Ph.D. Programme Manual

Doctor of Philosophy Programme

(Ph.D.)

PPSU

P P SAVANI UNIVERSITY

Effective From: Academic Year 2017-18

Authored by: P P Savani University

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CONTENT

P P SAVANI UNIVERSITY															
SCHOOL OF ENGINEERING															
TEACHING & EXAMINATION SCHEME FOR DOCTORAL PROGRAMME															
Year	Sem	Course Code	Course Title	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
I	I	SEDP9010	Research Methodology	4	-	-	4	4	40	60	-	-	-	-	100
I	I	SSCH9010	Polymer Chemistry	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSCH9020	Organic Spectroscopy	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSCH9030	Microscopy Techniques	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SECE9010	Machine Learning	4	-	-	4	4	40	60	-	-	-	-	100
I	II	SECE9020	Blockchain Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECE9030	Internet of Things	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SEDP9020	Research Writing	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLMG9010	General Management	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLMG9020	Business Statistics for Contemporary Decision	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SPPT9010	Managing your Health: The Role of Physiotherapy & Exercise	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SPPT9020	Ethics Review of Health Research	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SSMB9010	Bioprocess and Fermentation Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9020	Enzyme Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9030	Advanced Bioinstrumentation Techniques	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SSBT9010	Advances Techniques in Molecular Biology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSBT9020	Advances in Plant Microbe Interaction	4	-	-	4	4	100	-	-	-	-	-	100

I	II	SSBT9030	Advance Techniques in Proteomics	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SLEN9010	The History of the English Language	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLEN9020	Sociolinguistics	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLEN9030	Introduction to Literary Theory	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SNNR9010	Nursing Leadership	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SNNR9020	Principles of Management	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SLCS9010	Psychodermatology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLCS9020	Cognitive Behaviour Therapy	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLCS9030	Advanced Counselling Skills	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SECE9040	Programming with Python	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECE9050	Natural Language Processing	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECE9060	Machine Learning & Deep Learning	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SECV9010	Concrete Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECV9020	Advances in Concrete Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECV9030	Sustainable Advances in Civil Engineering Exploring	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSBT9040	Principles of Genetic Engineering	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSCH9040	Organic Reaction & Mechanism	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9040	Bacterial Physiology and Communication	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9050	Basic Calculation in Biology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9060	Analytical and Instrumentation Techniques	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLEN9040	Introduction to Literary Criticism	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLEN9050	Introduction to Translation Studies	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SLCS9040	Advanced Tools in Psychological Research	4	-	-	4	4	100	-	-	-	-	-	100

I	II	SLCS9050	Indigenous Psychology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSBT9050	Microbial Physiology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSBT9060	Molecular Biology & RDNA Technology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9070	Bioanalytical Techniques	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9080	Biostatistics, Bioinformatics and Analytical Calculations	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSMB9090	Environment Microbiology	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECV9040	Sustainable & Durable Green Concrete	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSBT9080	Genomics: Decoding Universal Language of Life	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SECE9070	Python for Research	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSCH9050	Experimental Techniques in Chemistry	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SSCH9060	Concepts in Chemistry	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SHHM9010	Organon of Medicine	4	-	-	4	4	100	-	-	-	-	-	100
I	II	SHHM9020	Philosophy of Homeopathy	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SECV9050	Performance Based design of Buildings	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SEME9010	Fundamentals of Surface Engineering	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SEME9020	Introduction to Tribology Engineering	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SSPY9010	General Experimental Techniques in Physics	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SSPY9020	Fundamentals of Physics	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SAAR9010	Smart Cities	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SAAR9020	Urban Design & Planning	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SOPH9010	Advances in Pharmaceutical Sciences	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SOPH9020	Modern Pharmaceutical Analytical Techniques	4	-	-	4	4	100	-	-	-	-	-	100

I	I	SSBT9090	Functional Genomics	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SLEN9060	Introduction to Tribology Engineering	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SLEN9070	Applied Linguistics and Current Trends in English Studies	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SEDP9030	Academic Writing and Ethical Research	4	-	-	4	4	100	-	-	-	-	-	100
I	I	SECE9080	AWS Cloud Solution Architect	4	-	-	4	4	40	60	-	-	-	-	100

P P SAVANI UNIVERSITY
Doctoral Programme (Ph.D.)

SECE9010: Machine Learning

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- understand the basic concepts and techniques of Machine Learning.
- become familiar with regression methods, classification methods, clustering methods.
- identify machine learning techniques suitable for a given problem.
- solve the problems and design applications using various machine learning techniques.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction** Learning Problems, designing a learning system, Types of machine learning, Life cycle of machine learning, Applications of machine learning algorithms, Issues and challenges with machine learning	10	15
2.	**Supervised Learning** Distance-based methods, Nearest-Neighbors, Decision Trees, Linear models: Linear Regression, Logistic Regression, Generalized, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Naïve Bayes classifier, Applications and challenges	15	25
3.	**Unsupervised Learning** Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models, Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods Applications and challenges	15	25
4.	**Artificial Neural networks and genetic algorithms** Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptron, Multilayer Networks and Back Propagation Algorithms, Remarks on Back Propagation Algorithms. Case Study: face Recognition. Applications and challenges	10	15
5.	**Recent advancements and research trends** Recent trends in various machine learning techniques, Use of machine learning techniques with cloud computing, IoT, Big data, blockchain, etc., Case study	10	20

Text Book/Reference Book (s):

Title	Author/s	Publication
Machine Learning	Tom M Mitchell	McGraw Hill
Pattern Recognition and Machine	Christopher Bishop	Springer-Verlag New York

Learning		Inc.
Real-World Machine Learning	Henrik Brink, Joseph Richards, Mark Fetherolf	DreamTech
Machine Learning in Action	Peter Harrington	DreamTech
Machine Learning: A Probabilistic Perspective	Kevin Murphy	MIT Press

Video Material Link(s):

- **https://nptel.ac.in/courses/106/105/106105152/**

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECE9020: Blockchain Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand blockchain and its applications.
- analyze IBM's strategy in blockchain platform.
- understand security in blockchain based networks.
- explore and understand cutting-edge advancements in blockchain technology

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Blockchain** Blockchain types, public key cryptography, Hashing, Digital Signature, Business networks, Assets, Ledgers, Transactions and Contracts, the problem with existing networks, how blockchain solves this problem, Requirements of a blockchain for business.	05	10
2.	**Blockchain Networks** Overview of active networks, TradeLens - Improving global trade, IBM Food Trust - Supply Chain Transparency, IBM World Wire - Global Payments, Decentralised and Trusted Identity, Further Examples by Industry, Key Players for Blockchain Adoption	10	15
3.	**IBM and Blockchain** How IBM can help with a Blockchain Project, IBM's Blockchain strategy, the IBM Blockchain Platform, The Linux Foundation's Hyperledger Project, Hyperledger Fabric, Continuing your Blockchain Journey	10	15
4.	**Blockchain composed and Blockchain fabric development** What is Hyperledger Composer, Components and Structure of Composer, An example Business Network: Car Auction Market, Extensive, Familiar, Open Tool Set, Participants and Components Overview, Developer Considerations	10	15
5.	**Blockchain architecture** Administrator (operator) Considerations, Security: Public vs. Private Blockchains, Architect Considerations, Network Consensus Considerations	10	15
6.	**Advanced Topics** Advanced Cryptography in Blockchain, Zero-Knowledge Proofs and their Applications, Interoperability between Blockchain Networks, Scalability Solutions: Sharding, Sidechains, and Layer 2 Protocols, Governance Models in Decentralized Systems, DeFi (Decentralized Finance) and its Impact on Traditional Finance, Non-Fungible	15	30

	Tokens (NFTs) and Digital Ownership, Blockchain Oracles: Bridging Smart Contracts with External Data, Privacy-Preserving Techniques in Blockchain Systems		

Text Book(s):

Title	Author/s	Publication
Blockchain Basics – A Non-Technical Introduction in 25 Steps.	Daniel Drescher	Apress
Mastering Blockchain	Imran Bashir	Packt
The Business Blockchain – Promise, practice, and application of the next internet technology.	William Mougayar	Wiley

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECE9030: Internet of Things

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- learn how to interface sensors and Actuators with embedded IoT devices.
- select connectivity and communication IoT protocols.
- implement IoT applications.
- explore cutting-edge advancements in IoT

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction** Introduction to Internet of things, end-to-end IoT Architecture, Requirement of IoT challenges and issues of IoT, selection of hardware and software, case studies of IoT applications.	05	10
2.	**Embedded IoT Devices, Sensors and Actuators** Choosing criteria for embedded IoT devices, Enlist MCU based and MPU based IoT devices, Comparison between Aruino Uno, NodeMCU and ESP32, Architecture of ESP8266, variants of ESP8266, Arduino C, GPIO programming, Types of sensors, working principles of actuators, Interfacing & Programming of digital, analog, protocol-based sensors and actuators	10	15
3.	**Networking IoT platform, RFID and iBeacons** Raspberry Pi and its variant, Raspberry Pi programming, choosing a right board, IoT gateway, Tools, Sensing IoT Environments, Introduction to RFID and iBeacon, Hardware & Software, Hardware used for IoT RFID, Connection to Serve, Data on RFID Server and Classic distributed the problem	10	15
4.	**IoT connectivity protocols and IoT communication protocol** Networks layer protocols: RPL and 6LowPAN, WiFi, Bluetooth, BLE, LORAwan, NFC, cellular, ZigBee, and Ethernet, Existing cloud platforms, Various application layer IoT protocols, MQTT protocol, building online server using MQTT, data exchange and storage in cloud, User Interface development.	10	15
5.	**IoT Security** IOT Security, Dangers, Assigning values to Information, Security Components, Key Management, Update Management.	10	15
6.	**Advanced Topics** Edge Computing in IoT, Blockchain for IoT Security and Data Integrity, AI and Machine Learning for IoT Analytics, Quantum Computing in IoT, Federated Learning and Privacy-Preserving	15	30

	Techniques, 5G and Beyond: Next-Generation Connectivity for IoT, Ethical and Regulatory Considerations in IoT, Digital Twins and IoT Simulation, Energy Harvesting and Sustainable IoT, Human-Computer Interaction and IoT User Experience		

Text Book(s):

Title	**Author/s**	**Publication**
Beginning Arduino (2nd Edition)	Michael McRoberts	TIA
Raspberry Pi IoT Projects	John C. Shovic	Apress
Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3	Peter Waher	Packt

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECE9040: Programming with Python

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand basics of python programming.
- identify appropriate approach to computational problems.
- to explore python libraries for the research

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
6.	**Introduction to Python** History, Features of Python, Applications of Python, Working with Python, Input and Output functions in Python, Variable types, basic operators and types of data. Conditional blocks using if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries Use of while loops in python, Loop manipulation using pass, continue, break and else.	10	15
7.	**Dictionary, List, Tuples and Sets** Dictionaries, accessing values in dictionaries, Working with dictionaries, properties, Functions and methods. Sets, accessing values in set, working with set, properties, functions and methods. Tuple, accessing tuples, Operations, Working, Functions and Methods. List, accessing list, Operations, Working with lists, Function and Methods, Two-dimensional Lists.	10	15
8.	**Functions, Modules and Packages in Python** Introduction to Functions, defining a Function, calling a Function, types of Functions, Function Arguments, Anonymous Functions, Global and Local Variables, Importing Module, Math Module, Random Module,	5	10
9.	**Python Object Oriented Programming** OOP Concept of class, object and instances, Constructor, class, attributes, methods, using properties to control attribute access, and destructors, Inheritance, overlapping and overloading operators. Objects in Python: creating Python classes, Modules and Packages, Inheritance in Python, Polymorphism in Python.	10	15
10	**Files in Python** Introduction to file input and output, Writing Data to a File, Reading Data from a File, Additional File Methods, Usingloops to process files, Processing records.	05	10
11	**Regular Expression in Python** RE Module, Basic Patterns, Regular Expression Syntax, Regular	05	10

	Expression Object, Match Object, Search Object, Findall method, Split method, Sub Method.		
12	**Python Libraries and Concepts used in Research:** **Introduction to NumPy:** Array, Indexing, slicing, data types, shape, reshape, iterating, join, split, search, short, filter **Introduction to Pandas:** Series, Data Frames, Read CSV files, Read JSON files, Analyzing Data. **Introduction to Matplotlib:** Plotting, markers, line, labels, grid, subplot, scatter, bars, histograms, pie charts.	10	15
13	**Introduction to PyTorch:** Introduction, Why PyTorch, working, PyTorch use cases (Business, Research & Education). **Introduction to TensorFlow:** Introduction, working, using TensorFlow with python, why TensorFlow, TensorFlow vs PyTorch.	05	10

Text Book(s):

Title	Author/s	Publication
Python Programming: A modular approach	Sheetal Taneja, Naveen Kumar	Pearson
Think Python: How to Think Like a Computer Scientist	Allen Downey	Green Tea Press
Python Cookbook	David Ascher, Alex Martelli Oreilly	O Reilly Media

Video Material Link(s):

Web Material Link(s):

- **https://www.tutorialspoint.com/python/**
- **https://www.w3schools.com/python/**
- **https://realpython.com/pytorch-vs-tensorflow/**
- **https://realpython.com/numpy-tensorflow-performance/**

Course Evaluation

- The course evaluation will be carried out of 100 marks.

P P SAVANI UNIVERSITY

Doctoral Programme (Ph.D.)

SECE9050: Natural Language Processing

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand basics of python programming.
- identify appropriate approach to computational problems.
- to explore python libraries for the research

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction** Introduction to NLP, History of NLP, Advantages of NLP, Disadvantages of NLP, Components of NLP, Applications of NLP, Phases of NLP, Challenges in NLP, NLP Libraries.	10	15
2.	**Language Modelling and Text Representation** Unigram Language Model, Bigram, Trigram, N-gram, Applications of Language Modeling, Bag of Word Model, Skip gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, Feature Weighing Techniques, Parts of Speech Tagging, Morphology.	20	25
3.	**Word Sense Disambiguation** Word Sense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation, Introduction to WordNet.	10	20
4.	**Text Analysis, Summarization and Machine Translation** Sentiment Mining, Text Classification, Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR, Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation (SMT).	15	25
5.	**Applications and Case studies:** Solving Downstream Tasks: Document classification, Sentiment Analysis, Named Entity Recognition, Semantic Textual Similarity, Prompting Pre-Trained Language Models	05	15

Text Book(s):

Title	Author/s	Publication
Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition,	Jurafsky, David, and James H. Martin	PEARSON

Foundations of Statistical Natural Language Processing.	Manning, Christopher D., and HinrichSchütze.	Cambridge, MA: MIT Press
Natural Language Understanding.	James Allen.	The Benjamin/Cummings Publishing Company Inc..
Handbook of natural language processing.	Dale, R., Moisl, H., & Somers, H.,	CRC Press.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECE9060: Machine Learning & Deep Learning

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand blockchain and its applications.
- analyze IBM's strategy in blockchain platform.
- understand security in blockchain based networks.
- explore and understand cutting-edge advancements in blockchain technology

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to ML** Introduction to ML, Performance Measures, Bias-Variance Trade off, Linear Regression. Bayes Decision Theory, Bayes Decision Theory, Normal Density and Discriminant Function, Bayes Decision Theory - Binary Features, Bayesian Belief Network, Parametric and Non-Parametric Density Estimation Parametric and Non- Parametric Density Estimation – ML and Bayesian Estimation, Parzen Window and KNN, Perceptron Criteria and Discriminative Models Perceptron Criteria, Discriminative models, Support Vector Machines (SVM).	15	20
2.	**Regression and Clustering** Logistic Regression, Decision Trees and Hidden Markov Model Logistic Regression, Decision trees, Hidden Markov Model (HMM) Ensemble methods Ensemble methods: Ensemble strategies, boosting and bagging, Random Forest, Dimensionality Problem Dimensionality Problem, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA),	15	20
3.	**Mixture Model and Clustering** Concept of mixture model, Gaussian mixture model, Expectation Maximization Algorithm, K- means clustering, Fuzzy K-means clustering, Hierarchical Agglomerative Clustering, Mean-shift clustering.	10	20
4.	**Neural Network** Neural network: Perceptron, multilayer network, backpropagation, RBF Neural Network, Applications Introduction to Deep Neural Networks Introduction to Deep Learning, Convolutional Neural Networks (CNN), Vanishing and Exploding Gradients in Deep Neural Networks, LeNet - 5, AlexNet, VGGNet, GoogleNet, and ResNet.	10	20
5.	**Recent Trends in Deep Learning**	10	20

	Generative Adversarial Networks (GAN), Auto Encoders and Relation to PCA, Recurrent Neural Networks, U-Net, Applications and Case studies.		

Text Book(s):

Title	**Author/s**	**Publication**
Introduction to Machine Learning	E. Alpaydin	Prentice Hall
Pattern Recognition and Machine Learning (Information Science and Statistics)	C. M. Bishop	Springer
Neural Networks and Deep Learning	Michael A. Nielsen	Determination Press

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECE9070: Python for Research

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand basics of python programming.
- identify appropriate approach to computational problems.
- to explore python libraries for the research

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction to Python** History, Features of Python, Applications of Python, Working with Python, Input and Output functions in Python, Variable types, basic operators and types of data. Conditional blocks using if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries Use of while loops in python, Loop manipulation using pass, continue, break and else.	10	15
2.	**Dictionary, List, Tuples and Sets** Dictionaries, accessing values in dictionaries, Working with dictionaries, properties, Functions and methods. Sets, accessing values in set, working with set, properties, functions and methods. Tuple, accessing tuples, Operations, Working, Functions and Methods. List, accessing list, Operations, Working with lists, Function and Methods, Two-dimensional Lists.	10	15
3.	**Functions, Modules and Packages in Python** Introduction to Functions, defining a Function, calling a Function, types of Functions, Function Arguments, Anonymous Functions, Global and Local Variables, Importing Module, Math Module, Random Module,	5	10
4.	**Python Object Oriented Programming** OOP Concept of class, object and instances, Constructor, class, attributes, methods, using properties to control attribute access, and destructors, Inheritance, overlapping and overloading operators. Objects in Python: creating Python classes, Modules and Packages, Inheritance in Python, Polymorphism in Python.	10	15
5.	**Files in Python** Introduction to file input and output, Writing Data to a File, Reading Data from a File, Additional File Methods, Usingloops to process files, Processing records.	05	10
6.	**Regular Expression in Python** RE Module, Basic Patterns, Regular Expression Syntax, Regular Expression Object, Match Object, Search Object, Findall method, Split	05	10

	method, Sub Method.		
7.	**Python Libraries and Concepts used in Research:** **Introduction to NumPy:** Array, Indexing, slicing, data types, shape, reshape, iterating, join, split, search, short, filter **Introduction to Pandas:** Series, Data Frames, Read CSV files, Read JSON files, Analyzing Data. **Introduction to Matplotlib:** Plotting, markers, line, labels, grid, subplot, scatter, bars, histograms, pie charts.	10	15
8.	**Introduction to PyTorch:** Introduction, Why PyTorch, working, PyTorch use cases (Business, Research & Education). **Introduction to TensorFlow:** Introduction, working, using TensorFlow with python, why TensorFlow, TensorFlow vs PyTorch.	05	10

Text Book(s):

Title	Author/s	Publication
Python Programming: A modular approach	Sheetal Taneja, Naveen Kumar	Pearson
Think Python: How to Think Like a Computer Scientist	Allen Downey	Green Tea Press
Python Cookbook	David Ascher, Alex Martelli Oreilly	O Reilly Media

Video Material Link(s):

Web Material Link(s):

- **https://www.tutorialspoint.com/python/**
- **https://www.w3schools.com/python/**
- **https://realpython.com/pytorch-vs-tensorflow/**
- **https://realpython.com/numpy-tensorflow-performance/**

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECV9010: Concrete Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand basics of modern concrete.
- use mineral and chemical admixtures.
- understand the material properties of concrete with emphasis on its durability.
- design the required concrete mix based on the field conditions.

Course Content:

Module	Content	Hours	Weightage in %
7.	**Cement** Portland Cement –Chemical Composition - Hydration, Setting and Fine nesses of Cement – Structures of Hydrated Cement – Mechanical Strength of Cement Gel - Water Held In Hydrate Cement Paste – Heat of Hydration Of Cement – Influence of Compound Composition On Properties of Cement – Tests On Physical Properties of Cement – I.S. Specifications – Different Types of Cements – Admixtures.	10	18%
8.	**Aggregates** Classification Of Aggregate – Particle Shape And Texture – Bond Strength And Other Mechanical Properties of Aggregate Specific Gravity, Bulk Density, Porosity, Absorption And Moisture In Aggregate – Soundness Of Aggregate – Alkali – Aggregate Reaction, Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Practical Grading – Road Note No.4 Grading Of Fine And Coarse Aggregates Gap Graded Aggregate – Maximum Aggregate Size.	10	18%
9.	**Fresh Concrete** Workability – Factors Affecting Workability – Measurement Of Workability By Different Tests – Effect Of Time And Temperature On Workability – Segregation And Bleeding – Mixing And Vibration Of Concrete – Quality Of Mixing Water. **Hardened Concrete** Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water In Mix – Nature Of Strength Of Concrete – Strength In Tension And Compression- Griffith's Hypothesis – Factors Affecting Strength – Autogeneous Healing –Relation Between Compression And Tensile Strength – Curing And Maturity of Concrete Influence Of Temperature On Strength – Steam Curing – Testing of Hardened	10	18%

	Concrete – Compression Tests – Tension Tests – Factors Affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.		
10.	**Elasticity, Shrinkage and Creep** Modulus of Elasticity – Dynamic Modulus of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Draying Shrinkage - Mechanism of Shrinkage – Factors Affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep of Concrete – Factors Influencing Creep – Relation Between Creep And Time – Nature of Creep – Effect of Creep.	10	18%
11.	**Mix Design:** Proportioning of Concrete Mixes By Various Methods – Fineness Modulus, Trial And Error, Mix Density, Road Note. No. 4, ACI And ISI Code Methods – Factors In The Choice of Mix Proportions – Durability of Concrete – Quality Control of Concrete – Statistical Methods – High Strength Concrete Mix Design. Special Concrete's: Light Weight Concretes – Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types of Fibers - Factories Affecting Properties of FRC – Applications Polymer Concrete – Types of Polymer Concrete Properties of Polymer Concrete and Applications	20	28%

Text Book(s):

Title	**Author/s**	**Publication**
Concrete Technology	M.S. Shetty	S. Chand
Concrete Technology	A.M. Neville and J.J. Brooks	ELBS
Concrete Structure, Material and Properties	P.K. Mehta	Prantice Hall Inc.
Cement based composites: Materials, Mechanical Properties and Performance	A.M. Brandt	E & FN Spon.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECV9020: Advanced in Concrete Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Develop the methods of manufacturing of concrete.
- Explain about various special concrete
- provide detailed information on electron microscopic technology (EM) including both Transmission electron microscopy (TEM) and Scanning electron microscopy (SEM).

