B. Tech. (Computer Engineering / Computer Science and Engineering / Computer Technology and Allied) Syllabus Aligned with the New Education Policy 2020 Effective from AY 2025 - 2026 (*Only for Second Year*)

(Affiliated Colleges)

Department of Computer Engineering

Dr. Babasaheb Ambedkar Technological University, Lonere - 402103

www.cse.dbatu.ac.in

Second Year in B.Tech in Computer Engineering and Allied Programs
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2025 - 2026)
Third Semester

Course Category	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
BSC	25AF1000BS301	Engineering Mathematics-III	3	-	20	20	60	3
PCC1	25AF1245PC302	Data Structures	3	-	20	20	60	3
PCC2	25AF1245PC303	Discrete Mathematics	3	-	20	20	60	3
PCC3	25AF1245PC304	Object-Oriented Programming	2	-	20	20	60	2
PCC4	25AF1245PC305	Digital Electronics	2	-	20	20	60	2
Open Elective I⁺	25AF1245OE306	Any Course from OE Bucket	2	-	20	20	60	2
MDM	25AF1245MD307	MDM Bucket *	2	2	20	20	60	3
VSEC	25AF1245VE308	Universal Human Values - II	2	-	20	20	60	2
PCC Lab	25AF1245PCL309	Data Structures Laboratory	-	2	60	-	40	1
PCC Lab	25AF1245PCL310	Object-Oriented Programming in Java Laboratory	-	2	60	-	40	1
PCC Lab	25AF1245PCL311	Digital Electronics Laboratory	-	2	60	-	40	1
VEC	25AF1245AE312	Life of Chhatrapati Shivaji Maharaj	1	-	50	-	-	1
		Total	**20**	**08**	**390**	**160**	**600**	**24**

Course Type and Acronyms used

1. Basic Science Course (BSC)
2. Engineering Science Course (ESC)
3. Program Core Course (PCC)
4. Vocational Skill Enhancement Course (VSEC)
5. Co-curricular Course (CC)
6. Ability Enhancement Course (AEC)
7. Indian Knowledge System (IKS)

L - Lecture,
P / PR - Practical,
CA - Continuous Assessment, TH - Theory,
MSE - Mid-Semester Examination,
ESE - End Semester Examination,
CR - Credit

*A student must select a course or courses from the minor degree program s/he wishes to pursue.
+ A student needs to select a course from the list of open elective courses attached to the Open Elective (OE) Bucket

Second Year in B.Tech in Computer Engineering and Allied Programs
Course Curriculum Aligned with New Education Policy 2020
(Effective from Academic Year 2025 - 2026)
Fourth Semester

Course Categories	Course Code	Course Name	Weekly Hours		Examination Scheme			Credit
			L	P	CA	MSE	ESE	
PCC1	25AF1245PC401	Design and Analysis of Algorithms	3	-	20	20	60	3
PCC2	25AF1245PC402	Computer Architecture and Organisation	3	-	20	20	60	3
PCC3	25AF1245PC403	Probability and Statistics	3	-	20	20	60	3
PCC4	25AF1245PC404	Operating Systems	3	-	20	20	60	3
Open Elective-II+	25AF1245OE405	Any course from OE Bucket List	2	-	20	20	60	2
MDM	25AF1245MD406	MDM Bucket*	2	2	20	20	60	3
AEC	25AF1000AE407	Modern Indian Languages A) Marathi B) Hindi C) Sanskrit	2	-	20	20	60	2
PCC Lab	25AF1245PCL08	Design and Analysis of Algorithms Laboratory	-	2	60	-	40	1
PCC Lab	25AF1245PCL09	Python Programming	1	2	60	-	40	2
PCC Lab	25AF1245PCL10	Operating Systems Laboratory	-	2	60	-	40	1
AEC	25AF1245SEM411	Seminar	-	2	60		40	1
VEC	25AF1000VE412	Constitution of India	2	-	60	-	40	Audit
VEC	25AF1000VE413	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	50	-	-	1
		Total	**22**	**10**	**490**	**140**	**620**	**25**
		Exit Requirements for Certificate Program						
VSEC	23AF1245VE414	Full Stack Development Project	-	16	60	-	40	8

*A student must select a course or courses from the minor degree program s/he wishes to pursue.

+   A student must select a course from the list of open elective courses attached to the Open Elective (OE) Bucket.

MDM Bucket list for Minor in B. Tech(Computer Engineering Program)

A student wishing to pursue a Minor program in B. Tech. (Computer Engg) needs to complete minimum 14 credits from the below list of courses.

Sem	Course Code	Course Name	L	P	CA	MSE	ESE	CR
III	25AF1245PC302	Data Structures	3	2	20	20	60	4
III	25AF1245PC304	Object-Oriented Programming	2	2	20	20	60	3
IV	25AF1245PC401	Design and Analysis of Algorithms	3	2	20	20	60	4
IV	25AF1245PC404	Operating Systems	3	2	20	20	60	4
Proposed Courses to be offered in V and VI Semester								
V	-	Data Base Managment System	3	2	20	20	60	4
V	-	Theory of Computation	3	-	20	20	60	3
VI	-	Software Engineering	3	2	20	20	60	4
VI	-	Computer Networks	3	-	20	20	60	3

List of Open Electives (OE)

In the vertical of Multidisciplinary courses, students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V are included in the basic minimum of 160-max.176 Credits. It is offered in the Second and/or Third year. Refer to the wise credit distribution table given below. Faculty-wise baskets of OE are prepared by the university. They are chosen from faculty other than that of the Major Faculty, i.e., in this case, the Major Faculty is the Faculty of Engineering. Other Faculties considered are as follows:

1. Faculty of Management and Commerce
2. Faculty of Law
3. Faculty of Humanities and Arts
4. Faculty of Architecture and Planning
5. Faculty of Health Sciences
6. Faculty of Science

Students must take up three courses of 08 credits over semesters III to V.

Elective Type	Subject Codes	Subject full name	Subject nature	Subject type	Subject credit
Faculty of Architecture and Planning	24UD1ARPOEM05B	Building Materials and Composites	THEORY	ELECTIVE	2
Faculty of Architecture and Planning	24UD1ARPOEM05D	Modern Indian Architecture	THEORY	ELECTIVE	2
Faculty of Architecture and Planning	24UD1ARPOEM05F	Contemporary Architecture and Design	THEORY	ELECTIVE	2
Faculty of Architecture and Planning	24UD1ARPOEM05A	Architectural Approaches to Decarbonization of Buildings	THEORY	ELECTIVE	3
Faculty of Architecture and Planning	24UD1ARPOEM05C	Building Materials as a Cornerstone to Sustainability	THEORY	ELECTIVE	3
Faculty of Architecture and Planning	24UD1ARPOEM05E	Sustainable Architecture	THEORY	ELECTIVE	3
Faculty of Health Sciences	24UD1HSCOEM05A	Basics of Health Promotion and Education Intervention	THEORY	ELECTIVE	2
Faculty of Health Sciences	24UD1HSCOEM05B	Research Methods in Health Promotion	THEORY	ELECTIVE	3
Faculty of Health Sciences	24UD1HSCOEM05C	Introduction to Psychology	THEORY	ELECTIVE	3
Faculty of Humanities and Arts	24UD1HAROEM05B	Folk and Minor Art in India	THEORY	ELECTIVE	2
Faculty of Humanities and Arts	24UD1HAROEM05C	Sustainable Happiness	THEORY	ELECTIVE	2
Faculty of Humanities and Arts	24UD1HAROEM05D	Soft Skill Development	THEORY	ELECTIVE	2
Faculty of Humanities and Arts	24UD1HAROEM05A	Developing Soft Skills and Personality	THEORY	ELECTIVE	2
Faculty of Humanities and Arts	24UD1HAROEM05E	Introduction to Market Structures	THEORY	ELECTIVE	3

Faculty of Humanities and Arts	24UD1HAROEM05F	Human Resource Development	THEORY	ELECTIVE	3
Faculty of Humanities and Arts	24UD1HAROEM05G	Educational Leadership	THEORY	ELECTIVE	3
Faculty of Humanities and Arts	24UD1HAROEM05H	Sustainable Development Goals	THEORY	ELECTIVE	3
Faculty of Humanities and Arts	24UD1HAROEM05I	Gender & Violence	THEORY	ELECTIVE	5
Faculty of Law	24UD1LAWOEM05A	Introduction to Law on Electricity	THEORY	ELECTIVE	2
Faculty of Law	24UD1LAWOEM05D	Conflict Management through Mediation	THEORY	ELECTIVE	2
Faculty of Law	24UD1LAWOEM05E	Biodiversity Protection , Farmers and Breeders Rights	THEORY	ELECTIVE	2
Faculty of Law	24UD1LAWOEM05B	New Labour Codes of India	THEORY	ELECTIVE	3
Faculty of Law	24UD1LAWOEM05C	Right to Information and Good Governance	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05A	Advanced Algorithmic Trading and Portfolio Management	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05B	Business Analytics & Text Mining Modeling using Python	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05E	Econometric Modelling	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05J	Fundamentals of Digital Marketing & e-Commerce	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05K	Corporate Communication	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05L	Basic Principle of Finance and Economy	THEORY	ELECTIVE	2
Faculty of Management and Commerce	24UD1MACOEM05C	Commodity Derivatives & Risk Management	THEORY	ELECTIVE	3

Faculty	Code	Course	Type	Category	Credits
Faculty of Management and Commerce	24UD1MACOEM05D	E-Business	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05F	Introduction to Marketing Essentials	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05G	Security Analysis & Portfolio Management	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05H	Equity Stock Market	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05I	Total Quality Management	THEORY	ELECTIVE	3
Faculty of Management and Commerce	24UD1MACOEM05M	Marketing for entrepreneurship	THEORY	ELECTIVE	3
Faculty of Science	24UD1SCIOEM05B	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	THEORY	ELECTIVE	1
Faculty of Science	24UD1SCIOEM05C	Quantum Information and Computing	THEORY	ELECTIVE	2
Faculty of Science	24UD1SCIOEM05F	CO2 Capture, Sequestration and Utilization	THEORY	ELECTIVE	2
Faculty of Science	24UD1SCIOEM05G	Waste to Energy	THEORY	ELECTIVE	2
Faculty of Science	24UD1SCIOEM05A	Quantum Computing	THEORY	ELECTIVE	3
Faculty of Science	24UD1SCIOEM05D	Dynamics of Classical and Quantum Fields	THEORY	ELECTIVE	3
Faculty of Science	24UD1SCIOEM05E	Introduction to MATLAB	THEORY	ELECTIVE	3
Faculty of Science	24UD1SCIOEM05H	History of Science & Technology	THEORY	ELECTIVE	3
Faculty of Science	24UD1SCIOEM05I	Algebra I	THEORY	ELECTIVE	5

