting materials – Stoichiometric GaAs, Non-Stoichiometric- ZnO and Hopping Semi Conductors-CdSe; Conducting polymers-polyacetylene.
Synthesis of nanoparticles-Bottom-Up approach- thin film growth by physical vapour deposition and chemical vapour deposition; Top-down approach- ball milling, Microfabrication-lithography- UV, electron beam and ion beam lithography; Energy applications of Nano metal oxides-cells

Unit-II Surface characterization **8** Periods

Adsorption - types of adsorption; adsorption isotherms-Langmuir, Freundlich, BET, Polyani's theory of adsorption.

Surface area determination from BET equation, Adsorption on porous solids; Pore size distribution- adsorption and mercury porosimetry.

Unit-III Electron microscopy **10** Periods

Introduction to Electron Microscopy - electron beam specimen interaction; Scanning Electron Microscopy (SEM) – instrumentation, specimen preparation, image interpretation and applications.

Transmission Electron Microscopy (TEM) – instrumentation, specimen preparation, image modes- intensity contrast, diffraction contrast, phase contrast and applications; Scanning Transmission Electron Microscopy (STEM) - image interpretation and applications.

Unit-IV X-ray diffraction **8** Periods

X-rays generation; crystal lattice, diffraction-Brags equation; X-ray diffractometer – instrumentation; Small and Wide angle X-ray diffraction.

Applications of Powder X-Ray Diffraction (PXRD)-identification of phases, crystallite size determination, intercalation in compounds; Quantitative X-ray diffraction-quantification of clay minerals.

Unit-V Thermal analysis **10** Periods

Introduction to thermal methods of analysis, Thermogravimetry- instrumentation, factors influencing TG, applications of TG.

Differential thermal analysis (DTA), block diagram of DTA apparatus, applications of DTA; Differential scanning Calorimetry- instrumentation and applications.

Prescribed Books

1. Nano science and Nanotechnology : fundamentals to frontiers by M.S. Ramachandra Rao, Shubra Singh, Wiley publications, 2014
2. Heterogeneous catalysis by D.K.Chakrabarthy, B.Viswanathan, New age international publishers, first edition 2008
3. Catalysis by John R. Anderson and Michel Boudart, Vol.7, published by Springer-Verlag, Berlin Heidelberg 1985 (for Unit III)
4. Engineering Chemistry by P.C.Jain and M.Jain, Dhanpat Rai publishing company (P) LTD. (for Unit V)
5. Hand book of Heterogeneous Catalysis, G.Ertl, H.Knowinger, F.Schuth, J.Weitkamph, second edition, Vol.1, Wiley-VCH.

Reference Books

1. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, by Yang Leng, John Wiley & Sons, 2013.
2. Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar, CRC press 2008.
3. Synthesis and Characterization of Advanced Materials, Michael A. Serio, Dieter M. Gruen, Ripudaman Malhotra, ACS publications, 1997.
4. Solid state Chemistry and its applications, Anthony R.West, Wiley India, New Delhi 2014.

PHYSICAL AND ANALYTICAL CHEMISTRY
(For Chemical Engineering)

Course Code - Category: CHE 123 - BS **Credits:3**

L	T	P	E	O
3	0	0	1	5

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives

- To understand the concept of Homogenous and heterogeneous chemical equilibriumwith its importance in industrial process.
- To get an idea about the Surface chemistry and its characterization.
- To give a knowledge on basic quantitative techniques of Titrimetry and Gravimetry.
- To inculcate the concept of various Electro-analytical techniques.
- To give an awareness on various Separation techniques.

Course Outcomes

By the end of the semester, the student will be able to:	
CO1	**Apply** the Homgeneous and heterogeneous Chemical equilibria laws in various systems and **Develop** Optimum conditions for these systems in Industrial Processes
CO2	**Familarize** in the concepts of surface characterisation by using X-Ray difraction and stabilization of colloids and nanomaterials.
CO3	Get **Knowledge** on the Quantitative determination of various samples either by using Titrimetry or gravimetry with least error.
CO4	Get adept in **Computing** pH, Potential and conductance by electro analytical methods
CO5	Separate impurities by **Applying** Solvent extraction and Gas chromotagraphy Techniques

SYLLABUS

UNIT- 1
12 periods

Chemical Equilibrium: Reversible and irreversible reactions, concept of equilibrium, Law of Mass action, Equilibrium constant, Factors influencing equilibrium constant, apply law of mass action tohomogeneous gaseous and liquid systems, Le-Chatelier principle- applications, Effect of temperature on equilibrium constant -derivation

Phase rule: Definition- explanation of terms- Derivation of Phase Rule- One component system (water system)- Two component system (Ag-Pb), Eutectic mixture- its significance.

Learning Outcomes:

At the end of the unit the student will be able to

- **list** the differences between Reversible and Irreversible reactions (L1)
- **Apply** the law of Mass action to different homogeneous and heterogeneous systems (L2)
- **State** Le- chatlier principle(L1)
- **Develop** Optimum conditions for few Industrial process reactions(L5)

UNIT- II **10 periods**

Surface Chemistry: Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, method of preparation of nanomaterialsby Chemical Vapour deposition methods, stabilization of colloids and nanomaterials by stabilizing agents.

Characterization of surfaces - X-ray diffraction- Principle & Instrumentation; Adsorption- B.E.T equation (no derivation), Surface area- importance and Determination by B.E.T method, Applications of colloids and nanomaterials.