Course Content:

Module	Content	Hours	Weightage in %
1.	**Durability of Concrete** Introduction, Permeability of concrete, chemical attack, acid attack, efflorescence, Corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, IS456-2000 requirement for durability.	15	25%
2.	**Special Concrete 1** Design and manufacture of normal concrete, Light weight concrete, Cellular concrete, No fines concrete, Aerated & foamed concrete	15	25%
3.	**Special Concrete 2** Design and manufacture of fiber reinforced concrete, Polymer concrete, Fly ash concrete	15	25%
4.	**Special Concrete 3** Design and manufacture of Self compacting concrete, High performance concrete, Very high strength concrete, High density concrete	15	25%

Text Book(s):

Title	Author/s	Publication
Concrete Technology	Neville, A.M. and Brookes	Pearson Education, 2010
Properties of Concrete	Neville, A.M	3rd Edition, Longman Scientific and General, 1992
Concrete repair and maintenance illustrated	Shanta Kumar A.R	Oxford University Press, New Delhi, 2000.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECV9030: Sustainable Advances in Civil Engineering Exploring Innovative and Contemporary Research Areas

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the Principles of Sustainability in Civil Engineering.
- Gain Knowledge of Green Building Materials and Construction Methods
- Learn About Green Concrete and Its Importance.
- Apply Sustainable Practices in Civil Engineering Projects.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to Sustainable Civil Engineering** Overview of sustainability in civil engineering, Key principles, economic, environmental, and social sustainability, Historical context and evolution of sustainable practices.	10	16%
2.	**Green Building Materials and Construction Methods** Recycled and alternative construction materials, Low-carbon and carbon-neutral materials, Case studies: green building projects.	10	16%
3.	**Introduction to Green Concrete** Overview of green concrete and its importance, Historical context and evolution of green concrete, Principles of sustainability in concrete production.	10	18%
4.	**Low-Carbon and Carbon-Neutral Concrete** Carbon footprint of traditional concrete, Carbon capture and storage in concrete production, Emerging technologies: bio-based materials, CO_2 utilization.	10	16%
5.	**Applications of Green Concrete** Building construction: residential, commercial, industrial, Infrastructure projects: roads, bridges, etc., Specialized applications: marine, underground, etc.	18%	16%
6.	**Current Research and Innovations in Green Concrete** Recent research papers and articles, Emerging trends and future directions, Student presentations on recent advancements.	18%	18%

Text Book(s):

Title	Author/s	Publication

Sustainable Concrete Solutions: Properties and Applications	Shahid M. Afridi, Asif Noor, and Naveed Ahmed	Pearson Education, 2010
Innovative Concrete Technology: Sustainability and Durability	Sanjay Kumar Shukla and Nanjundarao K. Ravindra	3rd Edition, Longman Scientific and General, 1992
Geopolymer Science and Applications	J.L. Provis and J.S.J. van Deventer	Oxford University Pres, 2000.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECV9040: Sustainable & Durable Green Concrete

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the Environmental impact of traditional concrete production in Civil Engineering.
- Gain Knowledge of exploring sustainable materials and implementing Green Production Techniques.
- Understand Testing and Evaluation of green concrete.
- Analyse Future Trends and Challenges in green concrete.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Sustainable Materials for Concrete** Introduction to sustainable aggregates (recycled, industrial by-products) Alternative cementitious materials (fly ash, slag, silica fume) Eco-friendly admixtures.	10	16
2.	**Production Techniques and Enhancing Durability in Green Concrete** Low-carbon footprint concrete production methods, Mix design principles for sustainability and durability, Life cycle assessment (LCA) of concrete materials, Durability mechanisms and challenges in green concrete, Chemical admixtures for durability (corrosion inhibitors, shrinkage reducers), Surface treatments for enhancing durability (sealers, coatings)	10	16
3.	**Construction Practices for Sustainable Concrete** Green construction techniques and practices. Importance of proper curing and maintenance	15	25
4.	**Testing and Evaluation of Green Concrete** Standard testing methods for green concrete (compressive strength, durability), Non-destructive testing techniques, Performance evaluation and monitoring of sustainable concrete structures.	10	16
5.	**Innovative Technologies in Green Concrete** Nanotechnology applications for improving concrete properties Self-healing concrete and smart materials,3D printing with sustainable concrete materials.	10	16
6.	**Future Trends and Challenges** Emerging trends in sustainable concrete research and development, Challenges and opportunities in mainstreaming green concrete, Role of policymakers, industry, and academia in promoting sustainable construction practices.	05	11

Text Book(s):

Title	Author/s	Publication
Sustainable Concrete Solutions: Properties and Applications	Shahid M. Afridi, Asif Noor, and Naveed Ahmed	Pearson Education, 2010
Innovative Concrete Technology: Sustainability and Durability	Sanjay Kumar Shukla and Nanjundarao K. Ravindra	3rd Edition, Longman Scientific and General, 1992

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SECV9050 Performance Based Design of Buildings

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the principles and fundamentals of performance-based design.
- Learn how to identify and prioritize performance objectives for different types of structures.
- Gain proficiency in structural analysis techniques for assessing performance.
- Develop skills in risk assessment and mitigation strategies.
- Learn optimization techniques to achieve desired performance objectives efficiently.
- Apply performance-based design principles to real-world engineering problems through case studies and projects.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction to Performance-Based Design** Overview of performance-based design philosophy, Historical development and evolution, Importance of performance criteria in structural design, Performance metrics and objectives.	10	15
2.	**Structural Analysis for Performance-Based Design** Fundamentals of structural analysis, Advanced analysis techniques (nonlinear analysis, dynamic analysis), Modeling considerations for performance-based design, Software tools for structural analysis.	10	17
3.	**Performance Criteria and Design Standards** Performance criteria for different types of structures (buildings, bridges, etc.) Design standards and guidelines for performance-based design, Limit states design approach, Reliability-based design principles.	10	17
4.	**Risk Assessment and Management** Risk assessment methodologies, Probabilistic approaches to risk analysis, Sensitivity analysis and uncertainty quantification, Risk mitigation strategies in structural design.	10	17
5.	**Optimization Techniques** Introduction to optimization in structural design, multi-objective optimization methods, Optimization algorithms and strategies, Application of optimization techniques to performance-based design problems	10	17
6.	**Case Studies and Applications** Review of case studies illustrating performance-based design principles, Application of performance-based design to different structural systems	10	17

Text Book/Reference Book (s):

Title	Author/s	Publication
Performance-Based Seismic Design of Concrete Structures and Infrastructures	Vagelis Plevris, Georgia Kremmyda	Engineering Science Reference

Performance-Based Seismic Design of Structures	Satyabrata Choudhury	CRC Press
Seismic Isolation, Structural Health Monitoring, and Performance Based Seismic Design in Earthquake Engineering: Recent Developments	Azer A. Kasimzade	Springer
Performance-Based Plastic Design: Earthquake-Resistant Steel Structures	Goel C. Subhash	ICC

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SEME9010 Fundamentals of Surface Engineering

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand the evolution and basic concepts of surface engineering.
- Explain the generation of solid surface, properties and phenomenon.
- Explain the formation of superficial layers and their properties such as geometrical properties, tribological properties etc.
- Understand and apply different coatings based on required applications.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction** Concept of Surface Engineering, History of Development, metallic structural materials, history of development of technology of surface improvement, surface engineering today.	10	15
2.	**Surface Engineering Evolution** General areas of activities of surface engineering, significance of surface engineering, direction of development of surface engineering, methods for creating surface layers, mathematical modeling, micro and nanometric testing, rational application of surface layers.	15	20
3.	**The Solid Surface** Significance of surface, geometrical concept, mechanical concept, physico-chemical concept, interface surface, surface energy, surface phenomenon	10	20
4.	**Superficial Layer** Shaping, structure, simplified models, general characteristic, strengthening and weakening, potential properties and geometrical parameters	10	20
5.	**Coatings** Concept, structure and types, metallic and non-metallic coatings, classification of coatings by application and manufacturing methods, potential properties and geometrical parameters	15	25

Text Book/Reference Book (s):

Title	Author/s	Publication
Surface Engineering of Metals	Tadeusz Burakowski, Tadeusz Wierzchon	CRC Press
Introduction to Surface Engineering	Peter Dearnley	Cambridge University Press
Surface Engineering: Methods and Applications	Edited By R.S. Walia, Qasim Murtaza, Shailesh Mani Pandey, Ankit Tyagi	CRC Press
Surface Engineering: Enhancing life of Tribological Components	Dheerendra Kumar Dwivedi	Springer Publications

Video Material Link(s):

- https://archive.nptel.ac.in/courses/112/107/112107248/

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SEME9020 Introduction to Tribology Engineering

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- To impart knowledge on the principles of friction and methods to minimize wear in engineering components.
- To understand the fundamental concepts of tribology including friction, wear, and lubrication.
- To explore various surface treatments and coatings to reduce wear.
- To examine the applications of tribology in different manufacturing processes.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1	**Basic Concept of Tribology** Definition and Scope of Tribology: Understanding what tribology is and its significance in engineering. Nature of Metallic Surfaces: Characteristics and properties of metallic surfaces. Surface Geometry: Analysis of the geometric aspects of surfaces. Measurement of Surface Topography: Techniques for assessing surface features. Quantifying Surface Roughness: Methods to quantify the roughness of surfaces. Contact Between Surfaces: How surfaces interact when they come into contact. Friction: Laws of Friction, Measurement of Friction, Origin of Friction, Theories of Friction, Adhesion Theory and its Extensions.	10	15
2	**Wear** Types of Wear: Different forms of wear and their characteristics. Adhesive Wear, Abrasive Wear, Erosion Wear, Archard's Law: Understanding this fundamental wear principle. Factors Affecting Corrosive Wear: Identifying and understanding the factors influencing wear due to corrosion. Wear Map: Mapping wear types and their occurrence. Wear Testing Methods: Pin on Disc, Pin on Drum, Slurry Wear, Air Jet Erosion, Water Jet Erosion, ASTM Standards: Standard testing methods as per ASTM.	15	20
3	**Lubrication and Tribological Properties of Solid Materials** Introduction to Lubrication: Basics and necessity of lubrication., Properties of Lubricants: Key properties that make substances suitable for lubrication. Tribological Properties of Materials: Hardness, Strength, Ductility, Work Hardening Rate, Effect of Crystal Structure, Effect of Microstructure, Mutual Solubility of Rubbing Pairs, Effect of Temperature.	10	20
4	**Surface Treatments to Reduce Wear** Surface Treatments: Techniques to modify surface properties with or without altering composition. Surface Coating Methods: Welding, Flame Spraying, Plasma Spraying, Electroplating, Electroless Coating, Chemical Vapour Deposition (CVD), Physical, Vapour Deposition (PVD), Super Hard Coatings.	10	20
5	**Applications** Application of Tribology in Manufacturing Processes: Practical	15	25

	applications of tribological principles in industry. Metal Machining and Cutting: Role of tribology in improving machining and cutting processes. Tool Wear: Understanding how tools wear out and how to mitigate this. Action of Lubricants in Manufacturing: Importance and role of lubricants in various manufacturing processes. Friction Welding: Using friction to join materials. Extrusion Process: Application of tribological principles in the extrusion process.		

Text Book/Reference Book (s):

Title	**Author/s**	**Publication**
Engineering Tribology	P. Sahoo	Prentice Hall of India
Principles and Applications of Tribology	D.F. Moore	Pergamon Press
Fundamentals of Tribology	Basu, Sengupta & Ahuja	Prentice Hall of India
Tribology Handbook	M.J. Neele	Elsevier Ltd
Principles and Applications of Tribology	Habeeb Adewale Ajimotokan	Springer Cham

Video Material Link(s):

- https://nptel.ac.in/courses/112102015

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SEDP9010: Research Methodology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	-	-	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the nuances of Research.
- Learn the terminology associated with Research Methodology.
- Get acquainted with various methods to carry out their Research.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Research Methodology: Introduction** Meaning and importance of Research, Types of Research, Selection and formulation of Research Problem, Research Design and Plan exploration, Selection of research area or topic, Hypothesis, Research methods.	10	16
2.	**Data Collection, Literature Search and Organization** Sources of Data, Methods of Collecting data, Research Lifecycle, Virtual research environment, Scientific publishing process, Global publications, Research & Discovery, Authoring & Research Output, Peer Review, Publication & Distribution, Post publication, Research proposal, publication and writing order, literature search, keywords, Search engines, Sources for searching, Basic search strategies, Search operators, Organization of literature review, Alerts from search engines etc., Scientific network.	10	16
3.	**Research steps and writing** Types of Research Writing, Structure and components, Types of Research Paper, Different steps in writing report, Research Writing Strategies and references style.	10	16
4.	**Research Methods and Methodology** Differentiating between methodology and methods, Qualitative or quantitative Research	5	10
5.	**Computer Applications and Statistics** Use of word processing, spread sheet and database software. Plotting of graphs. Internet and its application: E-mail, WWW, Web browsing, acquiring technical skills, drawing inferences from data, Introduction to Statistics – Probability Theories - Conditional Probability, Poisson distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi Square Test, Association of Attributes t Test –Anova, Standard deviation Coefficient of variations. Co relation and Regression Analysis.	10	16
6.	**Tips on Writing Research Papers, Thesis and Project Proposals** Steps in Research, Finding Research Resources, Getting to know	10	16

	research topic, Guiding questions, Bibliography & Footnotes, Citation, what is a research paper, Steps to write research paper and it's publication, Gain after writing a research paper, Transactions / Conference, When to Start Writing Paper, Writing a Good Paper, Sequencing the Sections and Subsections in a Paper, Writing the Title of the Paper, Writing the ABSTRACT of the Paper, Writing the Introduction of the paper, Explanation of the diagrams and figures in the text, Writing conclusion of the paper, Formats for References, Flowchart for Writing a Transaction Paper, Final checks after writing a paper, Impact Factor and it's calculation, Citation Index, Thesis Writing, Writing Project Proposals, Some Funding Agencies/Schemes.		
7.	**Social Media for Researchers** Using social media in research, Digital Methods as Mainstream Methodology, Data and debate, e- focus groups and e-interviews, Social Media Research, Human Behaviour, and Sustainable Society, Journals, Twitter, The use of new technologies on the British Birth Cohort Studies, Research in Social Media: Data Sources and Methodologies, Use of social media for accounting research, Social Media Networks, Social Media for Research Dissemination, Social Media and Research, Mixed Methods Social Networks Research.	5	10

Text Book(s):

Title	Author/s	Publication
Research Methodology – Methods & Techniques	C R Kothari	New Age International Publishers

Course Evaluation

- The course evaluation will be carried out for 50/100 marks.

P P SAVANI UNIVERSITY
Doctoral Programme (Ph.D.)

SEDP9020: Research Writing

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

- To contribute new insights, theories, or evidence to the existing body of knowledge in a particular field.
- To address specific problems or questions within a field or discipline.
- Serves as a means of communicating findings and ideas to other researchers, practitioners, policymakers, and the public.

Course Content:

Module No.	Content	Hours	Weightage in %
1	**Introduction to Research Writing** • Overview of research writing • Understanding the research process • Importance of research in various fields • Types of research and their characteristics	10	20
2	**Research Planning and Topic Selection** • Formulating research questions • Choosing a research topic • Literature review and its significance • Developing a research proposal	10	20
3	**Research Methods** • Qualitative vs. quantitative research • Experimental, correlational, and descriptive research designs • Sampling techniques	10	20
4	**Data Collection** • Data collection methods: surveys, interviews, observations, etc. • Tools and instruments for data collection • Ethical considerations in data collection	10	10
5	**Data Analysis** • Introduction to data analysis tools and software • Quantitative data analysis techniques (e.g., statistical analysis) • Qualitative data analysis techniques (e.g., thematic analysis)	10	10
6	**Writing the Research Paper** • Structure and components of a research paper (e.g., abstract, introduction, methodology, results, discussion, conclusion) • Citations and referencing styles (e.g., APA, MLA) • Avoiding plagiarism	5	10
7	**Revision and Publication**	5	10

	• Revision techniques for improving the quality of research papers • Peer review process and its importance • Strategies for publication and dissemination of research findings • Ethical considerations in research publication		

Text Book(s):

Title	Author/s	Publication
Research Methodology – Methods & Techniques	C R Kothari	New Age International Publishers

Course Evaluation

- The course evaluation will be carried out for 100 marks.

SEDP9030_Academic Writing and Ethical Research

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	0	0	0	0	100

CE: Continuous Evaluation **ESE:** End Semester Exam

Objective (s) of the course:
To help the learners to

- Outlining the basic knowledge of English in an academic setting.
- Extending the knowledge of grammar and writing strategies.
- Implementing the science of writing to your research articles, thesis and other professional writings.
- Distinguishing abstract writing from data commentary and critical analysis.
- Defending your hypothesis (tonality).
- Writing and presenting with correct grammatical expressions in dissertation, thesis work and other academia-based data.
- Equip PhD students with a strong understanding of research ethics principles.
- Develop critical skills for conducting ethical research and navigating research misconduct.
- Provide comprehensive knowledge of the publication process for academic journals.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Grammar in Academic Writing**: Sentence structure – subjects, verbs, and objects, types of sentences; simple, compound, complex, and compound-complex, ways of packing information in sentence, Parts of speech – nouns, pronouns, verbs, adjectives, adverbs, prepositions, conjunctions, and interjections, and how they function in a sentence. Verb tenses, Subject-verb agreement, Active and Passive Voice, Parallel structure – use parallelism when listing items or comparing ideas to maintain coherence and readability, Modifiers – learn how to use adjectives, adverbs and modifying phrases effectively to provide information about a word or phrase. Punctuation (commas, parenthesis, dash skewers et all) Clarity and conciseness - Coherence and cohesion, Proper use of transition - connectors**,** Syntax, style and vocabulary	15	25
2.	**Structure of an academic paper**: Introductions, Abstracts, Rhetorics and argument, Thesis statement, Methods, Data Commentaries, Annotated Bibliography/literature review, Results, Discussion/Conclusions, Acknowledgement, Paragraph development Critiques, Request for funding, Bio-data statements, Blogs, Paraphrasing, Voice and rhythm Composing v editing, Presenting ideas	15	25
3.	**Research Ethics:** Introduction to ethics, philosophy of ethics, ethical principles, research integrity and ethics, ethics and misconduct(plagiarism) Recognize and avoid research misconduct,	10	20

	including plagiarism, fabrication, falsification, and data manipulation. Understand proper data ownership, management, and sharing practices. Recognize potential conflicts of interest and develop strategies for disclosure.		
4.	**Publication Ethics and Authorship:** Conflict of interest, conflict of values, competing interest. Conflicting ownership, resolving conflict Publication Misconduct: Group Discussion: Subject-specific ethical issues, FFP, authorship; Conflicts of interest; complaints and appeals: examples and fraud from India and abroad Software Tools: Use of Plagiarism software like Turnitin, Urkund and other open-source software tools	10	15
5.	**Introduction to Scholarly Publishing** Research Metrics: Impact factor of journals as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g-index, i10 index, other research metrics	10	15

Text Book/Reference Book (s):

Title	Author/s	Publication
Research Ethics for Students In Social Science	JaapBos	Springer
Research Ethics	Gary Comstock	Cambridge
Ethics In Qualitative Research, Second Edition	Julie Jessop, Maxine Birch, Melanie Mauthner, Tina Miller	SAGE Publications Ltd

Video Material Link(s):

- https://nptel.ac.in/courses/110105091
- https://archive.nptel.ac.in/courses/127/105/109105115/

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SHHM9010: Organon of Medicine