List of Open Electives for

Faculty of Management and Commerce

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Advanced Algorithmic Trading and Portfolio Management	4 Hrs/Week	8	2	IIT Kanpur	Prof. Abhinava Tripathi	https://nptel.ac.in/courses/110104169
2	Business Analytics & Text Mining Modeling using Python	4 Hrs/Week	8	2	IIT Roorkee	Prof. Gaurav Dixit	https://nptel.ac.in/courses/110107129
3	Commodity Derivatives & Risk Management	4 Hrs/Week	12	3	IIT Kharagpur	Prof. Prabina Rajib	https://nptel.ac.in/courses/110105168
4	E-Business	4 Hrs/Week	12	3	IIT Kharagpur	Prof. Mamata Jenamani	https://nptel.ac.in/courses/110105083
5	Econometric Modelling	4 Hrs/Week	8	2	IIT Roorkee	Prof. Sujata Kar	https://nptel.ac.in/courses/110107153
6	Introduction to Marketing Essentials	4 Hrs/Week	12	3	IIT Roorkee	Prof. Zillur Rahman	https://nptel.ac.in/courses/110107147
7	Security Analysis & Portfolio Management	4 Hrs/Week	12	3	IIT Roorkee	Prof. J. P. Singh	https://nptel.ac.in/courses/110107154
8	Equity Stock Market		6	3	Indian Institute of Management Bangalore (IIMB)	P C Narayan	

List of Open Electives for

Faculty of Law

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Introduction to Law on Electricity	4 Hrs/Week	8	2	IIT Kharagpur	Prof. Uday Shankar	https://nptel.ac.in/courses/129105004
2	New Labour Codes of India	4 Hrs/Week	12	3	IIT Kharagpur	Prof. KD Raju	https://nptel.ac.in/courses/129105006
3	Right to Information and Good Governance	4 Hrs/Week	12	3	National Law School of India University	By Prof. Sairam Bhat	https://nptel.ac.in/courses/129106001
4	Conflict Management through Mediation	4 Hrs/Week	8	2	Vice Chancellor, National University of Study and Research in Law, Ranchi (NUSRL)	Prof. (Dr.) Ashok R. Patil	https://nptel.ac.in/courses/129106008
5	Biodiversity Protection , Farmers and Breeders Rights	4 Hrs/Week	8	2	IIT Kharagpur	By Prof. Padmavati Manchikanti , Prof. Narendran Thiruthy		https://nptel.ac.in/courses/129105008

List of Open Electives for

Faculty of Humanities and Arts

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Developing Soft Skills and Personality	4 Hrs/Week	8	2	IIT Kanpur	Prof. T. Ravichandran	https://nptel.ac.in/courses/109104107
2	Folk and Minor Art in India	4 Hrs/Week	8	2	IIT Kanpur	Prof. Shatarupa Thakurta Roy	https://nptel.ac.in/courses/109104106
3	Sustainable Happiness	4 Hrs/Week	8	2	IIT Kharagpu r	By Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105493
4	Soft Skill Development	4 Hrs/Week	8	2	IIT Kharagpu r	Prof. Priyadarshi Patnaik, Prof. V.N. Giri, Prof. D. Suar	https://nptel.ac.in/courses/109105110
5	Introduction to Market Structures	4 Hrs/Week	12	3	IIT Guwahati	Prof. Amarjyoti Mahanta	https://nptel.ac.in/courses/109103187
6	Human Resource Development	4 Hrs/Week	12	3	IIT Kharagpu r	Prof. KBL Srivastava	https://nptel.ac.in/courses/109105121
7	Educational Leadership	4 Hrs/Week	12	3	IIT Kharagpu r	Prof. Atasi Mohanty	https://nptel.ac.in/courses/109105122

List of Open Electives for

Faculty of Architecture and Planning

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Architectural Approaches to Decarbonizati on of Buildings	4 Hrs/Week	12	3	School of Planning and Architect ure, Vijayawa da, An Institute of National Importanc e under the Ministry of Education , Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106454
2	Building Materials and Composites	4 Hrs/Week	8	2	IIT Kharagpu r	Prof. Sumana Gupta	https://nptel.ac.in/courses/124105013
3	Building Materials as a Cornerstone to Sustainability	4 Hrs/Week	12	3	School of Planning and Architect ure, Vijayawa da, An Institute of National Importanc e under the Ministry of Education , Govt. of India	Prof. Iyer Vijayalaxmi Kasinath	https://nptel.ac.in/courses/124106455
4	Modern Indian Architecture	4 Hrs/Week	8	2	IIT Roorkee	Prof. P.S. Chani	https://nptel.ac.in/courses/124107161
5	Sustainable Architecture	4 Hrs/Week	12	3	IIT Roorkee	Prof. Avlokita Agrawal	https://nptel.ac.in/courses/124107011
6	Contemporary Architecture and Design	4 Hrs/Week	8	2	IIT Roorkee	Prof. Saptarshi Kolay	https://nptel.ac.in/courses/124107005

List of Open Electives for
Faculty of Health Sciences

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Basics of Health Promotion and Education Intervention	4 Hrs/Week	8	2	IIT Kharagpur	Dr. Arista Lahiri, Dr. Sweety Suman Jha, Prof. (Dr.) Chandrashek har Taklikar, Prof.(Dr.) Madhumita Dobe	https://nptel.ac.in/co urses/127105232
2	Research Methods in Health Promotion	4 Hrs/Week	12	3	IIT Kharagpur	Dr. Arista Lahiri, Dr. Sweety Suman Jha, Prof.(Dr.) Madhumita Dobe	https://nptel.ac.in/co urses/127105237

List of Open Electives for

Faculty of Science

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Quantum Computing	4Hrs/Week	12	3	IIT Kanpur	Prof. Debabrata Goswami	https://onlinecourses.nptel.ac.in/noc19_cy31/preview#:~:text=Building%20up%20on%20the%20digital,the%20laws%20of%20quantum%20mechanics.
2	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	4Hrs/Week	4	1	IIT Madras, IBM Research, IBM Systems	Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashaye Raghunathan	https://onlinecourses.nptel.ac.in/noc24_cs67/preview
	Quantum Information and Computing	4Hrs/Week	8	2	IIT Bombay	Prof.Dipan Ghosh Department of Physics	https://archive.nptel.ac.in/courses/115/101/115101092/
	Dynamics of Classical and Quantum Fields	4Hrs/Week	12	3	IIT Guwahati	Prof. Girish S. Setlur	https://onlinecourses.nptel.ac.in/noc22_ph29/preview

Detailed syllabus for Open Elective Courses in
Faculty of Management and Commerce

Advanced Algorithmic Trading and Portfolio Management

Week 1: Introduction to R Programming, R Fundamentals, Basic mathematical and logical operations with R, working with different data-types in R, wrangling with dataframes, Exploratory data analysis and data visualization with R.

Week 2: Introduction to Portfolio Construction : Risk-return framework in financial markets, risk diversification with portfolios, portfolio optimization in mean-variance framework, concept of market risk and beta, Portfolio Possibility curve, Efficient frontier, Minimum Variance portfolios, Introduction to risk-free lending and borrowing

Week 3: Asset Pricing Models: Capital Asset Pricing Model (CAPM), Capital Market Line, Security Market Line, Fallings of CAPM, Single-Index and Multi-Index models, Expected Risk and Return with Index models, 3-Factor Fama-French Model

Week 4: Portfolio Management and Performance Evaluation: Portfolio Management strategies, Active vs Passive Portfolio Management, Value vs Growth investing, One- parameter performance measures Timing & Selection performance measures, application of asset pricing models in performance management

Week 5: Introduction to Algorithmic Trading: Technical analysis and trend determination, Dow Theory, Moving averages, Momentum indicators, Classical price patterns.

Week 6: Advanced time-series regression algorithms: ARMA/ARIMA models, Mean reverting trading strategies with vector error correction models and cointegration, model risk management, back testing, model validation, and stress testing with R

Week 7: Advanced time-series algorithms for financial risk-management: Value-at-risk, Expected Shortfall, ARCH/GARCH models, implementation with R

Week 8: Advanced topics: Alternative versions of CAPM, Delineating Efficient Frontier, Performance Evaluation with Multi-index models, Portfolio construction, optimization, back-testing, and visualization with R

Business Analytics & Text Mining Modeling using Python

Week 1: Introductory overview of Text Mining
- Introductory Thoughts
- Data Mining vs. Text Mining
- Text Mining and Text Characteristics
- Predictive Text Analytics
- Text Mining Problems
- Prediction & Evaluation
- Python as a Data Science Platform

Python for Analytics
- Introduction to Python Installation
- Jupyter Notebook Introduction

Week 2: Python Basics
- Python Programming Features
- Commands for common tasks and control
- Essential Python programming concepts & language mechanics

Built in Capabilities of Python
- Data structures: tuples, lists, dicts, and sets

Week 3: Built in Capabilities of Python
- Functions, Namespaces, Scope, Local functions, Writing more reusable generic functions

Week 4: Built in Capabilities of Python
- Generators
- Errors & Exception Handling
- Working with files

Numerical Python
- N-dimensional array objects

Week 5: Numerical Python
- Vectorized array operations
- File management using arrays
- Linear algebra operations
- Pseudo-random number generation
- Random walks

Python pandas
- Data structures: Series and DataFrame

Week 6: Python pandas
- Applying functions and methods
- Descriptive Statistics
- Correlation and Covariance

Working with Data in Python
- Working with CSV, EXCEL files
- Working with Web APIs

Week 7: Working with Data in Python
- Filtering out missing data, Filling in the missing data, removing duplicates
- Perform transformations based on mappings
- Binning continuous variables
- Random sampling and random reordering of rows
- Dummy variables
- String and text processing
- Regular expressions
- Categorical type

Data Visualization using Python
- Matplotlib Library
- Plots & Subplots

Week 8: Text mining modeling using NLTK
- Text Corpus
- Sentence Tokenization
- Word Tokenization
- Removing special Characters
- Expanding contractions
- Removing Stopwords
- Correcting words: repeated characters
- Stemming & lemmatization
- Part of Speech Tagging
- Feature Extraction
- Bag of words model
- TF-IDF model
- Text classification problem
- Building a classifier using support vector machine

Commodity Derivatives & Risk Management

Week 1: Commodity Derivatives Trading & Commodity Exchanges, Commodity Contracts, Trading platform for Major Commodity Exchanges: Open Outcry vs. Electronics. Kerb Trading.