Learning Outcomes:

At the end of the unit the student will be able to

- **Illustrate** the role of an stabilizing agents in stabilization of colloids and nano material (L2)
- **Explain** the principles and instrumentation of X – Ray Diffrection (L2)
- **Apply** BET equation in measuring surface area(L3)

UNIT- III
10 periods

Introduction to Chemical analysis –Quantitative analysis, classification of errors- accuracy, precission- minimization of errors; Titrimetric Analysis,

Classification of reactions in titrimetric analysis- Standard solutions- Primary and Secondary standards, Theory of Indicators(Acid Base, Redox, Complexometric & precipitation Titrations); Gravimetric analysis- process of precipitation, contamination of precipitates (co-precipitation & post precipitaion)

Learning Outcomes:

At the end of the unit the student will be able to

- **Describe** different ways of minimization of errors(L2)
- **Explain** the theories behind different types of indicators (L2)
- **Analyse** the amount of Nickel present in the given sample(L4)

UNIT- IV

10periods

Electro- analytical Methods : Potentiometry- introduction, instrumentation and potentiometric titration (Redox); introduction to pH, determination of pH, pH metric titrations. Conductometry- conductance and types of conductance, Conductmetric Titrations (Acid-base) **,** variation of conductance with temperature, Kohlrausch's law and applications- calculation of equivalent conductance and degree of dissociation of weak electrolytes.

Learning Outcomes:

At the end of the unit the student will be able to

- **Define** electrode potential (L1)
- **Explain** the Instrumentation of Potentiometry(L2)
- **Compute** the strength of Acids and basesby pH meter (L3)
- **Apply** the Kohlrausch's law in measurement of equivalent conductance of weak electrolytes (L4)

UNIT- V
10 periods

Basics of Industrial SeparationTechniques:
Distribution law- partition coefficient, Solvent extraction -multiple extractions; Chromotography- principle, RF value, resolution and retention time, types of chromotogaphy- Thin layer and gas chromotography- instrumentation.

Learning Outcomes:

At the end of ths unit the student will be able to

- **State** Distribution Law (L1)
- **Explain** the efficiency of multiple extractions (L2)
- **Separate** impurities from an analyte using Gas chromatography (L4)

Prescribed text books

1. **Arun Bhal, B.S.Bhal and G.D.Thuli** "*Essentials of Physical chemistry*" S.Chand and company ltd. 2009.
2. **Chatwal and Anand**; "*Instrumental Methods of Chemical Analysis*" 5th edition, Himalaya Publishing Company.

Reference books

1. **Peter Atkins & Julio de Paula** "*Physical Chemistry*" 7th edition, oxford university
2. **B.R.Puri and L.R.Sharma** "*Principles of Physical Chemistry*", 44th edition press vishal publishing company, New Delhi.
3. **Vogel** "*Text book of Quantitative Chemical Analysis*" 6th edition, Pearson, 2014.

OPEN ELECTIVES – DEPARTMENT OF ENGLISH

Psychology of Learning

PAPER – I

UNIT – 1 Introduction:

a) Introduction to Psychology of Learning
b) Theories and Applications
c) Behavioral and Cognitive Theories by Bruner, Gagne
d) Constrictive Theories – Piaget, Vygotsky

UNIT – 2 Motivation Theories

a) Maslow's Need Hierarchy theory
b) Achievement Motivation and Goal Orientation
c) Prominent theories of motivation
d) Sustainable learning habits of mind

UNIT – 3 Memory & Cognition

a) Information processing model of memory
b) Sensory memory, working memory, long-term memory
c) Cognitive load and meta-cognition
d) Critical and reflective thinking, problem solving

UNIT – 4 Inclusive Education

a) Advantages of inclusive Education
b) Transformation of learning
c) Engaging emotions – Simulated learning
d) Critical pedagogy

UNIT – 5 Experiential and Multimedia Learning

a) Theoretical Foundations of EL and Methodologies
b) Virtual, online, hybrid, blended, mobile learning
c) Project-based, problem-based, game-based learning
d) Cyber-physical-social and contemplative learning

PAPER – II

TECHNICAL ENGLISH AND RESEARCH PAPER WRITING

UNIT – 1 Writing Reports and Letters

a) Report writing – External, informational, formal reports
b) Business letters – Inquiry, order, refusal, acceptance
c) Making quotation, claims and settlement
d) Follow up or cancelation

UNIT – 2 Note making and note taking, Minutes report

a) Outlining method and mapping method
b) Sentence, Cornell and Charting method
c) Writing minutes report before, after, during meeting
d) Action and discussion minutes

UNIT – 3 Writing circulars, notices, and memos

a) Internal and external circulars
b) Formal, informal and initiation notices
c) Response memo, meeting minutes memo
d) Status memo and field report memo

UNIT – 4 Abstract writing and introduction to research methodologies

a) Writing abstracts to different fields
b) Qualitative and quantitative research
c) Case studies and survey research
d) Referencing, academic integrity, plagiarism

UNIT – 5 Technical presentation and Visume

a) Preparing technical ppt
b) Interpretation, evaluation and presentation
c) Data collection and visual presentation
d) Visume – a visual resume

PAPER – 3

CRITICAL THINKING SKILLS

UNIT – 1 Introduction to Critical Thinking

a) What is critical thinking?
b) Critical thinking standards
c) Critical thinking: benefits and barriers
d) Characteristics of a critical thinker

UNIT – 2 Recognizing Arguments

a) What is an argument?
b) Identifying premises and conclusion
c) Deductive and inductive arguments
d) Deductive validity and inductive strength

UNIT – 3 Logical Fallacies and Analyzing arguments

a) The concept of relevance
b) Fallacies of relevance
c) Analytical skills
d) Innovative ideas and creativity

UNIT – 4 Analyzing and evaluating arguments

a) Diagramming short arguments
b) Summarizing longer arguments
c) Source of information
d) Evaluating sources of information

UNIT – 5 Writing an argumentative essay

a) Before writing contemplation
b) Writing the first draft
c) After the first draft
d) Implementation of ideas