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Have an in-depth study of the biography of the founder of Homoeopathy.
- Gain insight into the development and progress of Homoeopathy along with the timely changes for the advancement of the medical science.
- Understand the art of homoeopathic case taking, through insights from different stalwarts.
- Gain through knowledge regarding chronic miasms and its application in clinical practice.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
1.	**Biography of Hahnemann by Richard Haehl and T. L. Bradford.** A detailed in-depth study of the life of the founder of Homoeopathy, the situation and circumstances that led to the discovery and development of a new science in medical field, the struggle and opposition faced, the improvisations made as per the demand and the hard work that led to the present status of Homoeopathy.	10	16
2.	**All 6 editions of Organon of Medicine, along with an understanding of the core of all aphorisms and its applicability.** The "Organon of Medicine" comprises six editions authored by Samuel Hahnemann, the founder of homeopathy. Each edition represents Hahnemann's evolving understanding of the principles and practices of homeopathy. The core of its aphorisms encapsulates Hahnemann's principles, such as the law of similars, the concept of vital force, and the individualization of treatment. Its applicability lies in guiding homeopathic practitioners in understanding the nature of disease, selecting remedies, and administering treatment tailored to the individual's unique symptoms and constitution.	15	25
3.	**Hahnemannian concept of Man, Life, Health, Disease and Cure.** The Hahnemannian concept of man views the individual as a holistic being, comprising physical, mental, and emotional aspects. Life is governed by a vital force, an energy that maintains health when in balance. Health is a state of harmony and balance within the body and mind. Disease is seen as a disturbance in this balance, manifested by symptoms. Cure, according to Hahnemann, involves restoring balance by stimulating the body's innate healing ability through the administration of remedies that produce similar	5	11

	symptoms in healthy individuals, following the principle of "like cures like."		
4.	**The Art of Homoeopathic Case Taking – with guidelines from different stalwarts, along with Dr. Pierre Schmidt.** The art of homeopathic case-taking involves thorough observation and listening to understand the patient's physical symptoms, emotional state, and individual characteristics. Dr. Pierre Schmidt emphasized the importance of accurate history-taking, focusing on both physical and mental symptoms, to guide remedy selection and ensure effective treatment.	10	16
5.	**Detailed study of Hahnemann's concept of Chronic Miasms and its clinical application.** Hahnemann's concept of chronic miasms identifies inherited or acquired disease tendencies, such as Psora, Sycosis, and Syphilis. Understanding their characteristic symptoms and impact guides treatment strategies in homeopathy. By addressing the dominant miasm, homeopaths aim to promote lasting health and well-being.	10	16
6.	**Detailed study of Chronic Miasms by J. H. Allen** J.H. Allen's study on chronic miasms provides a comprehensive examination of Psora, Sycosis, and Syphilis in homeopathy. Through meticulous analysis and case studies, Allen elucidates the pathological characteristics and clinical manifestations of these deep-seated disease tendencies. His work serves as a valuable resource for homeopathic practitioners, offering insights into diagnosis and treatment strategies for addressing miasmatic diseases effectively.	10	16

Text Book(s):

Title	Author/s	Publication
1. Samuel Hahnemann – His Life and Work – Volume 1 and 2	Richard Haehl	B. Jain Publisher
2. The Life and Letters of Dr. Samuel Hahnemann – 1 and 2	T. L. Bradford	B. Jain Publisher
Organon of Medicine, 6th edition	William Boericke	B. Jain Publisher
The Art of Homoeopathic Case Taking	Dr. Pierre Schmidt	B. Jain Publisher
The Chronic Miasms	J. H. Allen	B. Jain Publisher
The Chronic Diseases	J. H. Allen	B. Jain Publisher

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SHHM9020: PHILOSOPHY OF HOMOEOPATHY

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- obtain knowledge about philosophy of homoeopathy which when applied in practice unable the students to achieve results, which he can explain logically and rationally in the medical practice.
- Homoeopathy is a complete system of medicine, it has individualistic and dynamistic approach to life, health, disease, remedy and cure. In order to achieve this integration, the study of logic, phycology and fundamentals of homoeopathic philosophy becomes necessary.
- As homoeopathy lays great emphasis on knowing the mind of and individual and his own way of living the life, his individualistic philosophy becomes imperative for a homoeopathic physician and describing the philosophy will assist the student in building up his conceptual base in the right direction.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
12.	Homeopathic philosophy is based on the principle of "like cures like." This means that a substance that causes symptoms in a healthy person can be used to treat similar symptoms in a sick person. Homeopathy also emphasizes individualized treatment, considering the person's physical, emotional, and mental symptoms. The remedies are highly diluted substances, often beyond Avogadro's number, which proponents believe retains the healing properties of the original substance without the associated toxicity. Additionally, homeopathy follows the principle of the minimum dose, meaning the remedies are diluted to the point where only a trace of the original substance remains. Homeopaths believe this enhances the remedy's effectiveness while minimizing any potential side effects.	10	15
13.	Law of Similars (Similia Similibus Curentur): This is the fundamental principle of homeopathy, which states that a substance that produces symptoms in a healthy person can be used to treat similar symptoms in a sick person. For example, if a substance causes symptoms resembling a cold in a healthy person, it may be used to treat someone suffering from a cold.	10	15
14.	Individualization: Homeopathy treats the individual as a whole, taking into account not only physical symptoms but also emotional and mental aspects. Homeopaths believe that each person has a unique set of symptoms and requires a remedy tailored to their specific condition.	10	20

15.	Minimum Dose: Homeopathic remedies are highly diluted substances, often to the point where no molecules of the original substance remain. Proponents believe that dilution and succussion (vigorous shaking) potentiate the remedy's healing properties while minimizing any potential toxicity or side effects.	10	15
16.	Potentization: The process of dilution and succussion is known as potentization. It is believed to release the vital energy or "vital force" of the substance, making it more effective in treating the underlying imbalance or disease.	10	15
17.	Holistic Approach: Homeopathy considers the interconnectedness of symptoms and aims to treat the underlying cause of illness rather than just alleviating symptoms. This holistic approach often involves lifestyle modifications, dietary changes, and emotional support in addition to the use of homeopathic remedies.	05	10
18.	Chronic vs. Acute Conditions: Homeopathy distinguishes between acute conditions, which are short-lived and often self-limiting, and chronic conditions, which persist over time and require deeper constitutional treatment. Chronic conditions are treated with remedies chosen based on the individual's overall constitution and personality.	05	10

Text Book(s):

Title	Author/s	Publication
"Organon of Medicine"	Dr. Samuel Hahnemann	B. JAIN PUBLISHER.
"The Science of Homeopathy"	George Vithoulkas:	B. JAIN PUBLISHER
"The Spirit of Homeopathy"	Rajan Sankaran:	THE OTHER SONG PUBLICATION, MUMBAI.
"The Principles and Art of Cure by Homoeopathy"	Herbert A. Roberts:	B. JAIN PUBLICATION.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLCS9010: Psychodermatology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to:

- Understand Psychodermatological disorders.
- Utilize various treatment methodologies in dealing with Psychodermatological patients.
- Able to deal with patient having Psychodermatoes.
- Understand the legal and ethical matters concerned with the field of Psychodermatology.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to psychodermatology:** Definition, boundary, psychological and behavioral influences on health and illness, Stress and psychoneuroimmunology, Biopsychosocial model of skin diseases, Behavioral patterns, theoretical models of health behavior and coping styles, Scope and application of psychological principles in health, illness and health care.	10	20
2.	**Psychodermatological Disorders:** Classification of psychodermatoses, Primary psychiatric disorders - Delusional infestation, trichotillomania, dermatitis artefacta, OCD, Dysmorphophobia. Secondary psychiatric disorders - Depression, anxiety, OCD, substance abuse. Psychophysiologic conditions - Psoriasis, Acne, Alopecia areata, Atopic dermatitis, Psychogenic purpura, Rosacea, Seborrheic dermatitis, Vitiligo. somatoform disorders - burning mouth syndrome, scalp dysesthesia etc.	10	20
3.	**Treatment strategies of Psychodermatological disorders:** Classification, indications, contraindications and side effects of psychotropic drugs, Therapeutic Relationship, Cognitive therapy, Behavior therapy; Solution Focused Model; Other Models: Family Therapy, Group therapy, Experiential Group Sessions	10	20
4.	**Legal and Ethical issues in Psychodermatology:** Issues related to training professional therapists, Ethical and legal issues involved in therapy work, Rights and responsibilities in psychotherapy, Issues related to consent (assent in case of minors), Planning and recording of therapy sessions, Structuring and setting goals; pre- and post- assessment, Practice of evidence-based therapies; How to start a psychodermatology liaison clinic?	10	20
5.	**Client Management:** History taking, Planning therapy session, Follow-up care.	10	20

Text Book(s):

Title	Author/s	Publication
Handbook of Psychodermatology	Abdul Latheef EN	Jaypee Brothers Medical Publishers.
The Essentials of Psychodermatology	Mohammad Jafferany Barbara Roque Ferreira Arsh Patel	Springer Publication.
Psychodermatology in Clinical Practice	Anthony Bewley Peter Leping Ruth E. Taylor	Springer Publication.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLCS9020: Cognitive Behaviour Therapy

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to:

- Gain basic knowledge about CBT.
- Administer CBT for different therapeutic conditions.
- Plan session wise treatment plan for different patients based upon their needs.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Cognitive Behaviour Therapy:** Definition, History of CBT, Theory and Research in CBT, The Basic CBT model, Cognitive Behavioural Assessments, Negative Automatic Thoughts.	10	20
2.	**Principles of CBT:** Legal and Ethical concerns in practicing CBT, Principles of Cognitive Behaviour therapy	10	20
3.	**Techniques of CBT:** Thought record, Relaxation, Behavioural Therapeutic Techniques, MOOD record, Session wise Planning.	10	20
4.	**Practice of CBT in different psychological disorders:** CBT for Panic and Generalized Anxiety, Phobia, Obsessional Disorders, Depression, Somatic Problems, Eating disorders, Marital Problems, Sexual Dysfunctions, Problem Solving, Chronic Illness.	20	40

Text Book(s):

Title	Author/s	Publication
Cognitive Behavior Therapy: Basics and Beyond	Judith S. Beck	Guilford Publications
The CBT Workbook for Depression: A Step-by-Step Program for Coping with Depressive Moods	Martin M. Muhn Addison-Wesley	Pearson Education
Mind Over Mood: Change How You Feel by Changing the Way You Think	Dennis Greenberger Christine A. Padesky	Guilford Publications

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLCS9030: Advanced Counseling Skills

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to:

- Explain the concepts of guidance and counselling, including their philosophical foundations and purposes.
- Distinguish between guidance and counselling.
- Identify the types of guidance and counselling.
- Describe the approaches to counselling and critically evaluate the approaches for specific counselling.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to guidance and counseling:** Counseling, Types of counseling, Principles of counseling, Therapeutic relationship between counselor and counselee, Phases of counseling, Techniques of counseling, Barriers in counseling, Therapeutic Communication, Legal and ethical issues in counseling	10	20
2.	**Approaches to counseling:** Psychodynamic approach, Existential approach, Behavioural approach, Cognitive approach, Social learning approach, Gestalt approach	15	30
3.	**Counseling services in psychosocial environments:** Victims of rape or sexual abuse, Domestic violence, Physical abuse, Emotional abuse, Counseling of child, Geriatric counseling, Marital counseling	15	30
4.	**Conflict resolution and anger management:** Conflict, Types of conflicts, Conflict resolution strategies and skills, Anger, Types of anger, Frustration, Anger management therapy	10	20

Text Book(s):

Title	Author/s	Publication
Theories And Practice Of Counseling And Psychotherapy	Samuel T. Gladding	Pearson Publication India
Theories And Practice Of Counseling And Psychotherapy	Gerald Corey	Cengage Learning India Pvt. Ltd
The Handbook Of Counseling Psychology	Barbara Douglas, Ray Woolfe, Sheelagh Straw-bridge, Elaine Kasket Victoria Galbraith	Sage Publication
Counseling Psychology: A Textbook For Study And Practice	David Murphy	Willey Publication

Course Evaluation- The course evaluation will be carried out of 100 marks.

P P SAVANI UNIVERSITY

Doctoral Programme (Ph.D.)

SLCS9040: Advanced Tools in Psychological Research

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to:

- Gain a comprehensive understanding of advanced statistical techniques for analyzing complex psychological data, including multilevel modeling, structural equation modeling (SEM), and network analysis.
- Explore the applications of machine learning and artificial intelligence (AI) in psychological research, including data mining, pattern recognition, and predictive modeling.
- Become proficient in using specialized software for data collection (e.g., eye-tracking, psychophysiological measures) and analysis (e.g., R, Mplus, Python).
- Develop the ability to design and implement research studies utilizing virtual reality (VR), augmented reality (AR), and other immersive technologies.
- Critically evaluate the ethical considerations associated with new research technologies and data privacy.
- Effectively communicate complex research findings using data visualization tools and innovative presentation methods.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Advanced Statistical Techniques and Software:** Introduction to advanced statistical methods (beyond basic techniques), Multilevel modeling (MLM) for nested data analysis, Structural equation modeling (SEM) for examining complex relationships, Network analysis for understanding interconnected systems, Familiarization with statistical software packages like Mplus, R, or Stata, Hands-on practice with data analysis exercises using chosen software.	10	20
2.	**Artificial Intelligence and Machine Learning in Psychology:** Introduction to AI and Machine Learning (ML) concepts, Applications of AI/ML in psychological research (e.g., data mining, pattern recognition), Ethical considerations of using AI/ML algorithms in research, Literature review focusing on a specific AI/ML application in current research, Class discussions on the potential and challenges of AI/ML in psychology.	10	20
3.	**Neuroimaging and Psychophysiology:** Introduction to different neuroimaging techniques (e.g., fMRI, EEG), Understanding the link between brain activity and psychological processes, Psychophysiological measures (e.g., heart rate, skin conductance) for studying physiological responses, Critical analysis of a research paper using neuroimaging data, Designing a research study that	10	20

	incorporates psychophysiological measures.		
4.	**Advanced Data Collection and Analysis Tools:** Virtual Reality (VR) and Augmented Reality (AR) applications in research, Designing research studies utilizing VR/AR technology, Big data and data mining techniques for extracting patterns from large datasets, Text analysis and Natural Language Processing (NLP) tools for analyzing textual data, Web-based survey design and online data collection methods, Proposing a research study that leverages VR/AR technology, Practicing data mining techniques using a chosen software platform, Text analysis exercise using a software tool like LIWC or spaCy, Designing a web-based survey instrument for data collection.	10	20
5.	**Scientific Communication and Ethical Considerations:** Data visualization techniques for effectively communicating research findings, Creating infographics or presentations that engage the audience, Ethical considerations in using new research technologies (e.g., data privacy, informed consent), Responsible data collection and analysis practices, Developing an infographic or presentation of research findings, Group discussion on ethical dilemmas associated with specific research technologies.	10	20

Text Book(s):

Title	**Author/s**	**Publication**
Advanced Statistical Methods in Psychology and the Behavioral Sciences	David Kenny	Guilford Publications
Introduction to Machine Learning for Psychologists: Concepts, Applications, and Statistics	Anthony Bewley Peter Leping Ruth E. Taylor	The Cognitive Neuroscience of Mental Imagery.
The Cognitive Neuroscience of Mental Imagery	Alan Paivio	Oxford University Press

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLCS9050: Indigenous Psychology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to:

- Critically evaluate the strengths and weaknesses of various research designs.
- Gain a comprehensive understanding of advanced statistical techniques for analysing complex psychological data.
- Explore the applications of computer technology in psychological research, including data collection, analysis, and modelling.
- Become familiar with emerging methodologies like neuroimaging, psychophysiology, and eye-tracking.
- Develop the ability to design and implement research proposals utilizing advanced tools.
- Effectively communicate research findings in written and oral formats.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Indigenous Psychology:** Fundamentals of Indigenous Psychology, History of Indigenous Psychology, Contemporary impact of Indigenous Psychology, Indigenous Research Methodology.	10	20
2.	**Concepts of Indigenous Psychology:** Spirituality and Healing, Indigenous Concept of Self and Wellbeing, Traditional knowledge system and research.	10	20
3.	**Indigenous Healing Practices:** Traditional Healing System, Specific Healing Techniques, Rituals and Ceremonies, Role of Storytelling and Song, Traditional Pharmacopoeia, Connection to Earth and Soil for Healing, Healing power of Community, Integration of Modern Medicines.	10	20
4.	**Cultural impact on Psychology:** Colonization, Society and Culture, Migration, Decolonization.	10	20
5.	**Legal and Ethical Issues in Indigenous Psychology:** Tribal Sovereugnty, Informed consent, Protection of traditional knowledge, Community review and approval, standardization and regulation, Trust building, Community based Participatory Researches, Maintaining confidentiality and Privacy.	10	20

Text Book(s):

Title	Author/s	Publication
Healing Ways: Decolonizing Therapeutics in the Aboriginal Context	Gerald Gone	University of Toronto Press

Indigenous Psychologies	Graham McLoughlin and C. James Firestone	Springer Publication.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLEN9010: The History of the English Language

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

This course aims to develop and enhance the knowledge related to the history of English Language. In a clear and methodical way, the course presents the details of the important aspects of the subject—vocabulary, syntax, etymology, etc.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Old English** (450-1150 AD): The earliest form of English, Old English, evolved from the Germanic dialects brought to Britain by the Anglo-Saxons in the 5th century. It was a highly inflected language, characterized by complex grammar and a vocabulary heavily influenced by Germanic languages.	15	20
2.	**Middle English** (1150-1500 AD): Following the Norman Conquest of 1066, Norman French became the language of the ruling class in England, leading to significant changes in English vocabulary and grammar. Middle English emerged as a blend of Old English and Norman French, characterized by the development of a more standardized grammar and vocabulary.	15	20
3.	**Early Modern** English (1500-1700 AD): The invention of the printing press in the 15th century facilitated the spread of English literature and contributed to the standardization of the language. During this period, English underwent significant changes in pronunciation, grammar, and vocabulary, largely influenced by the Renaissance and the reintroduction of classical languages.	10	20
4.	**Modern English** (1700 AD-present): Modern English began to take shape in the 17th century, marked by the Great Vowel Shift and the publication of influential dictionaries like Samuel Johnson's "A Dictionary of the English Language" in 1755. The colonization of the Americas, Africa, Asia, and Oceania spread English worldwide, leading to the emergence of numerous regional varieties and dialects.	10	20
5.	**Global English** (20th century-present): The 20th century saw English become a global lingua franca, used for international communication in fields such as science, technology, diplomacy, and entertainment. The rise of the British Empire and later the influence of the United States as a superpower played significant roles in the spread of English worldwide.	10	20

Text Book(s):

Title	Author/s	Publication
An Outline History of The English Language	Frederick T. Wood	Trinity Press, 2018.
Our Magnificent Bastard Tongue: The Untold History of English,	John McWhorter	Avery, 2009
The Adventure of English: The Biography of a Language	Melvyn Bragg,	Arcade, 2011
The Lexicographer's Dilemma: The Evolution of "Proper" English, from Shakespeare to South Park	Jack Lynch	Bloomsbury Publishing, 2010

Course Evaluation

- The course evaluation will be carried out for 100 marks.

SLEN9020: Sociolinguistics

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

This course aims to provide a view of different areas of language study with respect to society. It intends to provide access to specialist knowledge and stimulate an awareness of its significance.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	Language Variation and Change: Sociolinguists study how language varies and changes across different social, regional, and cultural contexts. This includes variations in pronunciation, vocabulary, grammar, and discourse patterns.	10	10
2.	Dialectology: Dialectology focuses on the study of regional variations in language, known as dialects. Sociolinguists investigate how dialects develop, spread, and are perceived within societies.	10	10
3.	Social Dialects and Sociolects: Social dialects refer to variations in language usage associated with social factors such as age, gender, ethnicity, socio-economic status, and education level. Sociolects are specific to particular social groups or communities.	5	10
4.	Language Contact and Multilingualism: Sociolinguists examine how languages come into contact with each other, leading to phenomena such as borrowing, code-switching, and language mixing. Multilingualism is a common feature of many societies, and sociolinguists study the dynamics of multilingual communities.	5	10
5.	Language and Identity: Language plays a crucial role in shaping individual and group identities. Sociolinguists explore how language choices and linguistic features are used to express and negotiate social identities such as ethnicity, nationality, gender, and social class.	5	10
6.	Language Attitudes and Ideologies: Sociolinguists investigate people's attitudes and beliefs about different language varieties, including standard and non-standard dialects. Language ideologies influence language planning, policy-making, and language education.	5	10
7.	Language Policy and Planning: Sociolinguists analyze language policies implemented by governments, institutions, and communities. They study the social, political, and cultural factors	5	10

	that shape language planning decisions and their impact on linguistic diversity and equality		
8.	Language and Power: Language is intimately linked to power dynamics within societies. Sociolinguists examine how language is used to exert social, political, and economic power, as well as how linguistic inequalities can reinforce existing social hierarchies	5	10
9.	Language and Technology: The advent of digital communication has transformed language use and interaction. Sociolinguists study how technology-mediated communication platforms shape language practices, social interaction, and identity construction	5	10
10.	Language Change in the Digital Age: Sociolinguists investigate how digital communication technologies influence language change and evolution, including the emergence of new linguistic forms, norms, and genres in online environments.	5	10

Text Book(s):

Title	**Author/s**	**Publication**
Sociolinguistics	Bernard Spolsky	OUP, UK, 2018
Through the Language Glass	Guy Deutscher	Cornerstone, UK, 2011
Opening Minds	Peter H. Johnston	Stenhouse Publishers, US, 2012.
The Unfolding of Language,	Guy Deutscher	Cornerstone, UK, 2011

Course Evaluation

- The course evaluation will be carried out for 100 marks.