Week 2: Commodity Indices creation, Collateralized vs. uncollateralized index, commodity index based on contract side.

Week 3: Introduction to Futures & Forwards, Pricing & valuation, Futures Pricing Valuation for Storable/non Storable Commodity.

Week 4: Contango/Backwardation, Hedge Ratio, Pricing & Valuation of Commodity Options.

Week 5: Introduction to Options, Swaps, Exchange of Futures for Physicals, Pricing & Valuation.

Week 6: Commodity Price risk for Agricultural committee, Seasonality in prices, Contango, backwardation

Week 7: Commodity Price risk in Crude Oil & Natural Gas, LOOP Storage contracts Week

8: Gold & Silver, Base Metal Commodity Derivatives.

Week 9: Electricity Derivatives Pricing and Trading. Week 10:

Carbon Credit Derivatives, Pricing & Trading. Week 11:

Weather Derivatives.

Week 12: Miscellaneous Derivatives: Freight, Water, Property and Non-Farm Payroll Index, Salmon, Bitcoin Derivatives.

E-Business

Week 2: Making Functional Areas E-Business Enabled : Value chain and supply chain, inter and intra organizational business processes, ERP.

Week 3: Making Functional Areas E-Business Enabled : E-Procurement.

Week 4: Making Functional Areas E-Business Enabled : E-marketing, E-Selling, E-Supply Chain Management.

Week 5: Technologies for E-Business: Internet and Web based system.
Week 6: Technologies for E-Business: Security and payment systems.

Week 7: Technologies for E-Business: Supply chain integration technologies (EDI, RFID, Sensors, IoT, GPS, GIS).

Week 8: Technologies for E-Business: Supply chain integration technologies (Web services and cloud).

Week 9:   Decision Support in E-Business: Web analytics.

Week 10: Decision Support in E-Business: Customer behavior modeling. Week

11: Decision Support in E-Business: Auctions.

Week 12: Decision Support in E-Business: Recommender systems.

Econometric Modelling

Week 1   :   Introduction
Week 2   :   Overview of Classical Linear Regression Model
Week 3   :   Multiple regression analysis and diagnostic tests
Week 4   :   Statistical inference and hypothesis testing
Week 5   :   Univariate Time Series Modelling
Week 6   :   Models with Binary Dependent and Independent Variables
Week 7   :   Multivariate Models
Week 8   :   Modelling Long Run Relationships

Introduction to Marketing Essentials

Week 1: Creating Customer Relationships and Value Through Marketing, TheNew Realities of Marketing, Developing Successful Marketing and Organizational Strategies.

Week 2: Organizing and Managing the Marketing Department, Developing a Marketing

Strategy,Understanding the Marketing Environment, Ethical Behavior, and Social Responsibility, Understanding Consumer Behavior.

Week 3: Understanding Consumer Behavior (Continued), Understanding Organizations as Customers.

Week 4: Understanding and Reaching Global Consumers and Markets, Marketing Research: From Customer Insights to Actions.

Week 5: Market Segmentation, Targeting, and Positioning, Crafting Customer Value Proposition, Sustainable Competitive Advantage and Communicating Positioning.

Week 6: Developing New Products and Services

Week 7: Developing New Products and Services(Continued), Managing Successful Products, Services, and Brands.

Week 8: Managing Successful Products, Services, and Brands (Continued), Pricing Products and Services.

Week 9: Managing Marketing Channels and Supply Chains, Retailing and Wholesaling.

Week 10: Integrated Marketing Communications and Direct Marketing, Advertising, Sales Promotion, and Public Relations, Using Social-Media to Connect with Consumers.

Week 11: Using Social-Media to Connect with Consumers (Continued), Personal Selling and Sales Management, Implementing Interactive and Multichannel Marketing.

Week 12: Managing Growth: Addressing Competition and Driving Growth, Building Customer Loyalty, Socially Responsible Marketing.

Security Analysis & Portfolio Management

Week 1: Concept of Investment, Investment Objectives and Constraints, Investment Classification. Financial Markets & Instruments, their role & classification. Regulation of Securities Markets, Primary & Secondary Markets, Trading, Clearing and Settlement procedures, Market Indices.

Week 2: Concept & Measures of Risk and Return, Portfolio Risk & Return, Reduction of Risk through Diversification.

Week 3: Concept of Intrinsic Valuation, Cash Flow based Equity Stock Valuation Models. Value Added & Asset based valuation. Use of Multiples & Relative Value.

Week 4: Fundamental Analysis for Determination of Inputs to Equity Valuation, Cash Flow &

Profitability Forecasting, EIC Framework, Economic Forecasting Methods, Industry Analysis, Industry Life Cycle, Structural Analysis.

Week 5: Company Analysis, Publicly accessible Corporate Information, Tools of Financial Statement Analysis.

Week 6: Financial Statement Analysis including Impact of Changes in Accounting Policies, Depreciation Methods, Revaluation of Fixed Assets, Foreign Exchange Transactions, Amortization of Preliminary and Preoperative Expenses, R&D Expenditure, Valuation of Inventory, Treatment of Leases etc.

Week 7: Measures of Bond Returns, YTM & Holding Period Yields, Bond Valuation, Spot & Forward Interest Rates, Term Structure & Yield Curves, Interest Rate Sensitivities, Duration & Elasticities. Key Rates & Bucket Rates.

Week 8: Efficient Market Hypothesis, Technical Analysis: Dow Theory, Types of Charts, Price Patterns, Trend Lines, Trend Channels, Support and Resistance Levels, Relative Strength Analysis, Moving Averages, Breadth of the Market, Volume, Momentum.

Week 9: Portfolio optimization in the mean variance framework: two security case, various combinations of risky & risk-free assets, implications of the results, concept of efficient frontier. Concept of Utility & Indifference Curves, Optimal Portfolio Selection.

Week 10: The multi-security case of portfolio optimization, Tracing of the full efficient frontier with/without the existence of risk-free asset.

Week 11: Single Index & Capital Asset Pricing Model, Systematic and Unsystematic Risk, Beta of a Portfolio, CML & SML, Arbitrage Pricing Theory, Comparison of CAPM and APT, Applications of APT.

Week 12: Active & Passive Portfolio Management, Portfolio Revision of Equity Portfolios, Measuring and Evaluating Portfolio Performance, Measures of Return on Active Portfolios, Buying the Index Approach. Fixed Income Portfolio Management. Active vs Passive Strategies, Portfolio Management Using Derivatives.

Equity Stock Market

Week 1: Overview of Equity Stock Markets
- Overview and Planner for Week 1
- Financial Markets: An Overview
- Equity Stock Market: An Overview
- Estimating the Price of Equity Stocks
- Equity Stock Market: Market Mechanism
- Equity Stock Market: Indices and Regulatory Mechanism
- Summary and Additional Reading

Week 2: Underlying Theories Governing Equity Stock Markets
- Overview and Planner for Week 2
- Fundamental Analysis
- Technical Analysis
- Fundamental vs. Technical Analysis
- Moving Averages
- Dow Theory
- Elliot Wave Theory
- Summary and Additional Readings

Week 3: Equity Risk and PortfolioTheories
- Overview and Planner for Week 3
- EquityRisk : An Overview
- Introduction to Portfolio Theory
- Portfolio Theory - CAL and CML
- Portfolio Theory - SML and CAPM
- Evaluating Equity Portfolio using Sharpe Ratio, Treynor Ratio andJensen's Alpha
- Summary and Additional Readings

Week 4: Hedging Using Derivatives in Equity Stock Markets
- Overview and Planner for Week 4
- Derivatives in Equity Market
- Hedging Using Stock Futures
- Hedging Using Index Futures
- Hedging Using a Single Option
- Multiple Options and Trading
- Strategies
- Summary and Additional Readings

Week 5: VaR, Margins, Private EquityMarket and Venture Capital
- Overview and Planner for Week 5
- VaR (Value at Risk)
- Computing and Enforcing Margins

- Private Equity Market
- Venture Capital
- Summary and Additional Readings

Detailed syllabus for Open Elective Courses in

Faculty of Law

Introduction to Law on Electricity

Week 1 :   Introduction of the Electricity Law; Constitutional Design; Brief Description of Pre-2003 Act and Post - 2003 Act

Week 2 :   Energy Security and Energy Mix and the Role of the Electricity Act; Relevance of National Electricity and Tariff Policies.

Week 3 :   De-licensing of Generation and Captive Power Plant

Week 4 :   Transmission and Load Dispatch Centre

Week 5 :   Open Access and Tariff

Week 6 :   Trading of Electricity and Trading Market

Week 7 :   Distribution and Universal Service Obligation

Week 8 :   Interest of Consumer and Redressal of the Grievances; Renewable Energy and 2003 Act including Renewable Purchase Obligations; Net and Gross Metering.

New Labour Codes of India

Week 1:
1. Introduction
2. Government Policies
3. History of Labour Laws in the Country
4. History: Previous Social Legislations in India (Cont…)
5. National Labour Commission Reports

Week 2:
6. Evolution of Trade Unions in India
7. Constitutional Freedom to Form Association and Unions
8. International Labour Organization on Trade Unions
9. Trade Union – Definition, Registration, Cancellation, Management of Funds
10. Trade Union – Recognition, Immunities

Week 3:
11. Industrial Dispute – Introduction, Definitions
12. Resolution of Industrial Disputes
13. Concept of Workmen, Contract of service, Contract for service
14. Strike
15. Lock-out

Week 4:
16. Lay-Off
17. Retrenchment
18. Closure of Undertakings
19. Industrial Employment (Standing Orders)
20. Disciplinary Action and Procedures

Week 5:
21. The Code on Wages 2019 – An Introduction
22. Minimum Wages, Floor Wages, Central and State Advisory Board
23. Payment of Wages, Deductions & Recovery, Fines
24. Equal Remuneration
25. Bonus

Week 6:
26. C131: Minimum Wage Fixing Convention, 1970
27. C026: Minimum Wage – Fixing Machinery Convention, 1928; C099: Minimum Wage Fixing Machinery (Agriculture) Convention, 1951
28. C095: Protection of Wages Convention, 1949
29. C100: Equal Remuneration Convention, 1951: International Instruments on Equality of Pay
30. C173: Protection of Workers' Claims (Employer's Insolvency) Convention, 1992; C111: Discrimination (Employment and Occupation) Convention, 1992

Week 7:
31. Code on Social Security, 2020 – Introduction
32. Definitions under Social Security Code, 2020
33. Social Security Organizations (SSO)
34. Employee's Compensation and Benefits
35. The Concept of arising out of and in the course of employment

Week 8:
36. Employees State Insurance
37. Different Benefits under the ESI Scheme
38. Employee's Provident Fund
39. Gratuity
40. Maternity Benefit

Week 9:
41. Social Security in case of Building and other Construction Workers
42. Social Security for Unorganized sector and Platform workers
43. Bonded Labour System Abolition and Regulation
44. Child Labour Prohibition
45. Plantation Labour

Week 10:
46. Occupational Safety, Health and Working Conditions Code, 2020 – Introduction, Definitions
47. Occupational Safety and Health
48. Health Safety and Working Conditions, Welfare Provisions
49. Regulation of Working H ours and the Concept of Decent Work
50. Duties of Employer and Employees, Special Provisions relating to Employment of Women, Hours of Works, Annual Leave with Wages, Maintenance of Registers

Week 11:
51. The Meaning of Factory, Manufacturing Process, Approval and Licensing of Factories
52. Role of Inspector-cum-facilitator and Other Authorities
53. Social Security Fund, Offences and Penalties
54. Contract Labour and Proposed ILO Convention
55. Inter-State Migrant Workers

Week 12:
56. Mines Workers
57. Beedi and Cigar Workers (Kerala & West Bengal Legislations)
58. Audio-Visual workers, Cine-workers and Dock workers
59. The Effective Abolition of Child Labour (ILO: C029, C105, C138 & C182)
60. The Governance Convention of ILO Labour Standards

Right to Information and Good Governance

Week 1: History and Background to RTI Week 2:
- Legislating RTI
- Official Secrets Act and RTI
- Role of NGOs and activist in RTI
- Mis-use of RTI
- Important SC and HC judgments in RTI

Week 3: Constitution and RTI

Week 4: Salient Features of RTI-1 Week

5: Salient features of RTI-2

Week 6: Powers and Functions of Information Commission Week

7: Public Authority

Week 8: Exempted Information Week 9:

RTI & Its interface
- Public Records Act
- Whistleblowers Protection Act

- Judiciary and RTI

Week 10:
- Ecological perspective on RTI
- Lessons from RTI: Sakaala: Public Service Guarantee Act

Week 11: RTI: A comparative perspective
- Comparative Constitutional and Comparative FOI regime
- RTI in Srilanka

Week 12: How to Draft RTI Application and Appeals: Do it yourself

Conflict Management through Mediation

Week 1: Introduction
- Basic Introduction
- Historical Perspective and Evolution in India
- Legal Recognition of Mediation in India
- Conflict and Conflict Management
(Relevant Case Laws)

Week 2: Concept of Mediation
- Basic Principles of Mediation
- Types of Mediation
- Advantages of Mediation
(Relevant Case Laws)

Week 3: Comparison of Judicial Process and Various ADR Processes
- A comparative Analysis of Judicial Process with modes of Alternate Dispute Resolution like Arbitration, Mediation, Conciliation, Negotiation and Lok Adalats.
- Illustrations to understand the difference and identify suitable conditions for ADR.

Week 4: Process of Mediation
- Pre-litigation Mediation
- Post-litigation Mediation
- Stages of Mediation
- Challenges
- The Mediation Act, 2023
(Relevant Case Laws)

Week 5: Mediators
- Role of Mediators
- Ethics
- Communication in Mediation
(Relevant Case Laws)

Week 6: Mediation under Consumer Protection Act, 2019
- Introduction of the Mediation under Consumer Protection Act, 2019
- Chapter V- Mediation
- Consumer Protection (Mediation) Rules, 2020
- Consumer Protection (Mediation) Regulations, 2020 (Relevant Case Laws)

Week 7: Mediation under other related laws
- Mediation under the Commercial Courts, 2015, Family Court Act, 1984, the Banking Ombudsman Scheme, 2006 and the Companies Act, 2013
- United Nations Convention on International Settlement Agreements Resulting from Mediation, 2018 (the "Singapore Convention on Mediation")
- Online Mediation including ODR Report
- ODR Policy of NITI Aayog (Relevant Case Laws)

Week 8: Drafting and Enforcement
- Enforcement of Mediation Outcome
- Drafting Mediation Settlement

Biodiversity Protection, Farmers and Breeders Rights

Week 1: Concept and Scope of biodiversity protection
1. Concept and Scope of biodiversity protection
2. Types of biodiversity, mega-biodiverse centers,
3. Type of bio-resources, conservation mechanisms
4. International resources/centers of conservation
5. Traditional Resource rights, ecosystem measures

Week 2: Protection of Biological diversity: International mandate
1. Overview of International framework
2. Convention on Biodiversity - Objectives and Articles
3. International Regime on ABS
4. Biodiversity and Climate Change
5. Biobanks – Governance issues

Week 3: Protection of Biological Diversity -Indian position
1. The Biological Diversity Act, 2002
2. Regulatory authorities in India – NBA & SBB
3. Biodiversity Management Committees
4. People Biodiversity Registers
5. ABS Regulation and Benefit Sharing Procedures in India

Week 4: CBD, TRIPS and other treaties relevant to biodiversity protection – Interrelationship and Developments
    1. Trade regime and Biodiversity
    2. Comparison of Biodiversity Laws of countries
    3. TRIPS-CBD relation
    4. CBD and relation to other international treaties related to environment and organization of related bodies
    5. Interrelationship and new Developments

Week 5: Biodiversity and Intellectual Property Rights
    1. Biodiversity and Interface with IPR
    2. Challenges related to Bio piracy - Case Studies
    3. Patenting Biodiversity – Recent trends and Developments
    4. Disclosure Requirements in Patent – Comparative Perspective
    5. Regulatory Law – Comparative Perspective

Week 6: Plant Breeding and breeders' right v the farmers' right
    1. Concept, Definitions and Criteria for Plant Variety Protection.
    2. Protection of Plant Varieties and Farmers' Right 2001 - Major provisions of the Act
    3. Plant Variety protection in US, EU, Japan, China etc.,
    4. International Union for protection of new plant varieties (UPOV)
    5. Farmers' Rights – other country models

Week 7: Biodiversity Governance and Compliance Procedures – Comparative Perspective
    1. Principles of Biodiversity Governance
    2. Compliance Procedures and Linkage with IPR
    3. Compliance Procedures under International Framework
    4. Compliance Procedures in India
    5. Compliance Procedures in EU

Week 8: Biodiversity and Human Wellbeing
    1. Biodiversity and Interrelationship with Life
    2. Sustainable Development Agenda
    3. Biodiversity, ecosystem functioning, ecosystem services
    4. Biodiversity and Human Happiness
    5. Nature Protects if She is Protected

Detailed syllabus for Open Elective Courses in
Faculty of Humanities and Arts

Developing Soft Skills and Personality

Week 1: Lecture 1: Introduction: A New Approach To Learning
            Lecture 2: Planning and Goal-Setting
            Lecture 3: Human Perceptions: Understanding People
            Lecture 4: Types Of Soft Skills: Self-Management Skills
            Lecture 5: Aiming For Excellence: Developing Potential And Self-Actualisation
            Lecture 6: Need Achievement and Spiritual Intelligence

Week 2: Lecture 7: Conflict Resolution Skills: Seeking Win-Win Solution
            Lecture 8: Inter-Personal Conflicts: Two Examples
            Lecture 9: Inter-Personal Conflicts: Two Solutions
            Lecture 10: Types Of Conflicts: Becoming A Conflict Resolution Expert
            Lecture 11: Types Of Stress: Self-Awareness About Stress
            Lecture 12: Regulating Stress: Making The Best Out Of Stress

Week 3: Lecture 13: Habits: Guiding Principles
            Lecture 14: Habits: Identifying Good and Bad Habits
            Lecture 15: Habits: Habit Cycle
            Lecture 16: Breaking Bad Habits
            Lecture 17: Using The Zeigarnik Effect For Productivity And Personal Growth
            Lecture 18: Forming Habits Of Success

Week 4: Lecture 19: Communication: Significance Of Listening
            Lecture 20:Communication: Active Listening
            Lecture 21:Communication: Barriers To Active Listening
            Lecture 22:Telephone Communication: Basic Telephone Skills
            Lecture 23:Telephone Communication: Advanced Telephone Skills
            Lecture 24: Telephone Communication: Essential Telephone Skills

Week 5: Lecture 25: Technology And Communication: Technological Personality
            Lecture 26: Technology And Communication: Mobile Personality?
            Lecture 27: Topic: Technology And Communication: E-Mail Principles
            Lecture 28: Technology And Communication: How Not To Send E-Mails!
            Lecture 29: Technology And Communication: Netiquette
            Lecture 30: Technology And Communication: E-Mail Etiquette

Week 6: Lecture 31: Communication Skills: Effective Communication
            Lecture 32: Barriers To Communication: Arising Out Of Sender/Receiver's
Personality

Folk and Minor Art in india

Week 1: Changing definition of Folk and Minor Art
        Timeline and Regions: General Mapping
        Traditional Roots: Elements and Principles
        Timelessness : Primitive Connection
        Evolution in Purpose: Ritualistic to Propagative
        Contemporary Practice

Week 2: Classification and Connections: Traditional Roots
        Available literary recourses
        Mythical Associations
        Idea of Nationalism in the Context of Folk art
        Idea of Modernism In the context of Folk Art
        Relevance of the Art Practice

Week 3: Contextualization and Decontextualization
        Concept of Communication for Social Purpose
        Aesthetic Perspective
        Secularity and Religious Plurality
        Ethnographic perspective on the study of Folk Art and Culture
        About the Exponents who brought the culture under the limelight

Week 4: Contextualization and Decontextualization
        School of Art in Madhubani Painting
        Art as a Feminine Preserve vs the Male painters of Madhubani
        Yamapata, Pytkar and other art practice of Jharkhand Yamapata by the Jadopatias
        Sohari Painters and their Art
        Patachitra of Bengal and Odisha