SLEN9030: Introduction to Literary Theory

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

Introduction to Literary Theory" is a foundational subject within the field of literary studies that examines various frameworks and approaches for interpreting and analyzing literature.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Overview of Literary Theory**: An introduction to the concept of literary theory, its purpose, and its relevance to the study of literature. This section may explore the evolution of literary theory from classical to contemporary approaches.	**5**	**10**
2.	**Formalism/New Criticism**: An examination of formalist approaches to literature, focusing on the analysis of literary texts based solely on their formal elements such as structure, language, and imagery. New Criticism, a prominent formalist approach, may be discussed in detail.	**5**	**10**
3.	**Structuralism and Semiotics:** Introduction to structuralist theory, which emphasizes the underlying structures and systems governing language and narrative. This section may include discussions on semiotics, the study of signs and signification, and its application to literary analysis.	**5**	**10**
4.	**Psychoanalytic Criticism**: Exploration of psychoanalytic approaches to literature, drawing on concepts and theories from Sigmund Freud and psychoanalytic thinkers. This section may examine how unconscious desires, fears, and conflicts manifest in literary texts.	**5**	**10**
5.	**Marxist Criticism**: Examination of Marxist literary theory, which analyzes literature in relation to social, economic, and political contexts. Topics may include class struggle, ideology, and the portrayal of power dynamics in literature.	**5**	**10**
6.	**Feminist Criticism and Gender Studies**: Discussion of feminist approaches to literature, focusing on gender roles, representation, and the critique of patriarchal norms in literary texts. This section may also cover LGBTQ+ studies and queer theory.	**5**	**10**
7.	**Postcolonial Criticism**: Exploration of postcolonial theory, which examines literature from the perspective of colonial and postcolonial contexts. This section may address themes such as	**5**	**10**

	imperialism, nationalism, identity, and cultural hybridity.		
8.	**Cultural Studies and Critical Race Theory**: Introduction to cultural studies as an intern disciplinary approach to literature, encompassing issues of race, ethnicity, nationality, and cultural identity. Critical race theory may be discussed in relation to the study of race and racism in literature.	**5**	**10**
9.	**Reader-Response Theory and Reception Studies**: Examination of reader-response theory, which emphasizes the role of the reader in interpreting and constructing meaning in literary texts. Reception studies may explore how literary works are received and interpreted by different audiences over time.	**5**	**5**
10.	**Postmodernism and Poststructuralism**: Overview of postmodern and poststructuralist theories, which challenge traditional notions of authorship, textuality, and meaning in literature. This section may include discussions on intertextuality, deconstruction, and the fragmentation of narrative.	**5**	**5**
11.	**Ecocriticism and Environmental Criticism:** Introduction to ecocritical approaches to literature, which examine the representation of nature, ecology, and the environment in literary texts. This section may address themes such as environmental degradation, eco-activism, and human-nature relationships.	**5**	**5**
12.	**Literary Theory in Practice:** Application of literary theories to specific literary texts or genres, allowing students to analyze and interpret literature using different theoretical frameworks.	**5**	**5**

Text Book(s):

Title	**Author/s**	**Publication**
How to Read Literature Like a Professor	Thomas C. Foster	
The Art of Fiction	John Gardner	
The Anatomy of Criticism	Northrop Frye	
Literary Theory: An Introduction	Terry Eagleton	

Course Evaluation

- The course evaluation will be carried out for 100 marks.

SLEN9040: Introduction to Literary Criticism

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

Course are multifaceted and aim to equip students with the analytical tools, critical perspectives, and theoretical frameworks necessary for engaging with and interpreting literature effectively.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Fundamentals of Literary Criticism:** An introduction to the basic concepts and principles of literary criticism, including the distinction between literary analysis and literary interpretation. This section may also discuss the role of the critic and the purpose of literary criticism.	5	10
2.	**Close Reading:** Close reading involves the detailed analysis of literary texts to uncover layers of meaning, themes, motifs, and literary devices. Students learn how to examine the language, structure, imagery, symbolism, and other elements of a text closely.	5	10
3.	**Historical Contexts:** Understanding the historical, cultural, and social contexts in which literary works were produced is crucial for interpreting them accurately. This section may explore how historical events, movements, and ideologies influence literature and shape literary meanings.	5	10
4.	**Biographical Criticism:** Biographical criticism examines the life, experiences, and personal background of an author to gain insights into their works. Students learn how biographical information can inform interpretations of literary texts but also the limitations of this approach.	5	10
5.	**Formalism and New Criticism:** Formalist approaches focus on the intrinsic qualities of literary texts, such as form, structure, language, and style. New Criticism, a prominent formalist approach, emphasizes close reading and textual analysis without considering external factors.	5	10
6.	**Reader-Response Criticism:** Reader-response criticism emphasizes the role of the reader in the interpretation and meaning-making process. Students learn how readers' personal experiences, beliefs, and cultural backgrounds influence their responses to literary texts.	5	10
7.	**Psychoanalytic Criticism:** Psychoanalytic criticism applies	5	10

	theories and concepts from psychology, particularly Freudian and Jungian psychoanalysis, to literary analysis. This section may explore how unconscious desires, fears, and conflicts manifest in literature.		
8.	**Marxist Criticism:** Marxist criticism examines literature through the lens of class struggle, ideology, and socio-economic power relations. Students learn how Marxist theory can be applied to analyze themes of social inequality, exploitation, and resistance in literary texts.	5	10
9.	**Feminist Criticism:** Feminist criticism focuses on gender issues, representation, and the portrayal of women in literature. This section may discuss feminist literary theory, gender roles, stereotypes, and the critique of patriarchal norms in literary works.	5	05
10.	**Postcolonial Criticism:** Postcolonial criticism examines literature from the perspective of colonial and postcolonial contexts, addressing themes of imperialism, nationalism, identity, and cultural hybridity. Students learn how postcolonial theory challenges Eurocentric interpretations of literature.	5	05
11.	**Literary Theory and Cultural Studies**: Exploring the intersection of literary theory and cultural studies, students examine how literature reflects and shapes cultural values, identities, and social norms. This section may cover topics such as cultural hegemony, representation, and identity politics.	5	05
12.	**Comparative Literary Criticism:** Comparative literary criticism involves the comparative analysis of literary texts from different cultures, languages, or historical periods. Students learn how comparative approaches can deepen their understanding of literary works and literary traditions.	5	05

Text Book(s):

Title	**Author/s**
How to Read Literature Like a Professor	Thomas C. Foster
The Norton Introduction to Literature	Kelly J. Mays
An Introduction to Literary Criticism	Michael Ryan
Ways of Reading	David Bartholomae and Anthony Petrosky
The Art of Fiction	John Gardner

Course Evaluation

- The course evaluation will be carried out for 100 marks.

SLEN9050: Introduction to Translation Studies

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100		--	--	--	--	100

Objective(s) of the Course:

To help learners to

Aourse are designed to provide students with a foundational understanding of the theory, practice, and complexities of translation.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Translation:** Overview of translation as a discipline, its history, and its significance in intercultural communication and global exchange of ideas.	5	10
2.	**Theories of Translation:** Introduction to key translation theories and concepts, such as equivalence, fidelity, dynamic equivalence, cultural translation, skopos theory, and the translator's invisibility.	5	10
3.	**Translation Techniques and Strategies:** Examination of various translation techniques and strategies used to transfer meaning from source to target language, including literal translation, paraphrasing, cultural adaptation, modulation, and compensation.	5	10
4.	**Types of Translation:** Exploration of different types of translation, such as literary translation, technical translation, legal translation, medical translation, audiovisual translation, and localization.	5	10
5.	**Translation Process:** Overview of the translation process, including analysis of the source text, translation drafting, revision, and proofreading. Discussion of the challenges and decision-making involved in each stage of the process.	4	10
6.	**Cultural and Linguistic Issues in Translation:** Examination of cultural and linguistic factors that influence translation, including cultural nuances, idiomatic expressions, linguistic register, linguistic variation, and pragmatic differences.	4	10
7.	**Ethical and Professional Considerations**: Discussion of ethical issues in translation, such as accuracy, fidelity, confidentiality, plagiarism, and conflicts of interest. Introduction to professional standards and codes of conduct in translation practice.	4	5
8.	**Translation Technologies**: Introduction to translation technologies and tools, such as computer-assisted translation	4	5

	(CAT) software, machine translation, translation memory systems, and terminology management tools.		
9.	**Specialized Translation Fields**: Exploration of specialized areas of translation, including legal translation, medical translation, technical translation, scientific translation, financial translation, and localization.	4	5
10.	**Literary Translation**: Examination of literary translation as a creative and interpretive process, with a focus on the challenges of translating literary texts across genres, cultures, and historical periods.	4	5
11.	**Audiovisual Translation:** Introduction to audiovisual translation modes, such as subtitling, dubbing, voice-over, and audio description. Discussion of the specific challenges and techniques involved in translating audiovisual content.	4	5
12.	**Quality Assessment and Evaluation**: Overview of methods and criteria for assessing the quality of translations, including linguistic accuracy, stylistic appropriateness, cultural fidelity, and readability.	4	5
13.	**Research Methods in Translation Studies**: Introduction to research methods and approaches used in translation studies, including qualitative and quantitative research methodologies, corpus analysis, and case studies.	4	5
14.	**Professional Development in Translation**: Discussion of career paths and opportunities in the field of translation, including freelance translation, in-house translation, interpretation, project management, and localization.	4	5

Text Book(s):

Title	**Author/s**
Translation Studies" by	Susan Bassnett
In Other Words: A Coursebook on Translation	Mona Baker
Translation in Global News	Esperança Bielsa and Susan Bassnett
The Translation Studies Reader	Lawrence Venuti:
Translation Changes Everything: Theory and Practice	Lawrence Venuti

Course Evaluation

- The course evaluation will be carried out for 100 marks.

P P SAVANI UNIVERSITY
PhD PROGRAMME

SLEN9060 Applied Linguistics & Current Trends in English Studies

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- Identify and describe the major fields in linguistics.
- Explain how language use (discourse, semantics, sociolinguistics) morphs under different conditions.
- Describe briefly the main points of a variety of language teaching methods and see the differences between them
- Enhance researcher's nuanced understanding of significant critical approaches to the study of literature, language and language pedagogy in the light of recent developments

Course Content:

Sr. No.	Topics	Hours	Weightage in %
1	**Language and Linguistics:** Scope of linguistics and its relevance in all the four modes LSRW, Approaches to the Study of Language, Theories of Applied Linguistics	15	25
2	**Language Analysis:** Levels and their hierarchy— phonetic/phonological, morphological, syntactic and semantic/pragmatic; their interrelations	15	25
3	**Branches Applied Linguistics** (Psycholinguistics, Language Learning and Introduction to Language Teaching, Translation, Lexicography, Computational Linguistics, Stylistics, Language and Media)	15	25
4	**Current Trends in English Studies (Any one)** Gender and Sexuality Studies, Dalit Studies, Translation Studies, New Directions in Comparative Studies, Narratological and Stylistic Studies, Migration Studies, Native Studies 8. Film and Cyber Literature Studies	15	25

Text Book(s):

Title	Author/s	Publication
An Introduction to Applied Linguistics: From Practice to Theory	Alan Davies	Edinburgh University Press
The Culture Industry: Selected Essays on Mass Culture. Ed. J. M. Bernstein. Routledge, 2001.	Theodor Adorno.	Cambridge University Press

Course Evaluation

- The course evaluation will be carried out of 100 marks (CE=40 Marks, 20 MCQs+ ESE=60 Marks, Subjective questions)

P P SAVANI UNIVERSITY
PhD PROGRAMME

SLEN9070 Literary Criticism

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- To acquaint learners with the art/craft of criticism of literary texts as have been practiced from the classical period to the early twentieth century.
- To provide the learners a broad survey of the history and development of literary criticism and theory in Western Culture from Plato and Aristotle to the early twentieth century.
- The learners would be familiarized with ideas as disparate as mimesis, representation, tragedy, republic, nature, the sublime, perception, the text, reception and so forth.
- The learners would be encouraged to read/analyse critically different texts from the lens provided by these concepts of criticisms and theories.

Course Content:

Sr. No.	Topics	Hours	Weightage in %
1	**Classical Criticism** Plato: The Republic Book 10 (Norton extracts) Aristotle: "On Representation" (section I-IX of Poetics)	15	25
2	**Poststructuralism: Reader-Oriented Theories- New Historicism-Postmodernism** Derrida: "Signature Event Context"/ "Structure, Sign and Play in the Discourse of Human Sciences" Barthes: "The Death of the Author"	15	25
3	**Queer Theory- Trauma Theory** Cathy Caruth: "The Wound and the Voice" (from Unclaimed Experience) Jeffrey C. Alexander: "Towards a Theory of Cultural Trauma"	15	25
4	**Ecocriticism-Ethical Criticism** Glotfelty: "Introduction" (The Ecocriticism Reader Irigaray: "An Ethics of Sexual Difference"	15	25

Text Book(s):

Title	Author/s	Publication
The Mirror and the Lamp: Romantic Theory and the Critical Tradition A Glossary of Literary Terms	Abrams, M.H Abrams, M.H., and Geoffrey Galt Harpham.	Oxford University Press Wadsworth, Cengage Learning,
An Introduction to Literature, Criticism and Theory	Andrew Bennett etc	Pearson Education India.
Critical and Cultural Theory.	Cavallaro, Dan	Athlone Press
The Theory Toolbox: Critical Concepts for the Humanities, Arts, and Social Sciences (Culture and Politics Series)	Nealon, Jeffrey T. and Susan Searls Giroux	Rowman and Littlefield, 2003.

Course Evaluation

- The course evaluation will be carried out of 100 marks (CE=40 Marks, 20 MCQs+ ESE=60 Marks, Subjective questions)

SLMG9010 General Management

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- To Understand the concepts related to Management
- To apply Multi-disciplinary learning journey focused on strategy, innovation in field of Management
- To explore the latest management principles and get prepared to face the management challenges

Course Content: Any 10 Topics will be covered out of listed below:

Sr. No.	Topic/s	Hours	Weightage in %
1.	Introduction to the Principles of Management & Planning	4	8
2.	Understanding How Organizations shape Behavior	4	8
3.	The Principal of Economics	4	8
4.	Understanding of Financial Accounting	4	8
5.	Introduction to Management Information System	4	8
6.	About Strategic management & it's environment	4	8
7.	Quantitative techniques in Decision Making	4	8
8.	Application of IT in Management	4	8
9.	Introduction of Environmental Issues	4	8
10.	Introduction to Production and Operation in Management	4	8
11.	Basic Theories of Entrepreneurship	2	7
12.	Social Responsibility and Managerial Ethics	2	7
13.	Contemporary Issues in Management	1	6

Text Book(s):

Title	Author/s	Publication
Management	Stephen Robbins, Mary Coulter	Person
Business Management	Paul JHoang	Paperback
Marketing Management	G.Shainesh Philip Kotler, Kevin lane Keller, Alexander Chernev, Jagdish N. Sheth	Paperback

Video Material Link(s):

https://www.youtube.com/watch?v=eI_VkTsjBnU
https://www.youtube.com/watch?v=NxJvS92uCus
https://www.youtube.com/watch?v=ZoKihFLCY0s
https://www.youtube.com/watch?v=QFpsW6zroag

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SLMG9020 Business Statistics for Contemporary Decision-Making

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:
To help learners to:

- Describe and discuss the key terminology, concepts tools, and techniques used in business statistical analysis.
- Critically evaluate the underlying assumptions of analysis tools.
- Understand and critically discuss the issues surrounding sampling and significance.
- Discuss critically the uses and limitations of statistical analysis.
- Solve a range of problems using the techniques. Conduct basic statistical analysis of data.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Statistics:** Statistics in Business, Basic Statistical Concepts, Data Measurement. **Charts and Graphs:** Frequency Distributions, Quantitative Data Graphs, Qualitative Data Graphs, Graphical depiction of Two- Variable Data: Scatter plots	6	10
2.	**Descriptive Statistics:** Measures of Central Tendency Unprogrammed Data, Measures of Variability Unprogrammed Data, Measures of central tendency and Variability: Grouped Data, measures of Shape, Descriptive statistics on the computer.	6	10
3.	**Decision Dilemma: Introduction to Probability**, Methods of Assigning Probabilities, the structure of Probability, Marginal, Union, Joint, and Conditional Probabilities, Addition Laws, multiplication Laws, Conditional Probability, Revision of Probabilities: Bayes' Rule	6	10
4.	**Discrete Distributions:** Discrete Versus Continuous Distributions, Describing a Discrete Distribution, Binomial Distribution, Poisson Distribution, or Hypergeometric Distribution. **Continuous Distributions:** The Uniform Distribution, Normal Distribution, Using the Normal Curve to Approximate Binomial Distribution Problems, Exponential Distribution.	6	10
5.	**Sampling and sampling Distribution:** Sampling, Sampling Distribution of X, Sampling Distribution Of p.	6	10
6.	**Statistical Inference: Estimation for Single Populations:** Estimating the Population Mean using the z Statistic, Estimating the population Mean using the t Statistic, Estimating the population Proportion, Estimating The population Variance, Estimating Sample Size.	6	10

	Statistical Inference: Hypothesis testing for Single Populations		
7.	**Statistical Inference About Two Populations:** Hypothesis Testing and Confidence Intervals About the Difference in two Means using the z statistic (population Variances Known) **Hypothesis Testing and Confidence Intervals About The difference in Two Means:** Independent samples and population Variances Unknown, statistical inferences for Two related populations, Statistical Inferences About two population proportions, testing hypotheses About Two Populations Proportions, Testing Hypothesis About Two populations variances.	6	10
8.	**Analysis of variances and Design of Experiments:** introduction to design of experiments, The completely Randomized design (one-way ANOVA), Multiple comparison tests, The Randomized block Design, A Factorial Design (Two-way ANOVA).	6	10
9.	**Simple Regression Analysis and Correlation**: correlation, Introduction to Simple regression Analysis, determining the Equation of the regression Line, Residual Analysis, Standard Error of the Estimate, Coefficient of determination, and Estimation.	6	10
10.	**Multiple Regression Analysis**: The Multiple Regression Model Significance Tests of the Regression Model and its coefficients, residuals, Standards error of the Estimate and $R^{2.}$	6	10

Text Book(s):

Title	Author/s	Publication
Business Statistics for Contemporary Decision-Making	Black, K	Wiley

Video Material Link(s):

- https://www.youtube.com/watch?v=BWbgiJz0_TA
- https://www.youtube.com/watch?v=BWbgiJz0_TA&t=213
- https://www.youtube.com/watch?v=BWbgiJz0_TA&t=397s
- https://www.youtube.com/watch?v=BWbgiJz0_TA&t=550s
- https://www.youtube.com/watch?v=BWbgiJz0_TA&t=701s
- https://www.youtube.com/watch?v=Vfo5le26IhY
- https://onlinecourses.nptel.ac.in/noc22_mg25/preview

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SNNR9010: Nursing Leadership

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Discuss the historical development of leadership and management theories and current approaches in the provision of quality nursing care.
- Describe leadership styles, behaviors, and characteristics of an effective leader.
- Develop effective strategies to implement patient safety and quality improvement initiatives in nursing practice.
- Demonstrate communication skills, motivation, leadership skills, stress and time management.
- Discuss the management of groups in relation to nursing leadership and management.
- Identify legal and ethical issues affecting nurse leaders and managers in a health care system.
- Demonstrate the ability to plan and effect change in nursing practice and in the health care delivery system.
- Demonstrate skill in conducting nursing research, interpreting and utilizing the findings from health-related research.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Fundamentals in Leadership** • Concept of leadership • Concept of professional nursing leadership • Evolution of nurse leadership • Core competencies of the professional nurse • Leader versus a manager. • Nursing knowing and knowledge • Professional self-concept • Characteristics of effective nurse leader	10	17
2.	**Leadership theories, Skills and Practice** • Common leadership theories (Trait, Contingency, Situational Theory, Transformational, Transactional, Behavioral Theory, Great Man, Path goal theory, Leader member exchange) • Common leadership styles in nursing. • Emotional intelligence and leadership • Leadership roles for nurses in health care organizations and educational institutions. • Communication in leadership • Leadership challenges in Changing Health Care Context and educational institutions. • Nursing Philosophy and Ethics	40	66

Module	Content	Hours	Weightage in %
	• Nursing knowing and nursing knowledge • Transformational Leadership • Nursing theories related to leadership • Theories of Motivation (Herzberg's two factor theory, Maslow's need Hierarchy theory, the Expectancy Theory, McGregor's Theory X/Theory Y, and the Goal Setting Theory) • Theories of networking in health care • Problem Solving and Critical Thinking • Innovative Technology in Nursing • Conflicts and resolution • Perception influencing leadership		
3.	**Leadership in Quality Management** • Concepts of Quality, Quality assessment and Quality Assurance in Nursing • Principles of total quality management • Approaches • Role of nurse leaders in quality management and patient safety	10	17

Text Book(s):

Title	Author/s	Publication
Introduction to spectroscopy: A guide for students of organic spectroscopy	Donald L. Pavia, Gary M. Lampman Geroge S. Kriz	Thomson Learning Academic Resource Center
Spectrometric Identification of Organic Compounds	Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce	John Wiley & Sons
Elementary Organic Spectroscopy	Y. R. Sharma	S. Chand

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SNNR9020: Principles of Management

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand and apply the knowledge of basic principles of management in healthcare delivery system in all healthcare settings
- Discuss the processes of management and their application to nursing practice.
- Appreciate leadership styles and their relevance to the nursing practice and profession.
- Discuss the process of change management in nursing with relevance to nursing practice.
- Discuss the planning, decision making in management of nursing in health care settings.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Fundamentals in Management and Theories of Management** • Concept of Management, Emergence of Profession, Definition, Nature, Scope, Purpose, and characteristics of Management • Functions, roles, skills of an effective Manager • Evolution of Management Thought - Classical Theory, Scientific Management - Management Process or Administrative Management, - Bureaucracy, Behavioural Science Approach, - Quantitative Approach, - Systems Approach, - Contingency Approach, - Operational Approach	10	17
2.	**Components /Functions of Management -1** • Planning **-** Types and Planning Process • Concept of Strategic Management and Types of Strategies • Understanding environment of business - Environmental appraisal - Industry Analysis - Porter's Model of competitive advantage -Analysis of organisational resources and capabilities • Forecasting and Premising - Meaning of Forecasting, -Essential Components in Forecasting -Determinants of Business Forecasts, -Benefits of Forecasting -Techniques of Forecasting -Limitations of Forecasting	20	33
3.	**Components/Functions of Management-2**	20	33

Module	Content	Hours	Weightage in %
	• Decision-making -Concept, -Components of Decision-making, - Decision-making Process, -Group Decision-making, -Creativity Problem-solving • Management by Objectives and Styles of Management -Core Concepts of MBO, -Characteristics of Management by Objectives, -Process of MBO, -Benefits & Limitations of Management by Objectives, -Styles of Management, • Organizing and Directing -Meaning, -Organizational Design & Hierarchical Systems, - Organization Structure and Types - Formal and Informal Organization, -Factors Determining Span of Management, -Centralization and Decentralization, -Span of control, -Understanding authority and responsibility, -Principles of Delegation, Authority -Developing a culture of Innovation and performance • Staffing and Coordination - Introduction on Human Resource Management, -Recent Trends in HRM, -Technology in HRM, -Economic Challenges, -Workforce Diversity, -Concept, Need and Importance of Coordination, - Principles of Coordination, -Coordination Process and Types of Coordination, -Issues and Systems Approach to Coordination, -Techniques of Coordination • Career Development Strategy - Concept and Elements of Career, -Overview Significance, Objectives and Advantages of Career Development - Types of Career Development Programme, -Different Stages of Career Development Process, - Career Anchors and Steps in the Career Planning Process		
4.	**Leadership styles, Organizational Communication in Management, Change management, Business challenges** Leadership - Leadership Concept, Nature, Importance, Attributes of a	10	17

Module	Content	Hours	Weightage in %
	leader, - Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture, and gender diversity in an organization, - Role of leader in conflict resolution and negotiations Organizational Communication - Introduction, Importance of Communication in the Workplace; - Understanding Communication Process, - Barriers to Communication, - Use of tone, language and styles in Communication, - Role of Perception and culture in influencing communication, Change management - Concept of change, - Change as a natural process, - Importance & Causes of change - Developing a climate for learning, - Concept of learning organizations Challenges of Contemporary Business -Role of Ethics, Corporate social responsibility, and environmental issues Financial management and budgeting Application of management to nursing practice		

Text Book(s):

Title	Author/s	Publication
Management of Nursing	Lamond, D, "A Matter of Style: Reconciling Henri and Henry," Management Decision 42, no. 2 (2004): 330–56.	Thomson Learning Academic Resource Center

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SPPT9010: Managing your Health: The Role of Physiotherapy & Exercise

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Explain the significance of physical activity and exercise in promoting overall health and well-being.
- Analyze the impact of different exercise modalities on cardiovascular disease, including their mechanisms of action and physiological effects.
- Evaluate the relationship between exercise and osteoporosis, including the role of exercise in prevention, management, and improving bone health.
- Investigate the influence of exercise on cancer risk reduction, treatment outcomes, and quality of life for individuals affected by cancer.
- Identify common sports injuries, their causes, symptoms, and appropriate preventive measures and treatment strategies.
- Assess the effects of exercise on arthritis, including its role in symptom management, joint health, and improving functional outcomes.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
1.	Principles, benefits, and importance of physical activity and exercise. Physiological and psychological effects of exercise, guidelines for safe and effective participation, and strategies for incorporating physical activity into daily routines for improved health and wellness.	10	16
2.	Relationship between exercise and cardiovascular health. Physiological adaptations induced by exercise, its impact on cardiovascular risk factors, and its role in preventing and managing cardiovascular diseases such as hypertension, coronary artery disease, and stroke. Exercise prescription strategies tailored to different populations, including those with existing cardiovascular conditions, emphasizing the importance of safe and effective exercise programming in promoting cardiovascular health and reducing the burden of cardiovascular disease on individuals and society.	10	16
3.	Nexus between exercise and osteoporosis management. Examining how weight-bearing, resistance, and impact exercises stimulate bone remodeling, density, and strength. Exercise's role in fracture prevention, risk reduction strategies, and exercise prescription considerations for individuals with osteoporosis or at risk. Interplay between nutrition, hormonal factors, and exercise in optimizing	15	25

	bone health. Practical applications encompass designing safe and effective exercise regimens.		
4.	Dynamic relationship between exercise and cancer. Exercise's influence on cancer risk reduction, treatment outcomes, and survivorship, encompassing its effects on tumor growth, immune function, and quality of life. Exercise prescription guidelines for cancer prevention and management across various cancer types and treatment modalities. Addressing common exercise-related concerns during and after cancer treatment, including fatigue, pain, and psychological well-being. Designing tailored exercise programs, integrating supportive care interventions.	10	16
5.	Prevalent sports-related injuries, including their causes, mechanisms, and management strategies. Acute injuries such as sprains, strains, and fractures, as well as overuse injuries like tendinopathies and stress fractures. Injury prevention strategies, including proper warm-up, conditioning, and biomechanical considerations. Diagnostic techniques, treatment modalities, and rehabilitation protocols for common sports injuries, Evidence-based practices and interdisciplinary approaches.	10	16
6.	Role of exercise in managing arthritis. Benefits of exercise for joint health, pain management, and improving functional outcomes. Exercise prescription guidelines, adaptive strategies, and considerations for different types and stages of arthritis to enhance quality of life.	05	11

Text Book(s):

Title	Author/s	Publication
"Exercise Physiology: Theory and Application to Fitness and Performance"	Scott K. Powers and Edward T. Howley	McGraw-Hill Educatio
"Exercise Physiology: Nutrition, Energy, and Human Performance"	William D. McArdle, Frank I. Katch, and Victor L. Katch	Lippincott Williams & Wilkins; 8th edition
Osteoporosis	Robert Marcus, David W. Dempster, Jane A. Cauley, David Feldman	eBook DRM-free (EPUB, PDF)
"Exercise and Cancer Survivorship"	Melinda L. Irwin and Kathryn H. Schmitz.	Springer
"Sports Medicine: Study Guide and Review for Boards"	Jonathan T. Finnoff and Mark A. Harras	Springer
"Exercise and Arthritis"	Margaret Rayman and Janet Lord	Peoples Medical Society

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SPPT9020: Ethics Review of Health Research

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the foundational principles of ethical considerations in biomedical research involving human participants, including the historical context and evolution of ethical guidelines in India.
- Analyze the contemporary issues and challenges in biomedical research ethics within the Indian context, considering cultural, societal, and regulatory frameworks.
- Evaluate the role and significance of various organizations and committees in India involved in shaping and implementing biomedical research ethics guidelines, including their functions, responsibilities, and impact on research practices.
- Apply the knowledge gained to critically assess research proposals, protocols, and practices to ensure compliance with ethical standards and guidelines in biomedical research involving human participants in India.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
1.	Introduction to Ethics Review of Health Research: Fundamental principles of research ethics in healthcare settings. Ethical theories, informed consent, confidentiality, and regulatory frameworks. Discussions on the importance of ethical review boards and case studies provide practical insights. Emphasis on ensuring ethical conduct and protecting participants' rights in health research.	10	16
2.	General Ethical Principles: Explores foundational ethical theories such as utilitarianism, deontology, and virtue ethics. Topics include moral reasoning, ethical decision-making frameworks, and application in various contexts. Discussions on autonomy, beneficence, and justice provide a comprehensive understanding of ethical principles guiding human conduct and interactions.	10	16
3.	Responsible Conduct of Research: Ethical guidelines, integrity, and professionalism in scientific inquiry. Data management, authorship, plagiarism, and conflicts of interest. Research misconduct, ethical dilemmas, and the role of institutional review boards ensure adherence to ethical standards and promote integrity in research practices.	15	25
4.	Review of Research Proposal: Evaluation criteria for research proposals, Clarity of objectives, methodology, ethical considerations, and significance of the study. Critical appraisal techniques and constructive feedback. Practical exercises and case studies enhance understanding.	10	16

5.	Protection of Research Participants: Ethical principles and regulatory frameworks safeguarding participants in research. Informed consent, privacy, confidentiality, and risk minimization. Vulnerable populations and research misconduct enhance understanding. Case studies and role-playing exercises provide practical insights.	10	16
6.	Group Discussion and Presentations: Communication skills, critical thinking, and collaboration. Effective presentation techniques, active listening, and constructive feedback. Practical exercises enhance public speaking and teamwork abilities. Emphasis on fostering a supportive and inclusive learning environment.	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Ethical Oversight in Health Research: An Introductory Guide	Dr. Emily Johnson	Springer
Ethics: Theory and Application	Dr. John Smith	Cambridge University Press
Ethics in Research: Principles and Practice	Dr. Samantha Miller	Oxford University Press
Research Proposal Evaluation: Principles and Practices	Dr. Benjamin Davis	Wiley
Ethics in Research: Ensuring Participant Protection	Dr. Rachel Adams	Oxford University Press
Effective Communication in Groups: Strategies for Discussion and Presentation	Dr. Laura Johnson	McGraw-Hill

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9010 Advance Techniques in Molecular Biology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- learn the principles behind advanced techniques, their applications, and the experimental design required for their implementation.
- integrate and analyze large-scale data sets generated from genomics, transcriptomics, proteomics, and metabolomics experiments.
- understand experimental variables, optimizing protocols, troubleshooting equipment issues, and interpreting unexpected results, fostering a comprehensive approach to scientific inquiry.
- Learn bioinformatics tools for biological data analysis

Course Content:

Module	Content	Hours	Weightage in %
1.	**Advanced Genomic Technologies** Introduction to next-generation sequencing (NGS) platforms and applications, Comparative genomics and evolutionary genomics Analysis of genomic variations: SNPs and structural variations Epigenomics: DNA methylation, histone modifications, and chromatin accessibility assays	10	16
2.	**Advanced Transcriptomic Techniques** Single-cell RNA sequencing (scRNA-seq) and spatial transcriptomics Isoform-level analysis and alternative splicing events, Transcriptome-wide association studies (TWAS) and expression quantitative trait loci (eQTL) analysis, Long-read sequencing technologies for transcriptomics	10	16
3.	**Advanced Proteomic Methods** Mass spectrometry-based proteomics: shotgun proteomics, targeted proteomics, and quantitative proteomics, Protein-protein interaction networks and pathway analysis, Structural proteomics and protein folding studies, Post-translational modifications (PTMs) analysis	15	25
4.	**Advanced Techniques in Molecular Imaging** Fluorescence microscopy: Live-cell imaging and single-molecule imaging, Molecular imaging in vivo: PET (Positron Emission Tomography), MRI (Magnetic Resonance Imaging), and bioluminescence imaging	10	16
5.	**Advanced Molecular Genetic Engineering** CRISPR-Cas systems: CRISPR-Cas9, base editing, prime editing, and CRISPR screening, Genome editing in non-model organisms and gene drive technologies, Synthetic biology approaches for pathway	10	16

	engineering and genome-scale engineering, Directed evolution and high-throughput screening methods for protein engineering		
6.	**Computational Analysis in Molecular Biology** Bioinformatics tools for omics data analysis: alignment, assembly, and annotation pipelines, Network analysis: gene regulatory networks, protein-protein interaction networks, and metabolic networks, Integration of multi-omics data	05	11

Text Book(s):

Title	Author/s	Publication
"Advanced Genomic Technologies"	Dr. Stephen H. Sekelsky, Dr. John F. Curnow, and Dr. Allan T. Soper	Oxford University Press, 2019
Advanced Techniques in Biophysics: Volume 1: Advanced Techniques in Molecular Imaging of Molecular Assemblies and Conformers	Enrico Gratton and Robert D. Weis	Springer; 1st ed. 2017 edition
"Bioinformatics Algorithms: An Active Learning Approach"	Phillip Compeau and Pavel Pevzner	Active Learning Publishers, 2015

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9020 Advances in Plant Microbe Interaction

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Explore the diverse interactions between plants and beneficial microbes, such as mycorrhizal fungi and nitrogen-fixing bacteria,
- Investigate the molecular mechanisms underlying plant-pathogen interactions, including the recognition of pathogens by plants, signal transduction pathways
- Examine symbiotic relationships between plants and microbes and to study plant-microbe interactions comprehensively.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Fundamentals of Plant-Microbe Interactions** Introduction to plant-microbe interactions: mutualistic, commensal, and pathogenic relationships, Molecular mechanisms underlying plant recognition of microbes and microbial colonization strategies, Signaling pathways involved in plant immune responses and microbial evasion strategies	10	16
2.	**Beneficial Microbes in Plant Health** Exploration of beneficial microbes: mycorrhizal fungi, rhizobia, and plant growth-promoting rhizobacteria (PGPR), Mechanisms by which beneficial microbes enhance plant growth, nutrient acquisition, and stress tolerance, Application of beneficial microbes in sustainable agriculture and bioremediation	10	16
3.	**Pathogen-Plant Interactions** Molecular mechanisms of plant defense against pathogens: pattern-triggered immunity (PTI) and effector-triggered immunity (ETI) Virulence strategies deployed by pathogens to overcome plant defenses, Epidemiology of plant diseases and strategies for disease management	15	25
4.	**Molecular Dialogues in Symbiotic Associations** Molecular basis of symbiotic interactions: nodulation in legumes, arbuscular mycorrhizal symbiosis, and endophytic associations Genetic determinants and signaling pathways involved in establishing and maintaining symbiotic relationships, Impact of symbiotic associations on plant fitness, nutrient cycling, and ecosystem resilience	10	16
5.	**Omics Technologies in Plant-Microbe Interaction Studies** Genomic, transcriptomic, proteomic, and metabolomic approaches for studying plant-microbe interactions, High-throughput	10	16

	sequencing and bioinformatics tools for analyzing microbial communities associated with plants, Integration of omics data to decipher complex regulatory networks and identify key genes and pathways modulating plant-microbe interactions		
6.	**Applications and Future Directions** Biotechnological applications of insights gained from studying plant-microbe interactions: biofertilizers, biocontrol agents, and microbial inoculants, Harnessing microbiome engineering for crop improvement and sustainable agriculture, Emerging trends and future directions in plant-microbe interaction research, including synthetic biology approaches and microbiome-based precision agriculture	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Plant Microbe Interactions	Michael G. A. van der Heijden, Ian R. Sanders	CRC Press; 1st edition
Plant Pathology Concepts and Laboratory Exercises	Robert N. Trigiano, Bonnie H. Ownley, and Mark T. Windham	CRC Press; 3rd edition
Omics Technologies in Crop Improvement: Principles and Application	Santosh Kumar Upadhyay and K.V. Ravikumar	Springer; 1st edition

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9030: Advance Techniques in Proteomics

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Know advanced proteomic techniques for protein identification, quantification, and characterization.
- Explore emerging technologies and methodologies in proteomics research.
- Develop proficiency in experimental design, data analysis, and interpretation of proteomic data.
- Critically evaluate current literature and contribute to the advancement of proteomics knowledge through independent research.
- Communicate scientific findings effectively through seminar presentations and written reports.

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Course Content:

Module	Content	Hours	Weightage in %
1.	**Advanced Protein Separation Techniques & Instrumentation:** Multi-dimensional chromatography: 2D-LC, SCX-RP. Capillary electrophoresis-based methods. High-resolution separation techniques: UPLC, nano LC, Orbitrap mass analyzers, Hybrid mass spectrometers: Q-TOF, Q-Exactive, Top-down proteomics, Advances in ion mobility spectrometry.	10	16
2.	**Post Translational Modification Strategies & Interaction Proteomics:** Enrichment strategies for PTMs, Phosphoproteomics: phosphopeptide enrichment, phospho-site localization, Glycoproteomics: lectin affinity chromatography, hydrazide chemistry, Protein interaction networks and functional annotation.	10	16
3.	**Spatial Proteomics and sub-cellular localization:** •Subcellular fractionation techniques, Mass spectrometry imaging, •Proximity labeling approaches: BioID, APEX., Protein structure prediction algorithms, Hydrogen-deuterium exchange mass spectrometry (HDX-MS), Cryo-electron microscopy (Cryo-EM) in structural proteomics.	15	25
4.	**Single cell proteomics and spatial Omics:** • Single-cell sample preparation techniques. Spatially resolved proteomics methods. Applications in developmental biology, neuroscience, and cancer research.	10	16
5.	**Clinical Proteomics and Translational Research:** Biomarker discovery and validation. Proteomic profiling of disease states. Personalized medicine approaches.	10	16
6.	**Bioinformatics for Proteomics Data Analysis:** Proteomic	05	11

	database search algorithms: MaxQuant, Proteome Discoverer. Machine learning approaches for proteomics, Integration of proteomic data with other omics datasets.		

Text Book(s):

Title	**Author/s**	**Publication**
Mass Spectrometry-Based Proteomics	Kris Gevaert	Humana Press
Proteomics: From Protein Sequence to Function	S. Pennington and L. Dunn.	Routledge Taylor & Francis Group
Protein Purification: Principles & Practice	Robert K. Scopes	Springer-Verlag

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9040: Principles Of Genetic Engineering

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the fundamental principles underlying genetic engineering techniques.
- Become proficient in the application of molecular tools for gene manipulation.
- Explore advanced concepts in genetic engineering such as genome editing and synthetic biology.
- Critically evaluate current research literature and ethical implications of genetic engineering.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Genetic Engineering & Gene cloning Techniques:** • Historical overview, Basic principles of molecular biology, Applications in medicine, agriculture, and industry, Restriction enzymes and DNA ligation, Plasmid vectors and transformation, Gene libraries and screening.	10	16
2.	**Molecular Tools for Genetic Manipulation & Genome Editing Technologies:** PCR (Polymerase Chain Reaction), DNA sequencing methods, Gene expression analysis techniques, CRISPR-Cas9 and other nucleases, Applications in gene therapy and biotechnology, Ethical considerations of genome editing	10	16
3.	**Synthetic Biology & Metabolic Engineering:** Engineering biological circuits, Designing synthetic genomes, Applications in biofuels, pharmaceuticals, and beyond, Pathway engineering for compound production, Optimization strategies, Systems biology approaches	15	25
4.	**Transgenic Organisms & Genetic Modification:** Transgenic animal and plant production, Regulation of genetically modified organisms (GMOs), Environmental and socio-economic impacts	10	16
5.	**Bioethics & Regulatory Framework:** Ethical considerations in genetic engineering, Regulation of biotechnological research and applications, public perception and engagement.	10	16
6.	**Case Studies and Applications**: Success stories in genetic engineering, Challenges and limitations, Future prospects	05	11

Text Book(s):

Title	Author/s	Publication
Molecular Biology of the Gene	James D. Watson	Pearson
Principles of Gene Manipulation and Genomics	Sandy B. Primrose and Richard M. Twyman	Wiley-Blackwell
Genetic Engineering	Jane K. Setlow	Springer

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9050: Microbial Physiology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Gain a comprehensive understanding of microbial metabolism and its regulation.
- Explore the mechanisms underlying microbial growth, survival, and stress responses.
- Examine the interplay between microbial physiology and environmental factors.
- Critically analyze current research literature in microbial physiology.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Microbial Physiology & Cellular Structure and Function:** Overview of microbial diversity, Importance of microbial physiology in biotechnology and ecology. Tools and techniques in microbial physiology research, Cell morphology and organization, Membrane transport mechanisms, Cell wall structure and composition.	10	16
2.	**Metabolic Pathways in Microorganisms & Regulation of Metabolism**: Overview of central metabolic pathways, Aerobic and anaerobic respiration, Fermentation pathways and products, Transcriptional and post-translational regulation of metabolic pathways	10	16
3.	**Energy Generation & Nutrient Uptake & Assimilation:** ATP synthesis and energy conservation, Chemiosmotic theory, Alternative energy sources in microorganisms, Transport systems for carbon, nitrogen, and other nutrients, Metabolic pathways for nutrient assimilation, Regulation of nutrient uptake and utilization.	15	25
4.	**Microbial Growth Kinetics & Stress Responses:** Growth curve analysis, Factors influencing microbial growth rates, Responses to temperature, pH, osmotic, and oxidative stresses, Heat shock response and chaperone-mediated protein folding, Adaptive mechanisms for survival in hostile environments.	10	16
5.	**Quorum Sensing, Cell-Cell Signaling & Biofilm Formation and Persistence:** Mechanisms of quorum sensing in bacteria, Role of quorum sensing in microbial physiology and pathogenesis, Interference with quorum sensing for biocontrol and therapeutics, Stages of biofilm development, Regulation of biofilm formation, significance of biofilms in microbial communities and disease	10	16
6.	**Host-Microbe Interactions & Emerging Topics:** Microbial pathogenesis and virulence factors, Immune evasion strategies of pathogens, Commensalism and symbiosis in host-associated	05	11

	microbiomes, Microbial synthetic biology, Systems biology approaches to studying microbial physiology		

Text Book(s):

Title	**Author/s**	**Publication**
Microbial Physiology	Albert G. Moat, John W. Foster, and Michael P. Spector.	Wiley-Liss
Microbial Physiology and Metabolism	Daniel R. Caldwell.	Wiley-Blackwell
Principles of Microbial Physiology	J. Wood.	Wiley-Blackwell