Week 5: Continuum of the Practice: Ancient Centres and Contemporary
        Case study 1 Stylistic Variety in Bengal
        Case study 2 Stylistic Variety in Odisha
        Case study 3 Stylistic Variety in Andhra Pradesh
        Exponents and their Contributions
        Hypothesis on Possible Stylistic influences

Week 6: Characteristics of Contemporary Collection
        Thematic Analysis
        Iconic Analysis
        Semiotic Analysis
        Effect of narratives: Qualitative Evaluation
        Individual Expression in Contemporary Art

Week 7: Cultural Condition: Colonial and Post colonial Ideologies
Social Formation during Preindependence
New Aesthetics: early Prints and Battala Prints
Artist Block Makers and Hybrid Aesthetics of Urban Folk Art
Kalighat Painting to Haripura Posters: A synergy
Jamini Roy: Accommodating Vernacular Idiom in Academic Practice

Week 8: Coexistence and Collaborations with Mainstream Art Strategies
for Future and Sustainability: Vision and Revision
Alternative Context: place of folk art in Contemporary Lifestyle
Ancient literary sources and canonization: Scholarly Comments
Need of Paradigm Shift
Conclusion

Sustainable Happiness

Week 1: Unit I-Sustainable Happiness-
A Sustainable sense of Self
    a. Sustainable Wellbeing
    b. Happiness & Collective Wellbeing
    c. Sustainable Happiness Theory (Catherine O'Brien)
    d. Happy Classrooms & Green Schools

Week 2: Unit II- Pedagogy of Sustainable Happiness-
    a. Education for Sustainable Happiness
    b. Learning a Path not a Goal
    c. Contemplative learning for Sustainable Transformations
    d. Happiness Curriculum: Need for Responsive pedagogy
    e. Education for Sustainable Environment/ Ecosystem

Week 3: Unit III- Sustainable Happiness at Work
    a. Positive Work culture & HR wellbeing
    b. Positive Cognitive & Emotional states & processes in the Workplace
    c. Pro-Social behavior & Mental health wellbeing
    d. Continuous Professional development
    e. Building Resilient Organizations
    f. Interplay of Sustainability& Happiness at Work

Week 4: Unit IV- Sustainable Organizations
    a. Corporate Social Responsibility & Sustainability
    b. Leveraging Workplace Diversity,
    c. Work Ethics, Equity & Inclusion Initiatives

d. Sustainability Policies & Practices

e. Sustainable Employee Training , happiness & wellbeing

Week 5: Unit V- Sustainable Leadership
    a. Sustainability & Leadership
    b. Transforming Self & Others
    c. Sustainability Competences
    d. Sustainable Lifestyle, Work-life balance &Wellbeing practices
    e. Nurturing knowledge &positive attributes for In-house Sustainable Leadership grooming

Week 6: Unit VI- Positive Psychology & Sustainable Happiness
    a. Positive character strengths for Sustainable Happiness
    b. Positive & Creative organizations
    c. Nurturing talent&Career growth
    d. Strength-based development in practice (Nudging)
    e. Habits of Mind& Life skills for Sustainable Happiness
    f. Sustainable Consumption,&Conservation of Resources

Week 7: Unit-VII - Sustainable Wellbeing-
    a. Challenges& Opportunities
    b. Need for sustainable learning & practices
    c. Creativity and Innovation
    d. Consumer Wellbeing & Socio-cultural Sustainability
    e. Convergence of Triple Bottom-line-Sustainable Ecology, Economy & Just Societies

Week 8: Unit VIII- Sustainable Happiness & UNESCO SDGs
    a. Education for Sustainable Development (ESD) for achieving UNESCO Sustainable Development Goals (17 SDGs),
    b. ESD for Organizational Sustainability
    c. ESD for Social Transformation
    d. Value Creation through ESG (Environment-Society-Governance) Services & Strategy
    e. Implementing ESD & ESG for Sustainable Collective Happiness/Wellbeing

Soft Skill Development

Week 1: Communication skills 1: The basics
Topics to be covered:
    i. Understanding the communicative environment-I
    ii. Understanding the communicative environment-II
    iii. What to listen for and why
    iv. When to speak and how
    v. Starting and sustaining a conversation

Week 2: Communication skills 2 : Presentation and interaction
    i. What to present and how – I
    ii. What to present and how – II
    iii. Multimedia presentation: Understanding the basics
    iv. Communication styles
    v. Speaking in groups

Week 3: Communication skills 3: Visual, nonverbal and aural communication
    i. The world of visual culture
    ii. Visual perception
ii. The aural: Its relevance and impact
iv. The body and the way it communicates
v. The face, its expressions and what it says

Week 4: Interpersonal communication 1: Individuals, groups and cultures
    i. Building Relationships
    ii. Understanding Group Dynamics- I
    iii. Understanding Group Dynamics- II
    iv. Groups, Conflicts and their Resolution
    v. Social Network, Media and Extending Our Identities

Week 5: Interpersonal communication 2: Emotional and social skills

Week 6: Developing key traits 1: Creativity, critical thinking and problem solving

Week 7: Developing key traits 2: Motivation, persuasion, negotiation and leadership
    i. Motivating oneself
    ii. The art of persuasion-I
    iii. The art of persuasion-II
    iv. From persuasion to negotiation
    v. Leadership and motivating others

Week 8: Essential and vocational skills: survival strategies
    i. Managing time
    ii. Managing stress
    iii. Resilience
    iv. Work-life balance
    v. Applying soft-skills to workplace

Introduction to Market Structures

Week-1: Introduction to Industrial Organization, Consumer behavior and Derivation of Demand curve

Week-2: Production and Cost curves

Week-3: Competitive Market

Week-4: Monopoly

Week-5: Game Theory: Static games of complete information (Nash equilibrium)

Week-6: Dynamic games of complete information (Subgame perfect Nash equilibrium)

Week-7: Cournot Competition

Week-8: Bertrand Competition Week-

9: Stackelberg Games Week-10:

Product Differentiation Week-11:

Entry Deterrence Week-12: Bundling

and Tying

Human Resource Development

Week 1: Introduction to Human Resource Development: Emergent of HRD, Critical HRD roles, challenges for HRD

Week 2: HRD in global perspective, HRD- Performance link, Strategic perspective of HRD Week

3: HRD Process Model: identification of HRD needs and Design and development of HRD programmes

Week 4: HRD Process Model: Methods of Implantation, Evaluation of HRD programmes Week

5: Employee coaching and performance management: Coaching to improve poor performance, coachinganalysis, coaching discussion, coaching skills

Week 6: HRD interventions: Mentoring for employee development: Role of mentoring in development,understanding the role and responsibilities of mentor, mentee, implementing the mentoring process,mentoring relationship,

Week 7: Employee counseling for HRD: Overview of counseling programmess, employee assistance programme, stress management, employee wellness and health promotion

Week 8: Competency framework of HRD: why competency mapping? Understanding the competency mapping framework, steps in competency mapping

Week 9: Career Planning, management, and development: Career development stages and activities, role of individual and organization in career planning, Issues in career management

Week 10: Intellectual capital (IC), its measurement and management: Components of IC, measurement models of IC, IC index and challenges for HR

Week 11: HRD, Organizational Learning, and learning organizations

Week 12: The future of HRD and HRD Ethics: Research, practice and education of HRD for innovation and talent development and management, Role of HRD in developing ethical attitude and behavior and development, Ethical problems with HRD roles

Educational Leadership

Week 1: Educational Management & Leadership: Issues & challenges Week

2: Professional Development & the Reflective Practitioner Week 3:

Professional Ethics & Values in Teaching

Week 4: Key Challenges for Educational Leaders: Grooming Capable & Authentic Educational Leaders

Week 5: Emotional Intelligence & Educational Leadership

Week 6: Leadership for Managing Diversity & Inclusion in Education

Week 7: Educational Leadership in a changing World : 21st Century Challenges

Week 8: Innovative Pedagogy ,Technology & Turnaround Leadership : The Stakeholders' Perspectives

Week 9: New Normal Education, Digital Pedagogy & Online classes, Online Assessment, Evaluation & Feedback Challenges & Opportunities

Week 10: Adult Learning/Andragogy Concept, Process & Outcomes, Critical Self-reflection & Contemplative Learning, National Education Policy2020 , MOOCs Sustainability Competences

Week 11: Transformative Learning: Theory and Practice, Paradigm shift for Indian Education system

Week 12: UNESCO Sustainable Development Goals(SDGs)- (SDG 4 and 4.7), Quality Education, Inclusive Education, Education for Sustainable Development(ESD) Global citizenship, Sustainable Leadership, Relationship building, Multi-stakeholder partnerships,

Detailed syllabus for Open Elective Courses in
Faculty of Architecture and Planning
Architectural Approaches to Decarbonization of Buildings

Week 1:

Module 1- Green House Gas Emission
1. Introduction to Green House Gases
2. GHG- Global Scenario and Indian Scenario
3. Strategies to reduce GHG emissions
4. Challenges and future trends in reducing GHGs in building industry

Week 2:

Module 2- India's stand on Decarbonization
5. India's current scenario -Economic & social characteristics on decarbonization
6. India's Environmental & energy strategy towards decarbonization
7. Strategic Low Emissions Development Transitions
8. India's approach to long low carbon development

Week 3:

Module 3- Embodied Energy and Embodied Carbon
9. Adaptation and Resilience to Climate Change
10. What is Embodied Energy and Embodied Carbon
11. Strategies to reduce Embodied Carbon in Built Environment
12. Impact, challenges and future trends in Embodied Carbon

Week 4:

Module 4- Operational Energy and Operational Carbon
13. Introduction to Operational energy and Operational carbon
14. Energy Benchmarking and Standards
15. Impact of Reducing Operational Energy and Carbon
16. Impact, challenges and future trends in operational energy and carbon reduction

Week 5:

Module 5- Architectural and Planning Strategies for Low Energy Consumption – Part 1
17. Passive architecture - Planning strategies
18. Factors Influencing Orientation
19. Passive architecture – Building Form
20. Passive architecture - Planning strategies

45. Embodied Carbon Value for Various Materials (Indian Context)
46. Impact of Building Materials on Embodied Carbon
47. Material Considerations for Specific Elements
48. Recap and Conclusion

Building Materials and Composites

Week 1: Clay products and alternatives like Fly-ash, CEB, CSEB
Week 2: Stone, stone tiles and stone dust blocksWood and engineered wood **Week 3:** Glass and glazing systems, ceramic tiles, vitrified tiles, insulation **Week 4:** Fine aggregate, Coarse aggregate, Cement, Concrete
Week 5: Precast items – flooring, roofing, walling system, HBC, AAB
     Week 6: Ferrous and non-ferrous metals
Week 7: Bitumen as damp proofing materials, Paints
Week 8: Plastics, Composites, nanotechnology applications

Building Materials as a Cornerstone to Sustainability

Week 1:

Carbon Negative Building Materials – Traditional Building Materials
1. Introduction – Building materials- classification and their significance in Green Buildings.
   Traditional Building materials and their characteristics (Carbon Negative BM)
2. Carbon Sequestration by Building Materials
3. Traditional Building Materials – Mud
4. Stone, Thatch

Week 2:
5. Bamboo
6. Binders- Lime, Cowdung
7. CLT,
8. Straw bale, Laterite Quarry waste

Week 3:
Alternate Building Materials
9. Introduction - Alternate Building Materials
10. Flyash concrete, Phosphogypsum
11. Furnace Slag
12. Fibre Reinforced Concrete

Week 4:
13. CWD
14. Aerated Concrete
15. Hempcrete, Papercrete
16. Alternate aggregates
17. Milk Paints, Recycled Plastics

Week 5:
Innovative Building Materials
18. Introduction – environmentally friendly, reliable and durable Building Materials
19. Permeable Concrete
20. Nanocellulose composite brick
21. Agro bricks (Date Palm Fibres, Rice Husk, Rice Husk Ash)

Week 6:
22. Agro bricks (Date Palm Fibres, Rice Husk, Rice Husk Ash)
23. Fabrick- cotton and textile ash bricks: Sustainable and Green Advanced Building Materials
24. Introduction -Advanced Building materials
25. Light Transmitting bricks

Week 7:
26. Mycelium composite brick
27. Geopolymer concrete
28. Bioluminous paints
29. Living Bricks for Carbon Sequestration

Week 8:
30. Ecobind tiles
31. Co2 absorbing concrete: Smart Building Materials
32. Introduction- Characteristics of smart materials in comparison to common architectural materials
33. Types of Smart Materials

Week 9:
34. Application of smart materials on building components - Facade systems - smart windows
35. Control of solar radiation transmitting through the building envelope Suspended particle panels - Liquid crystal panels – Photochromics, Electrochromics
36. Control of solar radiation transmitting through the building envelope Suspended particle panels Thermotropic, Thermochromics
37. Control of conductive heat transfer Exterior and exterior radiation (light) sensors Photovoltaics

Week 10:

38. Solid fuel cells
39. Controls / actuators: Shape memory alloys
40. Control of interior heat generation by Heat capacity of interior material Phase-change materials
41. Relative size, location and color of source Light-emitting diodes (LEDs) Lumen/watt energy conversion: Electroluminescents

Week 11:
42. Lighting systems - Optimization of lighting systems
43. Adhesion-changing smart materials - Photo-adhesive smart materials
44. Titanium Di Oxide Products,
45. Thermochromics

Week 12:
46. Magnetorheological and electrorheological
47. Thermotropic, Shape memory
48. Phototropics
49. Mechanochromics, Chemochromics

Modern Indian Architecture

Week 1: Introduction, Pre-Independence, Pre-Independence to Independence- Part 1

Week 2: Pre-Independence to Independence- Part 2, Revivalism, The First Generation 1945 - 1970- Part 1 to 3

Week 3: The First Generation 1945 - 1970- Part 4 to 7, Impact of Western Architects: Le Corbusier- Part 1

Week 4: Impact of Western Architects: Le Corbusier- Part 2 to 4, Impact of Western Architects: Louis I. Kahn- Part 1 to 2

Week 5: Impact of Western Architects: Louis I. Kahn- Part 3 to 4, Impact of Western Architects: Walter Gropius, Introduction to Critical Regionalism, Critical Regionalism: Climate Responsive Perspective- Part 1

Week 6: Critical Regionalism: Climate Responsive Perspective- Part 2 to 4, Critical Regionalism: Other Contexts

Week 7: Structure in Modern Indian Architecture, Points-Blocks and High-Rises, Housing in India- Part 1

Week 8: Housing in India- Part 2, Women in Modern Indian Architecture, Search for a new Architecture

Sustainable Architecture

Week 1: Fundamentals of sustainability, definitions, historical development of the concept of sustainability and sustainable development, Sustainable architecture as a subset of sustainable development.

Week 2: Impacts of built environment on natural environment, Sustainable Development, Agenda 21, UN Goals

Week 3: Characteristics of sustainable architecture, fundamentals of passive designing and climatology, thermal comfort, visual comfort, acoustic comfort

Week 4: Sustainable buildings, parameters of sustainable buildings, Green buildings, indicators of green buildings, Terminologies related to sustainable buildings- carbon footprint, life cycle analysis,

Week 5: Site development- site selection, UHI, Public Transport, vegetation, development footprint, storm water runoff, SRI

Week 6: Water – estimating the use, reductions in consumption, recycling, reuse, landscape requirement, strategies and technology for water conservation

Week 7: IEQ- day lighting, views, CFC free, ventilation, comfort, VOC free

Week 8: Materials and Resources- segregation, recycling, reduction in waste, reuse of materials and building, renewability

Week 9: Energy- energy efficiency, energy conservation, ECBC, renewable energy, M&V

Week 10: Codes and compliances – ECBC, NBC, other rating systems prevalent in india

Week 11: Vernacular architecture and sustainability, culture and sustainability

Week 12: Software use for Energy compliance- Design Builder, Climate Consultant etc

Contemporary Architecture and Design

Week 1: Preamble of Contemporary Architecture Architecture during Post Industrial Revolution Characteristics of Modern Architecture.

Week 2: Phases of Modern Architecture.

Week 3: Phases of Modern Architecture Characteristics of Post-Modern Architecture Phases of Post-Modern Architecture.

Week 4: Phases of Post-Modern Architecture Works of master architects from contemporary era.

Week 5: Phases of Modern Architecture" Brutalism" Phases of Modern Architecture Metabolism Phases of Modern Architecture Late Modern Architecture Modernism in Visual Design Modernism in Industrial Design.

Week 6: Genesis of Post- Modern Design Language Characteristics of Post-Modern Architecture and Design Phases of Post- Modern Architecture Historicism Phases

of Post- Modern Architecture High-tech Architecture Phases of Post- Modern Architecture Neo-modern.

Week 7: Phases of Post- Modern Architecture Critical regionalism Phases of Post- Modern Architecture Critical regionalism Phases of Post- Modern Architecture Deconstructivism Phases of Post- Modern Architecture Deconstructivism Postmodernism in Visual Design.

Week 8: Post-modernism in Industrial Design Works of master architects Modern era Works of master architects Modern era Works of master architects Post- Modern era Works of master architects Post- Modern era.

Detailed syllabus for Open Elective Courses in
Faculty of Health Sciences

Basics of Health Promotion and Education Intervention

Week 1: Concepts of health promotion including history
Week 2: Health behavior, health communication and Health Literacy
   Week 3: Information Education Communication (IEC), Behavior Change Communication (BCC), and Social and Behavior Change Communication (SBCC), and their applications in different settings (including role of social determinants of health)
Week 4: Need assessment for health promotion (including health behavior models)
Week 5: Planning and implementing a HPE intervention
Week 6: Designing of messages and pretesting
   Week 7: Materials and methods
   Week 8: Evaluation of HPE intervention

Research Methods in Health Promotion

Week 1: Introduction to Research Methods in Health promotion
Week 2: Theories and Models in Health Promotion and Health Behavior - part I **Week 3:** Theories and Models in Health Promotion and Health Behavior - part II **Week 4:** Quantitative Techniques in Health Promotion: Research designs
Week 5: Qualitative methods in Health Promotion
Week 6: Mixed methods techniques in Health Promotion
Week 7: Study Tool development in Health Promotion **Week 8:** Designing interventions in Health Promotion **Week 9:** BCC and SBCC
Week 10: Community-Based Participatory Research in context to Health Promotion
   Week 11: Data analysis in Health Promotion
Week 12: Research Proposal Writing and Reporting the Research Findings

Detailed syllabus for Open Elective Courses in

Faculty of Science

Quantum Computing

Course Plan:

•Quantum Measurements Density Matrices

- •Positive-Operator Valued Measure
- •Fragility of quantum information: Decoherence
- •Quantum Superposition and Entanglement
- •Quantum Gates and Circuits
- •No cloning theorem & Quantum Teleportation
- •Bell's inequality and its implications
- •Quantum Algorithms & Circuits
- •Deutsch and Deutsch–Jozsa algorithms
- •Grover's Search Algorithm
- •Quantum Fourier Transform
- •Shore's Factorization Algorithm
- •Quantum Error Correction: Fault tolerance
- •Quantum Cryptography
- •Implementing Quantum Computing: issues of fidelity
- •Scalability in quantum computing
- •NMR Quantum Computing
- •Spintronics and QED approaches
- •Linear Optical Approaches
- •Nonlinear Optical Approaches
- •Limits of all the discussed approaches
- •How promising is the future?

Books and references

1. Michael A. Nielsen and Issac L. Chuang, "Quantum Computation and Information", Cambridge (2002).

2. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd (2012).

3. Scott Aaronson, "Quantum Computing since Democritus", Cambridge (2013).

4. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge (2010).

Introduction to Quantum Computing: Quantum Algorithms and Qiskit

Course Plan:

Week 1: Introduction and IBM Quantum Perspective, Q Mission in India – Invited talk, Quantum Computing Applications, Quantum Computing Basics

Week 2: IBM Quantum Composer and Quantum Lab using Qiskit

Week 3: Quantum Algorithms-I (Oracles, Deustch Jozsa), Quantum Algorithms-II (Grover's Algorithm with Hands-on)

Week 4:Quantum Error Correction, NISQ era Quantum Algorithms (VQE/QAOA and industrial applications)

Books and references

1. Qiskit Textbook: https://qiskit.org/textbook/preface.html
2. YouTube Quantum learning series:
   https://www.youtube.com/playlist?list=PLOFEBzvs-Vvp2xg9-POLJhQwtVktlYGbY
3. Quantum Computation and Quantum Information, Textbook by M. A. Nielsen and I. Chuang, Cambridge University Press (2010).