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9060 Molecular Biology & rDNA Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand the fundamental concepts and principles of molecular biology, including DNA replication, transcription, translation, and gene regulation
- Equip students with the theoretical knowledge and practical skills necessary to perform recombinant DNA (rDNA) technology experiments
- Explore the diverse applications of molecular biology and rDNA technology in both research and industrial settings.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Molecular Biology** Overview of molecular biology principles: DNA structure, replication, transcription, and translation, Central dogma of molecular biology and genetic information flow, Basic laboratory techniques in molecular biology: DNA extraction, gel electrophoresis, and spectrophotometry	10	16
2.	**Recombinant DNA Technology Basics** Principles of recombinant DNA technology: gene cloning, DNA recombination, and molecular cloning techniques, Restriction enzymes and DNA ligases: mechanisms and applications in gene manipulation, Construction and analysis of recombinant DNA molecules: vector selection, DNA library preparation, and screening methods	10	16
3.	**Polymerase Chain Reaction (PCR)** PCR theory and applications: amplification of DNA sequences, including genomic DNA, cDNA, and plasmids, PCR primer design, optimization, and troubleshooting, Variations of PCR: quantitative PCR (qPCR), reverse transcription PCR (RT-PCR), and nested PCR	15	25
4.	**Gene Expression Analysis** Techniques for studying gene expression: Northern blotting, RT-PCR, and RNA sequencing (RNA-seq), Transcriptional regulation: mechanisms of gene regulation, transcription factors, and promoter analysis, Analysis of post-transcriptional modifications: mRNA processing, splicing, and stability	10	16
5.	**Protein Expression and Purification** Protein expression systems: bacterial, yeast, insect, and mammalian expression systems, Protein purification techniques: chromatography, electrophoresis, and affinity purification,	10	16

	Strategies for enhancing protein expression and solubility, and post-translational modifications		
6.	**Applications of rDNA Technology** Biotechnological applications of rDNA technology: recombinant protein production, gene therapy, and genetic engineering of organisms, Molecular diagnostics: PCR-based assays for detection of pathogens and genetic diseases, Ethical and regulatory considerations in rDNA technology: biosafety guidelines, intellectual property rights, and societal impacts	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Gene Cloning and DNA Analysis.	Brown TA.	Blackwell
Molecular Biotechnology- Principles and Applications of recombinant DNA.	Glick, B.R., Pasternak, J.J.	ASM Press
Principles of Gene Manipulation and Genomics	Primrose SB and Twyman RM	Blackwell

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSBT9080: Genomics: Decoding Universal language of Life

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the fundamental principles underlying genomics and genome organization.
- Become proficient in genomic data analysis techniques and bioinformatics tools.
- Explore advanced topics in genomics research, including comparative and functional genomics.
- Critically evaluate current research literature and applications of genomics in diverse fields.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Genomics:** •Historical perspective, Central dogma of molecular biology, Impact of genomics on biology and medicine, Transcriptomics: RNA-Seq and gene expression analysis, Proteomics: Mass spectrometry and protein identification, Metagenomics: Analysis of microbial communities	10	16
2.	**Genome Sequencing Technologies:** Sanger sequencing, Next generation sequencing platforms, Third generation sequencing technologies (PaceBio, Nanopore),	10	16
3.	**Genome Assembly, Annotation & Genomic Variation:** •Genome assembly algorithms and strategies, Gene prediction and annotation pipelines, Challenges and limitations in genome assembly and annotation, • Single nucleotide polymorphisms (SNPs) and indels Copy number variations (CNVs), Association studies and genome-wide association studies (GWAS).	15	25
4.	**Structural Genomics & Evolutionary Genomics:** Structural variation analysis, molecular evolution and phylogenetics, Comparative genomics of model organisms, Genomic insights into adaptation and speciation.	10	16
5.	**Meta Genomics & System Biology Analysis:** Metagenomic sequencing approaches, Microbial community analysis, Ecological and functional implications of microbial diversity, Reconstruction of biological networks, Pathway analysis and functional modules, Systems biology approaches to complex traits and diseases.	10	16
6.	**Emerging Technologies:** Single cell genomics, Long read sequencing platforms, artificial intelligence and machine learning in genomics.	05	11

Text Book(s):

Title	Author/s	Publication

Genomics: The Science and Technology Behind the Human Genome Project	Arthur M. Lesk	Wiley-Blackwell.
Principles of Genome Analysis and Genomics	Sandy B. Primrose and Richard M. Twyman.	Wiley-Blackwell.
Genomics: Essential Methods	Tore Samuelsson and Mårten Larsson	Horizon Scientific Press.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

P P SAVANI UNIVERSITY
PhD PROGRAMME

SSBT9090 Functional Genomics

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- providing comprehensive approaches to understand the genome functions
- develop and promote high throughput and large-scale approaches to investigate the function of the genomes, their products and the interactions between the two.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
1.	**Introduction to Functional Genomics**: Pre- and post-genomic era; major advancements in genomic approaches; epigenetics and metagenomics; forward versus reverse genetics	10	15
2.	**Genome Analyses - Part 1**: Genome editing approaches and their applications; gene expression analyses and applications	15	20
3.	**Genome Analyses - Part 2**: Methods for DNA/RNA sequencing, sequence analysis and their applications	10	20
4.	**Comparative Genomics**: Genomic insight into evolution; power of comparative genomic analysis	10	20
5.	Genome Editing via ZFNs, TALENs and CRISPR Cas Technology	15	25

Text Book/Reference Book (s):

Title	Author/s	Publication
Functional Genomics: Methods and Protocols (Methods in Molecular Biology)	Michael Kaufmann, Claudia Klinger, Andreas Savelsbergh	Humana; 3rd ed. 2017 edition (5 November 2017)
Crispr: Biology and Applications	Rodolphe Barrangou, Erik J. Sontheimer, Luciano A. Marraffini	John Wiley & Sons, Inc.
Comparative Genomics	Melody Clark	Springer-Verlag New York Inc.

Video Material Link(s):

- https://onlinecourses.nptel.ac.in/noc21_bt39/preview

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9010: Polymer Chemistry

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand the general structure of polymers, concept of molecular weight, degree of polymerization and mass fraction of chains present.
- gain knowledge about molecular weight determination via different techniques.
- distinguish between entropic and enthalpic contributions to understand crystallization.
- calculate the solubility of a given polymer in a given solvent, as well as the mutual miscibility of various polymer types.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction and Nomenclature:** Important concepts such as - monomer, functionality and physical state (amorphous and crystalline), Nomenclature of Polymers (IUPAC names, trade or commercial names, source based and structure-based names of various polymers. Abbreviations and grades of polymers) **Classifications of polymers:** On the basis of source (natural, synthetic & semi-synthetic), backbone composition (organic & inorganic polymer, homo & co-polymer, homo-chain & hetero-chain polymer), polymerization (addition & condensation), effect of heat (thermo-plastic polymers & thermo-setting polymers), geometric isomerism (cis-& trans-polymers) and stereo isomerism (tacticity- iso, syndiotactic, atactic polymers) molecular structure (linear, branched & cross-linked), microstructure (amorphous, crystalline & semi-crystalline). **Kinetics and mechanism of polymerization processes:** Chain reaction (Addition) polymerization: Free radical addition polymerization mechanism of vinyl polymerization, generation of free radicals, initiation, propagation, termination. **Kinetics of free radical addition polymerization:** experimental determination of rate constants, derivations for rate expressions and expressions for kinetic chain length and hence degree of polymerization. **Ionic and coordination chain (addition) polymerization:** common features of two types of ionic polymerization, Mechanism of cationic polymerization, expressions for overall rate of polymerization and the number average degree of polymerization.	15	25

	Mechanism of anionic, polymerization, expressions for overall rate of polymerization and the average degree of polymerization, living polymers. Mechanism of coordination polymerization – Ziegler-Natta catalysts, expressions for overall rate of polymerization. Ring opening polymerization-mechanism of polymerization of cyclic ethers, cyclic amides and cyclosiloxanes.		
2.	**Controlled polymerization methods:** Plasma polymerization, Photo polymerization, Electrochemical polymerization, Nitroxide mediated polymerization (NMD), Metathesis polymerization, Group transfer polymerization (GTP), Atom Transfer Radical Polymerization (ATRP), Reversible addition-fragmentation chain transfer polymerization (RAFT). **Phase System in polymerization:** Bulk polymerization, solution polymerization, Precipitation polymerization, Suspension polymerization, Industrial polymerization, and Emulsion polymerizations (Polymerization using metal catalysts and surfactants). **Specialty polymers:** Bio-polymers, Bio-degradable polymers, Fire retardant / Thermally stable polymers, Polymer electrolytes, Liquid armor polymers, conducting polymers (Electrically conducting polymers and their uses), Photoconductive polymers, Liquid crystal polymers (smectic, nematic and cholesteric structures).	15	25
3.	**Concepts of molecular weight in terms of polymer:** Types molecular weights (number average molecular weight, weight average molecular weight, and z-average molecular weight, definition and mathematical expressions), molecular weight distribution and its importance from the point of applications and polydispersity index. Methods to determine molecular weight of polymer- Fractional Precipitation, Fractional Elution, GPC, End group analysis, cryoscopic method, ebulliometric metric methods, membrane osmometry, vapour phase osmometry, light scattering, ultracentrifugation & viscometry.	15	25
4.	**Solution Properties and Thermodynamic Aspects of polymer:** Solution properties of polymer: Criteria of polymer solubility, conformations of dissolved polymer chain, stages and thermodynamics of polymer solutions nature (size and shape) of polymer in solutions, theta temperature, viscosity of dilute solution, phase separation in polymer solutions, moderately highly concentrated solutions. Thermodynamic Aspects of polymer Configurations of polymer chains, crystal structures of polymers, Morphology of polymer single crystals, structure of polymers crystallized from melt and solution, crystallization processes and kinetics, melting and glass transition temperature, Factors affecting Tm and Tg,	15	25

	DSC: theory, principle & interpretations of DSC thermogram, Applications- heat of fusion and degree of crystallinity or isotacticity, Random copolymer structure, Block copolymer structure, Polymer mixture melting point depression by diluents, crystallization, melt crystallization, cold crystallization, Tg, Tm, determination of blend composition, purity, identification of unknown, degree of crystallization. Thermogravimetric analysis: principle, theory, Applications- purity, identification of polymers and rubbers, thermal stability, thermal degradation, kinetics of thermal degradation. Principles of DMA and TMA-applications.		

Text Book(s):

Title	**Author/s**	**Publication**
Polymer Chemistry	V. R. Govariker & N. V. Vishwanathan	New Age International Publishers, India
Textbook of Polymer Science	Fred W. Bilmeyer	Wiley, India
Principles of Polymer Science	P. Bahadur & N. V. Sastry	Narosa Publishers, India.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9020: Organic Spectroscopy

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- obtain knowledge about the interactions of electromagnetic radiation with matter and their applications.
- be able to analyse and interpret spectroscopic data and understand molecular symmetry, purity and study molecular interactions by choosing suitable spectroscopic methods.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Ultraviolet Spectroscopy:** Introduction, the nature of electronic excitations, the origin of UV band structure, principle of absorption spectroscopy, Double beam and single beam UV-Visible, Chromophore, Auxochromes, bathochromic shift, hypsochromic shift, hyperchromic effect, hypochromic effect, effect of conjugation, Woodward-Fieser Rule, Substituents with unshared electrons, capable of pi-conjugation, Visible spectra-colour in compounds, Interpretation of UV spectra and examples.	15	25
2.	**Infrared Spectroscopy:** Introduction, IR absorption process, Different types of modes of stretching and bending, selection rule of IR, IR Instrumentation (FTIR spectrometer), preparation of samples for IR, Survey of important functional groups, Interpretation of IR spectra, examples, applications of IR spectrum.	15	25
3.	**^{1}H NMR Spectroscopy:** Basic theory – phenomenon of energy absorptions (resonance), mechanism of absorption, population densities of nuclear spin state, chemical shift, shielding, deshielding, continuous wave NMR spectrometer, Pulsed FT NMR, local dimegnetic shielding, chemical equivalence, chemical environment and chemical shift, magnetic anisotropy, spin–spin splitting origin and spin-spin splitting (n+1) rule, the coupling constant, A comparison of NMR spectra at low and high field strength, Interpretation of ^{1}H NMR spectra of organic compounds, examples. ^{13}C NMR Spectroscopy: Principles, calculation of ^{13}C chemical shift,	15	25

	broad band decoupling, Proton coupled and decoupled ^{13}C Spectra, Nuclear Overhauser enhancement (NOE), DEPT, Interpretation of ^{1}H NMR spectra of organic compounds and structural applications of ^{13}C NMR.		
4.	**Mass Spectrometry:** What Is Mass Spectrometry?, Mass Spectrometer, Mass Spectrum, Symbols and meaning, Sample introduction, ionisation principle and ion sources (electron ionisation, chemical ionisation, laser-induced desorption, chemical and photon ionisation at atmospheric pressure and electrospray), Mechanism of Ionizations (Protonation, Cationization, Deprotonation, Transfer of a Charged Molecule into the Gas Phase, Electron Ejection, Electron Capture), Calibration (Calibration for FAB, Calibration for MALDI, Calibration for Electrospray), Resolution, Mass Analysers (Quadrupole analyser, ion trap, Magnetic Mass Analyzer, Double-Focusing Magnetic Sector Mass Analyzer, Time-of-Flight Analyzer, Time-of-Flight Reflectron, Fourier Transform-Ion Cyclotron Resonance), Tandem Mass Spectrometry (MS/MS with a Triple-Quadrupole Mass Spectrometer, MS/MS with a Time-of-Flight Refiectron Mass Spectrometer, MS/MS with a Fourier Transform-Ion Cyclotron Resonance, MS/MS with an Ion Trap), Ion Detector (Faraday Cup, Electron Multiplier, Photomultiplier Conversion Dynode (Scintillation Counting or Daly Detector), Information received from a chromatogram, determination of molecular weights and molecular formulas, Isotope ratio data, fragmentation pattern of small molecules, Interpretation of spectra, Connection of separation methods (gas chromatography, liquid chromatography and capillary electrophoresis) to mass spectrometry. Data management. Strategies for both relative and absolute quantification. Analytical applications based on chromatographic and capillary electrophoretic methods.	15	25

Text Book(s):

Title	Author/s	Publication
Introduction to spectroscopy: A guide for students of organic spectroscopy	Donald L. Pavia, Gary M. Lampman Geroge S. Kriz	Thomson Learning Academic Resource Center
Spectrometric Identification of Organic Compounds	Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce	John Wiley & Sons
Elementary Organic Spectroscopy	Y. R. Sharma	S. Chand

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9030: Microscopy Techniques

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- understand theory and the practice of imaging using light microscopy. They also learn working of AFM and its data analysis.
- provide detailed information on electron microscopic technology (EM) including both Transmission electron microscopy (TEM) and Scanning electron microscopy (SEM).

Course Content:

Module	Content	Hours	Weightage in %
1.	**Light Microscopy:** Telescopes, Microscopes and the Eye. Numerical Aperture, Depth of Focus Contrast Mechanisms in optical microscopy: Bright field, Dark Field, DIC, Phase Contrast, Staining Role of Illumination: Koehler Illumination, Sample Preparation, Manipulation, and Micrometry, **Polarized Light Microscopy:** Plane Polarized Light, Double Refraction and Calcite, Plane Polarized Light and Birefringent Materials, Polarizing Light Microscopes, Interference Colors and Extinction Points, Retardation Plates and Compensators Example and Applications	15	25
2.	**Atomic Force Microscopy (AFM):** Introduction, AFM instrumentation, AFM modes, Sample preparation for AFM, Measuring AFM images in different modes, AFM image processing and Analysis, Artefact, Applications	15	25
3.	**Scanning Electron Microscopy (SEM):** Introduction and brief history of SEM, Component in SEM, Image formation, Beam specimen interaction, Origin of backscattered and secondary electrons, Types of contrast, Resolution, Depth of field, Influence of Operational Parameters on SEM Images, Effects of Electron Beam on the Specimen Surface, Influence of External Factors on SEM Imaging, Safety Requirements, Sample Preparation, Applications	15	25
4.	**Transmittance Electron Microscopy:** Some Fundamental Properties of Electrons, Why Use Electrons for the study of materials, History, Microscopy and the Concept of	15	25

	Resolution, Interaction of Electrons with Matter, Depth of Field and Depth of focus, Diffraction, Limitations of the TEM, Sampling, Interpreting Transmission Images, Electron Beam Damage and Safety, Specimen Preparation, Different types of TEMs, Microscopy and Analysis Software, tomography, EDAX.		

Text Book(s):

Title	**Author/s**	**Publication**
Elements of Applied Microscopy. a Text-Book for Beginners	Winslow C-E .A	Hardpress Publishing
Atomic Force Microscopy (AFM): Principles, Modes of Operation and Limitations	Hongshun Yang	Nova Publishers
Introduction to Light Microscopy: Tips and Tricks for Beginners	Dee Lawlor	Springer

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9040: Organic Reaction & Mechanism

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

- The present study enhances student's knowledge about Organic chemistry to understand their role in the field of sciences

Course Content:

Module	Content	Hours	Weightage in %
1.	**Rearrangement involving migration to electron deficient carbon:** (i) Expansion and contraction of rings/Demajnov rearrangement (ii) Benzil-benzilic acid rearrangement, Wagner-Meerwein, (iii) Pinacol-pinacolone, (iv) Wolf (Arndt-Eisterts Synthesis) (v) Rupe and Demjanov rearrangement **Rearrangement involving migration to electron rich carbon:** (i) Favorskii rearrangement (ii) Neber rearrangement (iii) Witting rearrangement (iv) Steven's rearrangement (v) Sommelet-Houser rearrangement **Rearrangement involving migration to electron deficient nitrogen:** (i) Schmidt rearrangement (ii) Curtius rearrangement Hofman, Curtius, Lossen and Beckmann rearrangement, Aromatic rearrangements: (i) Migration around the aromatic nucleus: Jacobsen rearrangement (ii) Migration of group from the side chain to the nucleus: Orton rearrangement, Hoffmann-Martius rearrangement, Rearrangement of Nnitrosoanilines (Fischer- Hepp rearrangement). Benzidine rearrangement and Free radical rearrangements **Rearrangement involving migration from oxygen to ring** (i) Fries rearrangement (ii) Claisen rearrangement Rearrangement electron deficient oxygen: (i) Baeyer Villiger rearrangement.	17	33

2.	**Oxidation** Introduction, Oxidation with Cr (VI), Mn (VII), Mn (IV), OsO_4, Periodic acid, Peroxy acid. Oxidation of hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and inactivated), aldehyde and ketones. **Reduction** Introduction, different reductive processes, hydrocarbons-alkenes, alkynes and aromatic rings, Carbonyl compounds- aldehydes, ketones, ($LiAlH_4$, $NaBH_4$ only for aldehyde and ketone) acids and their derivatives, epoxides, nitro, nitroso, azo and oxime groups, Birch reduction, Shapiro reduction.	13	17
3.	**Aromatic electrophilic substitution** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Qualitative treatment of reactivity in substrates and electrophiles. Diazonoium coupling, Vilsmeir reaction, Gattermann-Koch reaction. **Aromatic Nucleophilic Substitution** The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser, and Smile's rearrangements.	15	25
4.	**Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions; (1) Ugi reaction (2) Noyori reaction (3) Wittig reaction (4) Peterson olefination reaction (5) Mannich reaction (6) Stille reaction (7) Ene reaction (8) Staudinger reaction (9) Corey-Fuchs reaction (10) Ritter reaction (11) MacMurray reaction (12) Michael addition.	15	25

Text Book(s):

Title	Author/s	Publication
Organic synthesis using transition metals	Roderick Bates	Wiley
Organic chemistry	J. Clayden, N. Greeves, S. Warren and P. Wothers	Oxford Press
Some modern methods of organic synthesis	W. Carruthers	Cambridge
Guidebook to organic synthesis	R K Meckie, D M Smith and R A Atken	Wiley

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9050: Experimental Techniques in Chemistry

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- obtain knowledge about the interactions of electromagnetic radiation with matter and their applications.
- be able to analyze and interpret spectroscopic data and understand molecular symmetry, and purity, and study molecular interactions by choosing suitable spectroscopic methods.
- provide detailed information on electron microscopic technology (EM) including both Transmission electron microscopy (TEM) and Scanning electron microscopy (SEM).