Quantum Information and Computing

Course Plan:

Week 1: Why Quantum Computing?, Postulates of Quantum Mechanics – I, Postulates of Quantum Mechanics – II, Qubits and Bloch Sphere

Week 2: Basic Quantum Gates, Quantum Circuits , No Cloning Theorem and Teleportation , Dense coding

Week 3: Density Matrix-I, Density Matrix – II, Projective measurement, POVM, EPR and Bell's Inequalities-I, Bell's Inequalities – II

Week 4: Deutsch Algorithm , Deutsch-Jozsa Algorithm , Simon Problem , Grover's Search Algorithm – I , Grover's Search Algorithm –II , Grover's Search Algorithm –III , Grover's Search Algorithm –IV

Week 5: Quantum Fourier Transform –I , Quantum Fourier Transform –II , Period Finding, Method of Continued Fraction , Shor's Factorization Algorithm ,

Week 6: Quantum Error Correction Codes , Quantum error Correction Codes

Week 7: Classical Information Theory , Shannon Entropy -I , Shannon entropy-II , Von Neumann Entropy-I , Von Neumann Entropy –II

Week 8: Classical Cryptography , RSA Algorithm , Quantum Cryptography – BB 84 protocol , B-92 and Eckart protocol , Practical realization of a quantum computer-I , Practical Realization of Quantum Computer -II

Dynamics of Classical and Quantum Fields

Course Plan

Week 1: Review of Lagrangian mechanics and the Hamiltonian formulation.

Week 2: Symmetries and Noether's theorem.

Week 3: The Electromagnetic Field and Stress Energy Tensor.

Week 4: Elasticity Theory and Fluid Mechanics.

Week 5: Toward Quantum Fields: Scalar and Spinor Fields.

Week 6: Concept of Functional Integration.

Week 7: Quantum Mechanics Using Lagrangians: Path Integrals.

Week 8: Creation and Annihilation Operators in Fock Space.

Week 9: Quantum Fields on a Lattice.

Week 10: Green Functions: Matsubara and Nonequilibrium.

Week 11: Coherent State Path Integrals.

Week 12: Non-local operators in Quantum Many Body Physics.

Books and references

1. Girish S. Setlur, Dynamics of Classical and Quantum fields: An Introduction. CRC Press (2013)
2. Itzykson C., Zuber J.B., Quantum Field Theory, Dover Publications (2012)
3. Peskin and Schroeder, Introduction to quantum field theory, Addison-Wesley (1995)
4. L. D. Landau and E. M. Lifshitz, Classical Theory of Fields: Course of Theoretical Physics, vol.2 (4th edn.), Butterworth Heinemann (1975)
5. E. N. Economou, Green's functions in Quantum Physics, Springer Series in Solid State Sciences – vol 7 (2006)

Teaching Scheme			Semester III Engineering Mathematics - III	Examination Scheme	
TH	3	**Course Objectives:**		CA	20
PR	-	1. Able to comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions		MSE	20
CR	3			ESE	60
		2. Able to apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients.			
		3. Able to conceptualise the definitions and properties of Fourier transforms and to solve boundary value problems using Fourier transforms.			
		4. Able to find the solutions of partial differential equations governing real-world problems.			
		5. Able to conceptualise limit, continuity, derivative and integration of complex functions, complex integrals useful in real-world problems.			

COURSE CONTENT

Unit No.	Topic	Hours
1	**Laplace Transform:** Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.	08 Hrs
2	**Inverse Laplace Transform:** Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.	07 Hrs
3	**Fourier Transform:** Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.	07 Hrs
4	**Partial Differential Equations and Their Applications:** Formation of Partial differential equations by eliminating arbitrary constants and functions; heat Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications	08 Hrs

to find solutions of one-dimensional flow equation (*ie.* $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial t^2}$), and

one-dimensional wave equation (*ie.* $\frac{\partial^2 y}{\partial t^2} = C^2 \frac{\partial^2 y}{\partial x^2}$).

| 5 | **Functions of Complex Variables:** Analytic functions; Cauchy-Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs). | 07 Hrs |

Text Books:
1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & Co. Pvt. Ltd., New Delhi.
3. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books:
1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

Teaching Scheme		Semester III Data Structures	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	**CO1:** Explain fundamental concepts of data, data types, data structures, and Abstract Data Types (ADT), and analyse algorithms in terms of time and space complexity.	MSE	20
CR	3		ESE	60

CO2: Solve computational problems by applying appropriate data structures such as arrays, hash tables, stacks, queues, and linked lists.

CO3: Implement tree and graph data structures, including binary trees, binary search trees, heaps, and adjacency matrix representations, and perform related operations and traversals.

CO4: Demonstrate proficiency in searching and sorting algorithms, including sequential, binary search, skip lists, insertion sort, selection sort, and radix sort, along with file handling techniques.

CO5: Select and implement suitable data structures and algorithms to develop efficient, maintainable, scalable software solutions.

COURSE CONTENT

Unit No.	Topic	Hours
1	Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of an algorithm, program, analysing programs. **Arrays and Hash Tables:** Concept of sequential organisation, linear and non-linear data structures, storage representation, array processing, sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.	06 Hrs
2	**Stacks and Queues:** Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.	06 Hrs
3	**Linked Lists:** Concept of linked organization, singly and doubly linked list, and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.	06 Hrs
4	**Trees and Graphs:** Basic terminology, binary trees and their representation, insertion and deletion of nodes in binary trees, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.	07 Hrs

5   **Searching and Sorting:** Sequential, binary searching, skip lists – dictionaries,   07 Hrs
linear list representation, skip list representation, operations – insertion, deletion,
and searching. Insertion sort, selection sort, radix sort, and File handling.

Reference Books:

1. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition, 2008.
2. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.
3. Venkatesan & Rose, Data Structures, Wiley Publication, 1st Edition, 2015.
4. Goodrich & Tamassia, Data Structures & Algorithms in C++, Wiley Publication, 2nd Edition, 2011.
5. R. G. Dromey, How to Solve it by Computer, 2nd Impression, Pearson Education.
6. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition, 1999.

Text Books:

1. Mark Allen Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition, 2013.
2. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
3. Y. Langsm, M. Augenstin, A. Tanenbaum, Data Structure using C and C++, Prentice Hall India Learning Private Limited, 2nd Edition, 1998.
4. Trembley and Sorenson, Introduction to Data Structures, PHI Publication, 2nd Revised Edition, 1983.
5. Vishal Goyal, Lalit Goyal, A Simplified Approach To Data Structure, SPD Publication, 1st Edition, 2014.

Teaching Scheme		Semester III Discrete Mathematics	Examination Scheme	
TH	3	**Course Objectives:**	CA	20
PR	-	**CO1:** Apply principles of propositional and predicate logic to model, analyze, and validate logical arguments using truth tables, standard forms, rules of inference, and quantifiers.	MSE	20
CR	3		ESE	60

CO2: Use set theory, functions, and relations to represent, manipulate, and reason about mathematical structures and their properties.

CO3: Solve combinatorial problems using counting principles, recurrence relations, and graph theory concepts, including paths, connectivity, colouring, and spanning trees.

CO4: Implement algorithms for graph and tree problems such as shortest paths, minimal spanning trees, Huffman coding, and topological sorting.

CO5: Analyse and apply algebraic structures, including groups, rings, fields, and Boolean algebras, to formulate and solve problems in computer science and related domains.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Propositional Logic:** Propositions, truth values, Truth tables for operators, Truth Tables of Compound Propositions, Precedence of Logical Operators. **Propositional Equivalences:** Logical Equivalences, Constructing New Logical Equivalences, Normal Forms. **Predicates and Quantifiers:** Predicates, Quantifiers: Universal and Existential, Quantifiers with Restricted Domains, Precedence of Quantifiers, Binding Variables, Logical Equivalences Involving Quantifiers, Negating Quantified Expressions, Translating from English into Logical Expressions, Examples from Lewis Carroll, Nested Quantifiers: Understanding Statements Involving Nested Quantifiers, The Order of Quantifiers, Negating Nested Quantifiers. **Rules of Inference:** Valid Arguments in Propositional Logic, Rules of Inference for Propositional Logic, Using Rules of Inference to Build Arguments, Resolution, Fallacies.	09 Hrs
2	**Basic notions in set Theory:** Sets, Venn Diagrams, Subsets, The Size of a Set, Power Sets, Cartesian Products, Set operations, Set Identities, Generalized Unions and Intersections, Cardinality of Sets. **Functions:** Introduction, Subjective, Injective, Bijective, inverse functions, Composition of functions. **Relations:** Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence	09 Hrs

Relations, Equivalence classes and partitions, Partial Ordering, Hasse Diagram, Topological Sort.

3	**Combinatorics:** Applications of Recurrence Relations, Solving Linear Recurrence Relations.	06 Hrs
4	**Graph:** Some Special Simple Graphs, Bipartite Graphs, New Graphs from Old, Shortest path problems, Euler and Hamiltonian paths, Isomorphic graphs, Planar graphs, Connectivity, Matching Coloring. **Trees:** Prefix Codes, Huffman coding, Spanning trees and cut sets, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning trees.	07 Hrs
5	**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring.	05 Hrs

Text Books:
1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:
1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.
5. Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
6. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

Teaching Scheme			Semester III Object-Oriented Programming	Examination Scheme	
TH	2		**Course Objectives:**	CA	20
PR	-		1. To explain the fundamental properties of OOP.	MSE	20
			2. To describe the usefulness of basic OO abstractions like class, Methods, and Interfaces.		
CR	2			ESE	60
			3. To apply code reuse techniques through inheritance.		
			4. To apply design OO libraries for designing UI and other programmatic features.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Classes and Objects** (Java)**:** Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Classes, Objects, Methods and Instance Variables, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, set Methods and get Methods, Primitive Types vs. Reference type double Types, Initializing Objects with Constructors, floating point numbers. Contro Statements and Array	05 Hrs
2	**Modulization in Java: Java Package, importing packages,** Methods: static methods, static Fields, scope of declaration, method overloading, and Java API packages.	05 Hrs
3	**Inheritance and Polymorphism in Java:** Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, object class. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples, and Interfaces.	05 Hrs
4	**Exception-handling:** Exception-handling overview, handling Arithmetic Exceptions and Input Mismatch Exceptions, when to use exception handling, Java exception hierarchy, finally block. Java Iterator Methods Parametrized Classes in Java.	06 Hrs

Text Books:
1. Paul Deitel and Harvey Detail, Java: How to Program, Pearson's Publication, 9th Edition.

Reference Books:
1. Joel Murach and Michael Urban, Murach's Beginning Java with Eclipse, Murach's Publication, 1st Edition, 2016. Doug Lowe, Java All-in-One For Dummies, Wiley Publication, 4th Edition,2014.