Course Content:

Module	Content	Hours	Weightage in %
1.	**Ultraviolet Spectroscopy**: Introduction, the nature of electronic excitations, the origin of UV band structure, principle of absorption spectroscopy, Double beam and single beam UV-Visible, Chromophore, Auxochromes, bathochromic shift, hypsochromic shift, hyperchromic effect, hypochromic effect, effect of conjugation, Woodward-Fieser Rule, Substituents with unshared electrons, capable of pi-conjugation, Visible spectra-colour in compounds, Interpretation of UV spectra and examples.	10	16
2.	**Infrared Spectroscopy:** Introduction, IR absorption process, Different types of modes of stretching and bending, selection rule of IR, IR Instrumentation (FTIR spectrometer), preparation of samples for IR, Survey of important functional groups, Interpretation of IR spectra, examples, applications of IR spectrum.	10	16
3.	**^{1}H NMR Spectroscopy:** Basic theory – phenomenon of energy absorptions (resonance), mechanism of absorption, population densities of nuclear spin state, chemical shift, shielding, deshielding, continuous wave NMR spectrometer, Pulsed FT NMR, local dimegnetic shielding, chemical equivalence, chemical environment and chemical shift, magnetic anisotropy, spin–spin splitting origin and spin-spin splitting (n+1) rule, the coupling constant, A comparison of NMR spectra at low and high field strength, Interpretation of ^{1}H NMR spectra of organic compounds, examples.	15	25
4.	**^{13}C NMR Spectroscopy:** Principles, calculation of ^{13}C chemical shift, broad band decoupling, Proton coupled and decoupled ^{13}C Spectra, Nuclear Overhauser enhancement (NOE), DEPT, Interpretation of ^{1}H NMR spectra of organic compounds and structural applications of ^{13}C NMR.	10	16
5.	**Scanning Electron Microscopy:** Introduction and brief history of	10	16

	SEM, Component in SEM, Image formation, Beam specimen interaction, Origin of backscattered and secondary electrons, Types of contrast, Resolution, Depth of field, Influence of Operational Parameters on SEM Images, Effects of Electron Beam on the Specimen Surface, Influence of External Factors on SEM Imaging, Safety Requirements, Sample Preparation, Applications		
6.	**Transmittance Electron Microscopy:** Some Fundamental Properties of Electrons, Why Use Electrons for the study of materials, History, Microscopy and the Concept of Resolution, Interaction of Electrons with Matter, Depth of Field and Depth of focus, Diffraction, Limitations of the TEM, Sampling, Interpreting Transmission Images, Electron Beam Damage and Safety, Specimen Preparation, Different types of TEMs, Microscopy and Analysis Software, tomography, EDAX.	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Introduction to spectroscopy: A guide for students of organic spectroscopy	Donald L. Pavia, Gary M. Lampman Geroge S. Kriz	Thomson Learning Academic Resource Center
Spectrometric Identification of Organic Compounds	Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce	John Wiley & Sons
Elementary Organic Spectroscopy	Y. R. Sharma	S. Chand

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSCH9060: Concepts in Chemistry

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to acquire

- Basic concepts of thermodynamics and their properties related to chemical behaviours
- Process of polymerization and its thermodynamic properties
- Concepts of stereochemistry related to symmetry, chirality, and selectivity
- Knowledge of green chemistry and green chemical reactions in terms of organic and nano chemistry

Course Content:

Module	Content	Hours	Weightage in %
1.	**Thermodynamics:** Basic Concepts, First & Second Law of Thermodynamics (CLOSED MASS ANALYSIS, Properties of Pure Substances, Thermodynamic Relations, Chemical equilibrium, phase diagram and relative stability, Statistical Thermodynamics, Thermodynamic Cycles, Ideal Gas Mixtures.	15	25
2.	**Polymers:** Introduction and Nomenclature, Classifications of polymers: Kinetics and mechanism of polymerization processes (Chain reaction (Addition) polymerization, Kinetics of free radical addition polymerization, Ionic and coordination chain (addition Polymerization), Controlled polymerization methods, Phase System in polymerization, Specialty polymers, Concepts of molecular weight in terms of polymer, Methods to determine molecular weight of polymer-Solution Properties and Thermodynamic Aspects of Polymer.	15	25
3.	**Stereochemistry:** Molecular symmetry, Configurational and conformational Isomerism, Conformation of Fischer Projection, Newman and Sawhorse Projections, Chiral and Achiral Molecules, D/L- and R/S-Nomenclature, Enantiomers, Diastereomers, enantiomeric excess, Stereochemistry of Acyclic and Cyclic Compounds, Asymmetric Synthesis, Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing N, S and P, chemoselectivity, regioselectivity, stereoselectivity, enantioselectivity.	18	30
4.	**Green Chemistry:** Introduction, Need for Green Chemistry. Principles of Green Chemistry. Green synthesis. Microwave assisted reactions, Green Analytical Methods, Limitations of Green	12	20

	Chemistry, Nanotechnology in Green Chemistry.		

Text Book(s):

Title	Author/s	Publication
Principles of Physical Chemistry	Puri, Sharma & Pathania	Vishal Publishing Company
Physical Chemistry	Thomas Engel & Philip Reid	Pearson
Polymer Chemistry	Paul C. Hiemenz	**CRC Press**
Stereochemistry of Organic Compounds: Principles and Applications	D. Nasipuri	NEW AGE; Third edition
New Trends in Green Chemistry	Prof. V. K. Ahluwalia and Dr. M. Kidwai	Springer science & Business Media
An Introduction to Green Chemistry	V. Kumar	Vishal publishing Co.

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9010: Bioprocess and Fermentation Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Develop proficiency in bioprocess engineering fundamentals.
- Gain an in-depth understanding of microbial physiology and metabolism.
- Acquire practical skills in industrial fermentation and downstream processing.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Fundamentals of Bioprocess Engineering** Introduction to bioprocess engineering Microbial growth kinetics Mass and energy balances in bioprocess systems Sterilization and sterilization methods Reactor types and design considerations Bioreactor instrumentation and control systems	10	16
2.	**Microbial Physiology and Metabolism** Cellular structure and function of microorganisms Metabolic pathways in microbial cells Regulation of metabolic pathways Substrate utilization and product formation kinetics Microbial stress responses and adaptation Genetic engineering approaches in microbial metabolism	10	16
3.	**Downstream Processing in Bioprocessing** Overview of downstream processing Cell separation techniques: centrifugation, filtration, and sedimentation Cell disruption methods: mechanical, enzymatic, and chemical Extraction and purification of biomolecules Chromatographic separation techniques Formulation and stabilization of bioproducts	15	25
4.	**Industrial Fermentation Processes** Overview of industrial fermentation Types of fermenters and their applications Fed-batch and continuous fermentation strategies Scaling up fermentation processes Downstream processing considerations for industrial fermentations Case studies of industrial fermentation processes	10	16
5.	**Bioprocess Monitoring and Control** Importance of monitoring and control in bioprocess engineering Sensors and analytical techniques for bioprocess monitoring Real-time monitoring of key process parameters Feedback control strategies in bioprocess systems	10	16

	Advanced control techniques: model predictive control, fuzzy logic, etc. Process optimization and automation in bioprocessing		
6.	**Bioprocess Scale-Up** Principles of scale-up in bioprocessing Scale-up methodologies and scaling criteria Challenges and considerations in scaling up bioprocesses	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Principles of Fermentation Technology	A. Whitekar, P. F. Stanbury& S. J.	Elsevier
Textbook of Biotechnology	W. Crueger and A. Crueger	Medtec Publishers
Industrial Microbiology	L. E. Casida	New Age International Publishers
Fermentation Technology	H A Modi	Avishkar Publishers

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9020: Enzyme Technology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Explore the role of enzymes in environmental biotechnology and sustainability.
- Understand the applications of enzymatic bioremediation and waste treatment processes.
- Discuss the potential of enzymes in addressing environmental challenges and promoting sustainable practices.

Course Content:

Section-I			
Module	**Content**	**Hours**	**Weightage in %**
1.	**Basics of Enzymology:** Definitions, Brief nomenclature and classification of enzymes, Enzyme assays, Isoenzymes, Monomeric and oligomeric enzymes, Enzyme localization, Multienzyme complex, Methods for purification of enzymes	10	16
2.	**Enzyme Kinetics:** First order and second order reaction, Significance of activation energy, Km, Vmax, Turnover number, Kcat, Transformation of M M equation (Line weaver-Burk plot, Eadie – Hofstee plots, Hanes plots), Kinetics of multi substrate reactions (Ping-pong bi-bi mechanism), Mechanism of catalysis of Enzymes- Serine proteases, Chymotrypsin, Triose phosphate isomerase	10	16
3.	**Enzyme regulation:** General mechanism of enzyme regulation, Allosteric enzymes, Sigmoidal Kinetics and significance, Symmetric and sequential modes for action of allosteric enzymes and their significance, Reversible and irreversible covalent modifications of enzyme, proteolytic activation, Feed Back Inhibition	15	25
4.	**Immobilization and Applications enzymes:** Methods of enzyme immobilization, Effect of immobilization on enzyme activity, partitioning/ diffusion limitations, Importance of Immobilization, Study of Industrial important enzymes, Enzyme as a biosensor, Case study	10	16
5.	**Enzyme Production and Purification** Microbial, plant, and animal sources of enzymes Fermentation techniques for enzyme production Downstream processing for enzyme purification Enzyme stabilization and storage techniques	10	16

	Quality control and assay methods for enzyme characterization		
6.	**Enzyme Applications in Biomedicine** Enzymes as therapeutic agents: drug targets and delivery systems Diagnostic applications of enzymes in healthcare Enzymes in tissue engineering and regenerative medicine Enzyme-based biosensors and bioimaging techniques Challenges and future prospects in medical enzyme technology	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Fundamentals of Enzymology	Nicholas Price & Lewis Stevens	Oxford Univ. Press
Enzymes	Trevor Palmer	East-West Press
Biochemistry	Donald Voet, Judith G. Voet	John Wiley & Sons

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9030: Advanced Bioinstrumentation Techniques

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Familiarize the students with the laboratory safety measures and hazards.
- Apply advanced knowledge of the laboratory equipments to their research.
- Emphasize about the advanced techniques and its application in analyzing different biological samples.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Laboratory Safety and Guidelines:** General safety measures in a laboratory, Personal protection, Chemical and Biological hazards, Spillage and Waste disposal and First aid	10	16
2.	**Laboratory Equipments:** Theory, Principle, Working and Applications of: pH meter, Autoclave, Laminar Air Flow and Centrifuge, Performance efficacy and testing of pH meter, Autoclave, Laminar Air Flow and Centrifuge, Centrifuge types and Centrifugation: Differential, Rate, zonal, Isopycnic, Density gradient, Rotor types and Ultra-centrifugation	10	16
3.	**Chromatography Techniques:** Theory, Principle, Apparatus, Methods and Applications of Paper Chromatography, TLC, HPTLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Chromatography and HPLC	15	25
4.	**Electrophoretic Techniques** Theory, Principle, Apparatus, Methods and Applications of Paper Electrophoresis, Poly Acrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis, Principle and Applications of Iso-electric Focusing, Immuno-Electrophoresis, Enzyme- Linked Immunosorbent Assay (ELISA), Southern, Northern and Western Blotting	10	16
5.	**Radio-isotopic Techniques** Introduction to radioisotopes and their biological applications, Principles and Applications of Geiger Muller (GM) counter, Solid and Liquid scintillation counter, Autoradiography, Radioimmunoassay (RIA)	10	16
6.	**Spectroscopic:**	05	11

	Principle, Working, Instrumentation and Applications of: UV/Vis spectroscopy, IR spectroscopy, atomic absorption spectroscopy, NMR spectroscopy, Mass spectroscopy, Raman spectroscopy		

Text Book(s):

Title	Author/s	Publication
Principles and Techniques of Biochemistry and Molecular Biology	Wilson Keith and Walker John	Cambridge University Press
Proteins NMR Spectroscopy: Principles and Practice	Cavanagh John	Academic Press
Understanding NMR Spectroscopy	Keeler, J.	John Wiley & Sons

Course Evaluation

- The course evaluation will be carried out of 100 marks

P P SAVANI UNIVERSITY
Doctoral Programme (Ph.D.)

SSMB9040: Bacterial Physiology and Communication

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:
To help learners to

- Analyze the ecological dynamics of bacterial populations and microbial communities.
- Explore the evolutionary mechanisms driving bacterial diversification and adaptation.
- Investigate the applications of ecological and evolutionary insights in biotechnological and environmental contexts.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Bacterial Physiology** Overview of bacterial cell structure and function Metabolism and energy generation in bacteria Bacterial growth kinetics and factors affecting growth Regulation of gene expression in bacteria Bacterial adaptation and response to environmental changes	10	16
2.	**Bacterial Communication Systems** Introduction to bacterial communication and signaling Quorum sensing: mechanisms and regulation Inter- and intra-species communication in bacterial communities Role of signaling molecules in bacterial behavior and virulence Evolutionary significance of bacterial communication systems	10	16
3.	**Bacterial Stress Responses** Overview of bacterial stressors: temperature, pH, osmolarity, etc. Molecular mechanisms of stress response pathways Heat shock response and molecular chaperones Osmotic stress response and compatible solutes Bacterial biofilm formation as a stress response strategy	15	25
4.	**Bacterial Metabolic Diversity** Overview of bacterial metabolic pathways Anaerobic metabolism and fermentation Chemolithotrophy and photosynthesis in bacteria Metabolic interactions in microbial communities Metabolic engineering of bacteria for biotechnological applications	10	16
5.	**Bacterial Pathogenesis and Host Interactions** Mechanisms of bacterial pathogenesis: adhesion, invasion, and colonization Host-bacterial interactions: immune evasion and modulation Virulence factors and their role in bacterial infections Bacterial biofilms in infectious diseases	10	16

	Strategies for combating bacterial pathogens		
6.	**Ecological and Evolutionary Aspects of Bacterial Physiology** Bacterial ecology: niche adaptation and community dynamics Co-evolution of bacteria with hosts and environments Microbiome dynamics and ecosystem services Applications of ecological and evolutionary principles in biotechnology	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Bacterial Physiology: A Molecular Approach	Walid M. El-Sharoud	Wiley-Blackwell
Molecular Microbiology: Diagnostic Principles and Practice	David H. Persing, Fred C. Tenover, Randall T. Hayden, Frederick S. Nolte	ASM Press
Bacterial Stress Responses	Fabio L. de Moraes, Jr., Stuart A. Ralph	Springer

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9050: Basic Calculation in Biology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

- Understand and apply basic mathematical principles in the context of biological research.
- Develop proficiency in performing calculations relevant to biological data analysis.
- Gain hands-on experience with statistical methods commonly used in biological research.
- Enhance critical thinking and problem-solving skills in the biological sciences.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Basic Mathematical Operations:** Overview of arithmetic operations (addition, subtraction, multiplication, division), Scientific notation and significant figures Order of operations, Practical exercises and applications in biological contexts	10	16
2.	**Descriptive Statistics in Biology:** Measures of central tendency (mean, median, mode), Measures of dispersion (range, variance, standard deviation), Graphical representation of data (histograms, box plots), Calculation and interpretation of descriptive statistics using biological datasets	10	16
3.	**Probability and Probability Distributions:** Basic concepts of probability theory, Probability distributions (binomial, normal, Poisson), Application of probability distributions in biological experiments and data analysis.	15	25
4.	**Statistical Inference in Biology:** Hypothesis testing: concepts and principles, Parametric vs. non-parametric tests, Common statistical tests in biology (t-tests, ANOVA, chi-square test), Interpretation of statistical results and significance levels	10	16
5.	**Correlation and Regression Analysis;** Understanding correlation coefficients (Pearson, Spearman), Simple linear regression analysis, Multiple regression analysis and its application in biology, Practical exercises using biological datasets for correlation and regression analysis	10	16
6.	**Introduction to Bioinformatics Tools for Data Analysis:** Overview of bioinformatics and its significance in biology, Introduction to bioinformatics databases and resources, Hands-on experience with bioinformatics tools for data analysis, including BLAST, NCBI, and others, Application of bioinformatics tools in biological research projects	05	11

Text Book(s):

Title	Author/s	Publication
Biostatistics: A Foundation for Analysis in the Health Sciences	Wayne W. Daniel and Chad L. Cross	John Wiley & Sons
Practical Statistics for Field Biology	Jim Fowler, Lou Cohen, and Phil Jarvis	Wiley
Bioinformatics Data Skills: Reproducible and Robust Research with Open Source Tools	Vince Buffalo	O'Reilly

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9060: Analytical and Instrumentation Techniques

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Analytical principles, covering various techniques such as chromatography, spectroscopy, and mass spectrometry.
- Develop practical skills in operating analytical instruments and analyzing data, enabling students to conduct experiments and interpret results effectively.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Analytical Chemistry and Instrumentation** Overview of analytical chemistry and its significance Basic principles of analytical instrumentation Calibration and validation of analytical methods Introduction to spectroscopic techniques Data analysis and interpretation in analytical chemistry	10	16
2.	**Chromatographic Techniques** Principles of chromatography: gas chromatography (GC) and liquid chromatography (LC) Separation mechanisms and column selection Instrumentation and operation of GC and LC systems Method development and optimization Applications of chromatography in chemical analysis	10	16
3.	**Spectroscopic Techniques** Introduction to spectroscopy: UV-Visible, infrared (IR), and atomic absorption spectroscopy (AAS) Principles of operation and instrumentation for each technique Spectral interpretation and qualitative analysis Quantitative analysis using spectroscopic methods Advanced spectroscopic techniques: fluorescence, Raman, and nuclear magnetic resonance (NMR) spectroscopy	15	25
4.	**Mass Spectrometry (MS)** Fundamentals of mass spectrometry: ionization techniques and mass analyzers Instrumentation and operation of mass spectrometers Fragmentation patterns and interpretation of mass spectra Quantitative analysis using mass spectrometry	10	16

	Applications of MS in proteomics, metabolomics, and environmental analysis		
5.	**Electrochemical Techniques** Principles of electrochemistry and electrochemical cells Potentiometric, voltametric, and amperometry techniques Instrumentation and operation of electrochemical analyzers Applications of electrochemical techniques in pharmaceuticals, environmental monitoring, and food analysis Electrochemical impedance spectroscopy (EIS) and its applications	10	16
6.	**Advanced Analytical Techniques** Introduction to advanced analytical techniques: X-ray diffraction (XRD), nuclear magnetic resonance (NMR) spectroscopy, and electron microscopy Applications of advanced analytical techniques in materials science, structural biology, and nanotechnology	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Principles and Techniques of Biochemistry and Molecular Biology	Wilson and Walker	Cambridge Press
Biophysical Chemistry	Upadhyay and Nath	Himalaya Publishing House
Instrumental methods of analysis	Willard, Merritt, Dean & Settle	CBS Publications
Instrumental analysis	D.A. Skoog, Holler & Crouch	Thomson Press

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9070: Bioanalytical Techniques

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

- Familiarize students with the fundamental principles underlying various bioanalytical techniques.
- Enable students to critically evaluate different bioanalytical methods and select the most appropriate technique for specific research objectives.
- Develop practical skills in the operation of bioanalytical instruments and equipment.
- Instill proficiency in data analysis, interpretation, and presentation of bioanalytical results.
- Foster an understanding of the importance of quality control and assurance in bioanalytical experiments.
- Encourage independent research and innovation in the application of bioanalytical techniques to address biological questions.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Introduction to Bioanalytical Techniques:** Overview of bioanalytical techniques and their significance in Biological research, Basic principles of spectroscopy, chromatography, electrophoresis, and mass spectrometry, Applications of bioanalytical techniques in various fields of biology	10	16
2.	**Spectroscopic Techniques:** Principles and applications of UV-Vis spectroscopy, Fluorescence spectroscopy: theory and practical applications, Circular dichroism spectroscopy in structural biology, Introduction to Fourier-transform infrared spectroscopy (FTIR) and its applications	10	16
3.	**Chromatographic Techniques:** Introduction to chromatography: principles and types, High-performance liquid chromatography (HPLC) and its applications in bioanalysis, Gas chromatography (GC) and its relevance in biological research, Capillary electrophoresis (CE) for separation and analysis of biomolecules	15	25
4.	**Mass Spectrometry in Bioanalysis:** Fundamentals of mass spectrometry (MS), Ionization techniques: MALDI, ESI, and others, Mass analyzers: Quadrupole, TOF, Ion Trap, and Orbitrap, Applications of MS in proteomics, metabolomics, and lipidomics	05	11
5.	**Electrophoretic Techniques:** Gel electrophoresis: principles and types, SDS-PAGE for protein separation and analysis, Agarose gel electrophoresis for nucleic acid analysis, Capillary electrophoresis (CE) for DNA sequencing and fragment analysis	10	16
6.	**Advanced Topics in Bioanalytical Techniques:**	10	16

	Microscopy techniques in biological research: confocal microscopy, electron microscopy, Surface plasmon resonance (SPR) for studying biomolecular interactions, Biosensors: principles and applications in real-time monitoring, Emerging trends and technologies in bioanalytical techniques		

Text Book(s):

Title	**Author/s**	**Publication**
Bioanalytical Chemistry	Andreas Manz, Nicole Pamme, and Dimitri Iossifidis	World Scientific
Introduction to Modern Liquid Chromatography	Lloyd R. Snyder, Joseph J. Kirkland, and John W. Dolan	Wiley
Principles and Practice of Biological Mass Spectrometry	Chhabil Dass	Wiley‐Blackwell

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9080: Biostatistics, Bioinformatics and Analytical Calculations

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

- Understand the basic fundaments of various statistical methods, various tools in bioinformatics instruments and various Analytical calculations used during the research
- Developing the skills and techniques, knowledge how to use the calculations, using statistical methods in research, its principles, mechanics, uses and applications.
- Updating the knowledge with analytical calculations, biostatistics and bioinformatics.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Biostatistics:** Branches and Scope of Biostatistics, Sampling: Rules for sample collection, Sampling error and Sampling techniques, Analysis of data: Measures of central tendency – Mean (arithmetic, harmonic and geometric), Median and Mode, Data presentation, Measures of central tendency, Measure of disparity: Mean deviation, Standard deviation, Standard error, Coefficient of variation; Correlation and regression	10	16
2.	**Probability theory and distributions:** Binomial, Poisson, and Normal distributions, Statistical inference-Hypothesis testing (t test, Z test, Chi square test), ANOVA for one way and two way classified data, Inferential statistics: Basic idea of significance test, Statistical hypothesis, types of errors, level of significance, Parametric and Nonparametric tests: Paired and Unpaired Students t test, Karl Pearsons Correlation coefficient and Simple linear regression Response Surface Methodology Placket Burman Design, Taguchi Design	10	16
3.	**Bioinformatics:** Scope and Branches of Bioinformatics, Gene structure and information content: Nucleotides and theirs orientation, Promoter sequences, Open reading frames, Introns and Exons, Structural features of RNA: Primary, Secondary, Tertiary Structures. 18S-rDNA Sequencing, PCR, 16S-rDNA Sequencing,	15	25
4.	**Data mining tools:** Data submission tools; Data analysis tools (BLAST & FASTA); Gene prediction tools; Tools for Phylogenetic prediction, Sequence Analysis, Sequence alignment, Primer Designing, Mass Spectrometry based proteomics tools, System biology approach to understand microbial enzyme machinery Hypothesis testing: concepts and principles, Parametric vs. non-parametric tests, Common statistical tests in biology (t-tests, ANOVA, chi-square test), Interpretation of statistical results and	10	16

	significance levels		
5.	**Analytical Calculations:** Standard Solutions- Per cent Solutions, Weight per unit weight Weight per unit volume, Volume per unit volume, Part Dilutions, Molar Solutions, Normal Solutions, Molal solutions	10	16
6.	**Analytical Calculations:** Mass Percent, Reference solution, Standard solution, Stock solution, PPM, Specific gravity, Mole fraction, Calculations and Numericals	05	11

Text Book(s):

Title	**Author/s**	**Publication**
Introduction to Biostatistics and Research Methods	P.S.S SundarRao and J. Richard.	PHI Learning
Basic Biostatistics	B. Burt Gertsman	Jones and Bartlett Publishers,
Introduction to Bioinformatics in Microbiology	Henrick Christensen	Springer
Bioinformatics – Data, Sequence Analysis and Evolution	Jonathan Keith Springer	Springer

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSMB9090: Environmental Microbiology

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	100	-	-	-	-	-	100

Objective(s) of the Course:

- Understand the basic fundaments of Environment, Ecosystem, various ecosystems, pollutions, various methods to treat and control pollution, biodegradation, bioremediation approach to be used during the research
- Developing the skills and techniques, knowledge how to use and manipulate microbes for ecofriendly environment, exploring the microbes for better earth, use in research, its principles, mechanics, uses and applications.
- Updating the knowledge with Various environmental Parameters, usefulness in Industries and Society.

Course Content:

Module	Content	Hours	Weightage in %
1.	**Physico-chemical Analysis of Waste Water:** pH, temperature, Turbidity, Conductivity, Color, Odor, Acidity, Alkalinity, Calcium, Magnesium, Hardness, TDS, TS, TSS, Chlorides, Phosphates, Sulphates, Nitrates, Oil, BOD, DO, COD, TOC, Heavy Metals Municipal treatment of drinking water. Water pollution and its sources. Role of organic pollutants in water, concepts of C-BOD, N-BOD and COD, Oxygen-sag curve.	10	16
2.	**Common effluent treatment treatments:** Concept of common effluent treatment plant (CETP) their importance and advantages, role in wastewater treatment. Unit processes involved. Effluent discharge standards, industry specific minimum and national standards.	05	11
3.	**Waste Water Treatment:** Sources of Waste Water, Treatment of Industrial Effluent, Primary treatment: screening, neutralization, equalization, sedimentation and coagulation, Primary, Secondary and tertiary treatment, Removal of dissolved inorganic matter, organics (biodegradable & other organics), oil & grease, acid and alkali, toxic material, carbon, nitrogen, phosphorus and microorganisms.	10	16
4.	**Biological treatment processes for wastewater**: Aerobic processes: Suspended floc type- Activated sludge processes, Extended aeration, Septic tanks, Imhoff tanks, Biodiscs, Oxidation ponds, Aerated lagoons, Waste stabilization ponds, rotating biological contact system, the trickling filter process., Anaerobic processes: Flow through	10	16

	systems and contact systems. UASB reactors and modifications. Sludge types, treatment and disposal. Processing of sludges- conditioning, thickening, dewatering, drying, incineration and disposal., SBR **Evaluation of toxicity:** Methods used to assess toxicity classification of toxic materials. Concepts of Bioassay- types, characteristics. Importance and significance of bioassay, Microbial bioassay for toxicity testing, Bioassay test models and classification, Threshold limit value, LC50 LD50.Toxicity Testing		
5.	**Bioremediation and Biodegradation:** Microbial remediation of xenobiotics, Concept, principal and mechanism of bioremediation acclimatization, detoxification, transformation, degradation, mineralization, co-metaboilsm, metabolism, bio stimulation, bioaugmentation, Bioleaching, Factors affecting bioremediation, nature of pollutants, bioavailability of pollutants, production of bioremediation metabolites and intermediates, Growth kinetics of organisms., In situ and Ex situ bioremediation technology detection of microbial community and metagenomics of polluted sites, Alpha, beta and gamma biodiversity, Phytoremediation, Bioventing, Biosparging. Restoration of ground water, oil spills, Commercialization of bioremediation technology	15	25
6.	**Xenobiotic Compounds and Degradation:** Bioremediation, Biodegradation, Decolorization and Degradation of Dyes and effluent. Metals, Pesticicdes, Insecticides, Polyaromatic Hydrocarbons, Chlorinated and Nitrated aromatic compounds.Microbial Enzymes with special characteristics and metabolic pathways of degradation of xenobiotic compounds.Uses of Various Enzymes, Advantages, Applications, Enzymes Purification and Characterization, Various Purification Methods, Enzyme Activity, Specific activity, Purification Fold and Yield	10	16

Text Book(s):

Title	Author/s	Publication
Waste Water Microbiology	Garbiel, Bitton.	Wiley
Biopesticides: A Biotechnical Approach	S R Joshi	New Age Publication
Advances in Microbial Ecology	K C Marcell	Plenum Press.
Textbook of Microbiology	Paniker	Orient Longman Publication

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSPY9010 General Experimental Techniques in Physics

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- understand the basic concepts of Experimental Techniques that are generally used.
- discover theories between experimental devices and learn about functions and operation of it.
- apply various general experimental techniques in diversify research areas.

Course Content:

Module No.	Content	Hours	Weightage in %
1	Solution growth of crystals., binary and ternary phase diagrams, Normal freezing, Bridgman and Zone melting techniques, thin film deposition techniques, thin film structure, X-ray diffraction by crystals and thin films.	15	25
2	Detectors: optical detectors, photoemission detectors, particle and ionizing radiation detectors, signal to noise ration detection, surface barrier detector, Particle detector: interactions of charged particles and photons with matter; gaseous ionization detectors, scintillation counter, solid state detectors	15	25
3	Vacuum Pumps: Rotary Pump, Diffusion Pump, Sputter – Ion pump, Sorption pump, Turbomolecular pump.	15	25
4	Gauges: Bourdon Gauge, McLeod gauge, Pirani gauge, Thermocouple gauge, Hot and Cold cathode ionization gauge.	15	25

Text Book(s):

Title	Author/s	Publication
Thin Film Technology and Applications	K.L. Chopra & L.K. Malhotra	Tata McGraw Hill Publ., New Delhi
Solid State Physics	R.L. Singhal	7th Ed. Kedarnath Ramnath & Co.
Techniques for Nuclear and Particles Physics Experiments	W.R. Leo	2nd edition, Springer
Modern Vacuum Practice	Nigal Harris	Tata McGraw Hill Publ., New York

Video Material Link(s):

- https://www.youtube.com/watch?v=RXf6nHTw-wA
- https://www.youtube.com/watch?v=yUDOt5B5M_k
- https://www.youtube.com/watch?v=o3xXjczEGkQ

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SSPY9020 Fundamentals of Physics

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand and explain fundamental physical co021ncepts within the subjects of the course.
- Define and apply basic concepts and terminology in physics.
- Analyze experimental data in the context of physical concepts and theories.

Course Content:

Module No.	Content	Hours	Weightage in %
1	Laplace and Poisson equations, boundary value problems, method of images, Electrostatics in dielectric media, Ampere's theorem. Bio-Savart law, electromagnetic induction, Maxwell's equations in free space and in linear isotropic media, Boundary conditions on fields at interfaces, scalar and vector potentials. Gauge invariance.	15	25
2	One dimensional problems, Harmonic oscillator, hydrogen atom, spherically symmetric potential: bound states and scattering states, angular momentum algebra, time independent and time dependent perturbation theories	15	25
3	Crystal classes and systems, lattice vibration, free electron theory, energy bands in solids, electronic structure of quantum confined structures, impurity levels in doped semiconductor structures. Electron transport, Dielectrics, Clausius-Mosstti equation	15	25
4	Lagrange's and Hamiltonian Formalisms, Conservation theorems and symmetry properties, Two- body central force problem- reduction to one body problem, scattering in a central force field. Small oscillations, orthogonal transformations, Eulerian angles, Rigid body motion.	15	25

Text Book(s):

Title	Author/s	Publication
Classical Mechanics	N. C. Rana and P. S. Joag	Tata McGraw Hill Publ., New Delhi
Introduction to Electrodynamics	David J. Griffiths	Prentice Press
Fundamentals of statistical and thermal physics	Fedrick Reif	Tata McGraw Hill Publ., New Delhi
Quantum Physics	Stephen Gasiorowicz	John Wiley & Sons Inc.

Video Material Link(s):

- https://www.youtube.com/watch?v=sCZ80l6UarM
- https://www.youtube.com/watch?v=EdYqKU-AaPw

- https://www.youtube.com/watch?v=cGSZNCIDKh0

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SAAR9010 Smart Cities

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Provide students with a foundational understanding of the concept of smart cities, including the technological, social, and economic drivers behind their development.
- Explore the interdisciplinary nature of smart cities development by examining the integration of technology, urban planning, sustainability, governance, and policy frameworks.
- Analyze case studies of successful smart city projects from around the world to identify best practices, lessons learned, and key success factors.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
14.	**Introduction to Smart Cities** Understanding the concept of smart cities, Historical evolution and drivers of smart city initiatives, Key components and technologies of smart cities, Challenges and opportunities in smart city development	10	15
15.	**Smart Infrastructure and IoT** Overview of smart infrastructure systems, Internet of Things (IoT) and its role in smart cities, Sensor networks, data collection, and analytics, Case studies of smart infrastructure projects, TOD guidelines for Smart Cities.	10	17
16.	**Urban Mobility and Transportation** Smart transportation systems and solutions, Intelligent traffic management and optimization, Public transit innovations and multimodal transportation, Sustainable mobility and reducing carbon emissions, TOD guidelines for Smart Cities, Urban Dynamics and railway stations.	10	17
17.	**Sustainability and Resilience** Integrating sustainability principles into smart city planning, Renewable energy, energy efficiency, and smart grids, Enhancing urban resilience to climate change and natural disasters, Green building technologies and sustainable urban design	10	17
18.	**Governance and Policy in Smart Cities** Governance models and policy frameworks for smart city development, Data governance, privacy, and cybersecurity considerations, Stakeholder engagement and community participation, Best practices and lessons learned from smart city initiatives, Land Acquisition Act 2013.	10	17
19.	**Case Studies and Future Trends** Case studies of successful smart city projects from around the world, Emerging trends in smart city technology and innovation, Ethical, social, and equity implications of smart city development, Opportunities for future research and collaboration in the field of smart cities	10	17

Text Book/Reference Book (s):

Title	Author/s	Publication
Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia	Anthony M. Townsend	W. W. Norton & Company
The Smart Enough City: Putting Technology in Its Place to Reclaim Our Urban Future	Ben Green	The MIT Press
Smart Cities: Governing, Modelling and Analysing the Transition	Mark Deakin, Husam Al Waer	Routledge
The Responsive City: Engaging Communities Through Data-Smart Governance	Stephen Goldsmith and Susan Crawford	Jossey-Bass

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SAAAR9020 Urban Design & Planning

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Gain insight into the multifaceted nature of urban environments by examining the interactions between social, economic, environmental, and spatial factors shaping cities.
- Survey the historical development of urban planning theories to understand their relevance in addressing modern urban challenges.
- Develop practical skills in urban design to create sustainable, functional, and visually appealing urban spaces.
- Explore issues of social justice and inclusivity in urban development, and propose strategies to ensure equitable access to resources and opportunities for all residents.
- Incorporate principles of sustainability into urban planning and design practices to mitigate environmental impacts, promote resilience, and contribute to global sustainability goals.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
20.	**Introduction to Urban Design & Planning** Overview of urban design and planning concepts, Historical evolution of cities and urban planning theories, the role of urban designers and planners in shaping the built environment, Key stakeholders and their interests in urban development	10	15
21.	**Urban Analysis and Site Planning** Methods for analyzing urban sites, including GIS, mapping, and site surveys, Understanding land use patterns and zoning regulations, Principles of site planning and design, Case studies of successful urban redevelopment projects	10	17
22.	**Transportation Planning and Infrastructure** Importance of transportation in urban planning, Analysis of transportation systems and their impact on urban development, Sustainable transportation strategies and policies, Integration of transportation infrastructure with land use planning	10	17
23.	**Housing and Community Development** Affordable housing policies and strategies, Community development principles and practices, Role of public and private sectors in housing provision, Urban renewal and gentrification issues, Land Acquisition Act -Objectives and it's Applicability.	10	17
24.	**Sustainable Urban Design** Principles of sustainable urbanism, Green infrastructure and sustainable development practices, Urban resilience and adaptation to climate change, Sustainable transportation and energy-efficient urban design, Analysis models for the environmental impact of Railway stations to nearby neighborhoods. CRZ mapping.	10	17
25.	**Urban Design Studio** Application of urban design principles to real-world projects, Group	10	17

	projects focusing on specific urban design challenges, Presentation of design proposals and critiques, Incorporation of community feedback and stakeholder input		

Text Book/Reference Book (s):

Title	Author/s	Publication
The Death and Life of Great American Cities	Jane Jacobs	Vintage Books
Urban Planning Theory since 1945	Nigel Taylor	Sage Publications Ltd
Urban Design: A Typology of Procedures and Products	Jon Lang	Architectural Press
The Urban Design Handbook: Techniques and Working Methods	Urban Design Associates	W. W. Norton & Company

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SOPH9010 Advances in Pharmaceutical Sciences

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand core pharmacokinetics and pharmacodynamics principles.
- Gain proficiency in pharmacokinetic modeling and simulation tools.
- Acquire advanced skills in drug metabolism and analytical methods.
- Study genetic influences on drug response and personalized medicine.
- Engage in real-world case studies to solve complex pharmacokinetic and pharmacodynamic problems.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
26.	**Introduction to Pharmacokinetics and Pharmacodynamics:** Overview of pharmacokinetics (PK) and pharmacodynamics (PD). Key milestones in PK/PD research. Role in drug design and therapeutic efficacy. Factors affecting drug absorption, first-pass metabolism. Volume of distribution, plasma protein binding. Phase I and Phase II reactions, enzyme induction and inhibition. Renal and biliary excretion, clearance. Definitions, calculation methods, significance in clinical practice. Types of receptors, binding affinities. Potency, efficacy, therapeutic index, agonists vs. antagonists.	15	25
27.	**Advances in Pharmacokinetic Modeling and Simulation:** One-compartment and multi-compartment models. Area under the curve (AUC), mean residence time (MRT). Introduction to commonly used PK/PD software (e.g., NONMEM, Phoenix WinNonlin). Parameter estimation, goodness-of-fit tests, sensitivity analysis. Role of PK/PD modeling in dose selection, safety assessment. Adjustments for pediatric, geriatric, and renal/hepatic impaired patients.	15	20
28.	**Drug Metabolism and New Bioanalysis Techniques:** Michaelis-Menten kinetics, enzyme-substrate interactions. Types of enzyme inhibition, impact on drug metabolism. High-performance liquid chromatography (HPLC), mass spectrometry (MS). Techniques for biological sample processing, extraction methods. Bioavailability (Single-dose vs. multiple-dose) Studies, crossover designs.	10	20
29.	**Advanced Pharmacodynamic Concepts:** Signal transduction pathways, second messengers. Impact on cellular functions, therapeutic targets. Indications for drug monitoring, therapeutic ranges. Influence of genetic polymorphisms on drug response. Tailoring therapy based on genetic profile, case studies.	10	20
30.	**Specialized Topics and Case Studies:**	10	15

	Dose-dependent kinetics, saturation of metabolism. Modeling complex biological systems, multi-scale modeling. Quantitative Systems Pharmacology (QSP): Applications in drug discovery, disease modeling. Case studies illustrating PK/PD principles. Exercises and examples to apply theoretical knowledge in practical scenarios.		

Text Book/Reference Book (s):

Title	Author/s	Publication
Pharmacokinetics: Second Edition	Milo Gibaldi, Donald Perrier	Informa Healthcare
Bioavailability and Bioequivalence in Drug Development	Sarfaraz K. Niazi	CRC Press
Goodman & Gilman's: The Pharmacological Basis of Therapeutics	Laurence L. Brunton	McGraw-Hill Education
Nonlinear Pharmacokinetics and Pharmacodynamics	Susan R. Mikkelsen, Eduardo Cortón	Academic Press
Pharmacokinetics and Pharmacodynamics: Current Problems	G. Parthasarathy	Jaypee Brothers Medical Publishers

Course Evaluation

- The course evaluation will be carried out of 100 marks.

SOPH9020 Modern Pharmaceutical Analytical Techniques

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- Understand the interaction of matter with UV/electromagnetic radiations and its applications in drug analysis
- Study the quantitative & qualitative analysis of drugs using various analytical instruments.
- Understand the chromatographic separation and analysis of drugs.
- Explain and apply the thermal Analysis technique for analysis of drugs.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
31.	**UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible Spectroscopy **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications	15	30
32.	**Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass Spectroscopy	15	20
33.	**NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy	10	20
34.	**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters,	10	15

	factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography		
35.	**Potentiometry:** Principle, thermal transitions and instrumentation (heat flux and power compensation and designs) working, Ion selective Electrodes and Application of potentiometry. **Thermal Analysis:** Polymer behavior, factors affecting and instrumentation, and working, application of TGA	10	15

Text Book/Reference Book (s):

Title	**Author/s**	**Publication**
Principles of Instrumental Analysis	Doglas A Skoog, F. James Holler	Eastern press
Instrumental methods of analysis	Willards	CBS publishers
Organic Spectroscopy	William Kemp	ELBS publishers
Quantitative Analysis of Drugs in Pharmaceutical formulation	P D Sethi	CBS publishers
Pharmaceutical Analysis- Modern methods	J W Munson	Marcel Dekker Series

Course Evaluation

- The course evaluation will be carried out of 100 marks.

P P SAVANI UNIVERSITY
PhD PROGRAMME

SECE: AWS Cloud Solution Architect

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	0	0	4	40	60	-	-	-	-	100

Objective(s) of the Course:

To help learners to

- introduce students to the fundamentals of cloud computing and AWS, including the benefits, cloud value proposition, and foundational security practices.
- provide an in-depth understanding of AWS compute services, networking concepts, and storage solutions.
- design and implement a serverless web backend using AWS services.
- design a serverless data analytics solution leveraging various AWS services.
- design a hybrid cloud solution for managing container-based workloads on AWS.

Course Content:

Sr. No.	Topic/s	Hours	Weightage in %
36.	**AWS Overview & Security:** Definition of Cloud Computing, Benefits of Cloud Computing, Cloud Value Proposition, Workloads: On-Premises vs. Cloud, creating an AWS Account, Overview of Amazon Web Services, AWS Regions and Availability Zones, Interacting with AWS, AWS Identity and Access Management (IAM)	10	15
37.	**Compute & Networking:** AWS Compute Services Overview, Amazon Elastic Compute Cloud (Amazon EC2) Architecture, Containers vs. Virtual Machines (VMs), Serverless Technologies, Basic Networking Concepts, Amazon Virtual Private Cloud (Amazon VPC) **Storage & Databases on AWS:** Amazon Simple Storage Service (Amazon S3), Amazon Elastic Block Store (Amazon EBS), Databases on AWS, Use Cases for AWS Storage Services	15	20
38.	**Designing a serverless web backend on AWS:** Customer Use Case Introduction, Solution Design Overview, Amazon API Gateway, AWS Lambda, Amazon Simple Queue Service (Amazon SQS), Amazon Simple Notification Service (Amazon SNS), Amazon DynamoDB	10	20
39.	**Designing a serverless data analytics solution for AWS:** Customer Use Case Introduction, Solution Design Overview, Amazon Simple Storage Service (Amazon S3), Amazon Kinesis Data Firehose, Amazon Athena, Amazon QuickSight, Additional AWS Services	10	20
40.	**Designing a hybrid solution for container-based workloads on AWS:** Customer Use Case Introduction, Solution Design Overview, AWS Direct Connect, Amazon Elastic Container Service (Amazon ECS), Amazon ECS Anywhere, Amazon Relational Database Service (Amazon RDS), AWS Systems Manager, Additional AWS Services	15	25

Text Book/Reference Book (s):

Title	Author/s	Publication
AWS Certified Solutions Architect – Associate All-in-One Exam Guide	Joyjeet Banerjee	McGraw-Hill Education
AWS Certified Solutions Architect Study Guide	Joe Baron, Hisham Baz,	Sybex
AWS Certified Solutions Architect Official Study Guide	R.S. Walia, Qasim Murtaza	Sybex

Video Material Link(s):

- https://www.coursera.org/professional-certificates/aws-cloud-solutions-architect
- https://www.coursera.org/learn/aws-cloud-technical-essentials?specialization=aws-cloud-solutions-architect
- https://www.coursera.org/learn/architecting-solutions-on-aws?specialization=aws-cloud-solutions-architect
- https://cloudacademy.com/blog/aws-certified-solutions-architect-associate-study-guide/

Course Evaluation

- The course evaluation will be carried out of 100 marks.

P P Savani University

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