2. Herbert Schildt, Java: The Complete Reference, McGraw-Hill Publication, 9th Edition.
3. Patrick Niemeyer, Daniel Leuck, Learning Java, O'Reilly Media, 4th Edition, 2013.
4. JavaScript: The Good Parts‖, Douglas Crockford, O'Reilly, ISBN: 9782744055973.

Teaching Scheme		Semester III Digital Electronics	Examination Scheme	
TH	2	**Course Objectives:**	CA	20
PR	-	1. To acquaint the students with the fundamental principles of two-valued logic and various devices to implement logical operations on variables.	MSE	20
CR	2	2. To lay the foundation for further studies in areas such as communication, VHDL, and computer. 3. Understand the principles of asynchronous counters and design them to meet specific counting requirements. 4. Solve real-world problems related to arithmetic operations, code conversion, counter applications, and other digital logic scenarios.	ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR, and Exclusive-OR operations, Boolean algebra, examples of IC gates.	05 Hrs
2	**Number Systems:** binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.	05 Hrs
3	**Combinational Logic Design:** Standard representations for logic functions, K-map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto four variables), and don't care conditions.	05 hrs
4	**Design Examples:** Arithmetic Circuits, BCD-to-7 segment decoder, Code converters. Adders and their use as subtractors, look-ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and Demultiplexers, and Decoders.	05 Hrs
5	**Sequential Circuits and Systems:** 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T, and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, a special counter IC's, asynchronous sequential counters, applications of counters.	06 Hrs

Text/Reference Books:
1. R. P. Jain, Modern Digital Electronics, McGraw-Hill Education, 2009.
2. M. Morris Mano, Digital Logic and Computer Design, 4th edition, Prentice Hall of India, 2013.

3. Anand Kumar, Fundamentals of digital circuits, 1st edition, Prentice Hall of India, 2001.
4. Pedroni V. A., Digital Circuit Design with VHDL, Prentice Hall India, 2nd Edition, 2001.

Teaching Scheme		Semester III Universal Human Values - II	Examination Scheme	
TH	3	CO1: Explain the concept of value education, self-exploration, and the relationship between happiness, prosperity, and basic human aspirations.	CA	20
PR	-		MSE	20
CR	3		ESE	60
		CO2: Distinguish between the needs of the self and the body, and apply methods to achieve harmony within the individual and between the self and the body.		
		CO3: Demonstrate understanding of harmony in the family and society by applying foundational values such as trust and respect in human relationships.		
		CO4: Analyse the interconnectedness and mutual fulfilment among the four orders of nature and relate it to sustainable living and coexistence.		
		CO5: Apply a holistic understanding of human values to professional ethics, decision-making, and strategies for value-based life and profession.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Value Education:** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity, the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations.	05 Hrs
2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to Ensure self-regulation and Health.	05 Hrs
3	**Harmony in the Family and Society:** Harmony in the Family, the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order	04 Hrs
4	**Harmony in the Nature (Existence):** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment	05 Hrs

among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

5   **Implications of the Holistic Understanding – a Look at Professional**   05 Hrs
Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics- Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Text Books:
1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

Reference Books:
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Teaching Scheme		Semester III Life of Chhatrapati Shivaji Maharaj	Examination Scheme	
TH	1	**CO1:** Analyse Shivaji Maharaj's military strategies, including guerrilla warfare, fortress defence, naval power, and intelligence networks, in historical and tactical contexts.	CA	50
PR	-		MSE	-
CR	1		ESE	-

CO2: Evaluate Shivaji Maharaj's leadership, management practices, and innovations in logistics, fortifications, and military technology.

CO3: Interpret Shivaji Maharaj's views on women's rights, religious tolerance, democracy, and nationalism, and relate them to contemporary socio-political values.

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COURSE CONTENT

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Unit No.	Topic	Hours
1	Shivaji Maharaj as a Great Conqueror, Master Strategist and innovator in Military Tactics Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.	05 Hrs
2	Shivaji Maharaj's Management and leadership strategies, Architecture and metallurgy of Raigad Fort, Use of Light Cavalry, Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains, Fortifications and Military Architecture	05 Hrs
3	Shivaji Maharaj's views about Women's rights, their dignity and religious views. His views on Democracy & Nationalism	05 Hrs

Teaching Scheme	Semester III Data Structures Laboratory	Examination Scheme
PR: 2 CR:1	**List of Experiments**	CA: 60 ESE: 40

1. Write a program to implement a stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement a circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list, (b) Double linked list, (c) Circular linked list
10. Write a program to implement a stack using a linked list such that the push and pop operations of the stack still take O (1) time.
11. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b), Maximum key, (c) Search for a given key, (d) Find predecessor of a node, (e) Find successor of a node, (f) Delete a node with given key.
12. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
13. Implement the following sorting algorithms: (a) Insertion sort, (b) Merge sort, (c) Quick sort, (d) Heap sort.
14. Write programs for the implementation of graph traversals by applying: (a) BFS, (b) DFS.

Teaching Scheme	Semester III Object-Oriented Programming in Java Laboratory	Examination Scheme
PR: 2 CR: 1	**List of Experiments**	CA: 60 ESE:40

1. Programs on Operators, Arithmetic Promotion, and Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate the following Function concepts
   i. Function overloading
   ii. Constructors of all types
   iii. Default parameters, returning by reference
4. Programs on dealing with Arrays.
5. Programs on Classes: String and Math.
6. Programs on Inheritance and Polymorphism.
7. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
8. Programs on Exception Handling.
9. Write a Java program that illustrates the following
   a) Creation of a simple package.
   b) Accessing a package.
   c) Implementing interfaces.
10. Create a simple GUI using JFrame, JButton, JLabel, and JTextField. Handle user events using action listeners.Create a simple GUI using JFrame, JButton, JLabel, and JTextField. Handle user events using action listeners.Create a simple GUI using JFrame, JButton, JLabel, and JTextField. Handle user events using action listeners.Create a simple GUI using JFrame, JButton, JLabel, and JTextField. Handle user events using action listeners.Demonstrate usage of List, Set, and Map. Iterate using an enhanced for-loop and an Iterator.

Teaching Scheme	Semester III Digital Electronics Laboratory	Examination Scheme
PR: 2 CR: 1	**List of Experiments**	CA: 60 ESE: 40

1. Study of gates – AND; OR; NOT; NAND; NOR; EX-OR; EX-NOR

2. Verification of Boolean Theorems using basic gates.

3. Design a circuit to convert a binary number to its two's complement representation.

4. Design and realize a given function using K-maps and verify its performance.

5. Verify

    a. Demorgan's Theorem for 2 variables.

    b. The sum-of product and product-of-sum expressions using universal gates.

6. Design and implement

    a. Full Adder using basic logic gates.

    b. Full subtractor using basic logic gates.

7. Implementation of 4x1 multiplexer using Logic Gates.

8. To verify the truth tables of S-R; J-K; T and D type flip flops.

9. Design, and Verify the 4- Bit Synchronous Counter.

10. Design, and Verify the 4-Bit Asynchronous Counter.

11. Design and implementation of a simple digital system (Mini Project).

Semester – IV

Teaching Scheme	Semester IV Design and Analysis of Algorithms		Examination Scheme	
TH 3	CO1: Explain fundamental algorithm design, analysis, and performance evaluation concepts using asymptotic notations and recurrence solving techniques.		CA	20
PR -			MSE	20
CR 3			ESE	60

CO2: Solve computational problems by applying algorithmic paradigms such as divide-and-conquer, greedy, dynamic programming, backtracking, and branch-and-bound.

CO3: Implement algorithms for searching, sorting, shortest path, matrix operations, and combinatorial optimisation, and evaluate their time and space complexity.

CO4: Compare algorithmic strategies for problem-solving and justify the choice of technique based on efficiency and problem constraints.

CO5: Classify problems into complexity classes P, NP, and NP-complete, and apply polynomial-time reductions to analyse computational hardness.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Algorithms:** Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithms Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem, Changing Variable, Heap Sort.	07 Hrs
2	**Divide and Conquer:** Introduction, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.	07 Hrs
3	**Backtracking:** Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem, Branch and Bound: Introduction, Traveling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.	07 Hrs
4	**Greedy Algorithms:** Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm.	07 Hrs
5	**Dynamic Programming:** Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Subsequence, matrix multiplication, shortest paths: Bellman-Ford, Floyd Warshall, Application of Dynamic Programming.	07 Hrs

NP Completeness: Introduction, the Complexity Class P, the Complexity Class NP, Polynomial-Time Reduction, the Complexity Class NP-Complete.

Text Books:
1. T. Cormen, Introduction to Algorithms, PHI Publication, 4th Edition, 2022.

Reference Books:
1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition, 1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition,2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.
4. Ellise Horowitz, Sartaj Sahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988.

Teaching Scheme		Semester IV Computer Architecture and Organization	Examination Scheme	
TH	3	**CO1:** Explain the structure, function, and interconnection of computer components, including CPU, memory, and I/O systems.	CA	20
PR	-		MSE	20
CR	3	**CO2:** Interpret instruction set architectures, addressing modes, and execution flow, and compare RISC and CISC architectures.	ESE	60

CO3: Apply principles of computer arithmetic to perform integer and floating-point operations, and analyse ALU design.

CO4: Evaluate memory organisation techniques, including cache, virtual memory, and external storage systems, for performance and reliability.

CO5: Analyse control unit design, I/O organisation, pipelining, and parallel processing techniques for improving system performance.

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.	07 Hrs
2	**Instruction Sets:** Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.	07 Hrs
3	**Computer Arithmetic:** The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.	08 Hrs
4	**Memory Organization** **Internal Memory:** Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. **External Memory:** Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.	08 Hrs
5	**Control Unit and Input / Output Organization** **Control Unit Operation:** Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Microinstruction sequencing, Microinstruction execution, Applications of micro-programming. **Input / Output Organization:** External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface.	08 Hrs

Instruction Pipe-lining and Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Books:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufmann Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Teaching Scheme			Semester IV Probability and Statistics	Examination Scheme	
TH	3	**Course Objectives:**		CA	20
PR	-	1. To explain basic concepts in statistics and probability. 2. To describe various probabilistic distributions.		MSE	20
CR	3	3. To apply regression and correlation techniques.		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Probability Theory** Definition of probability: classical, empirical, and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.	10 Hrs
2	**Random Variable and Mathematical Expectation:** Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs.	06 Hrs
3	**Theoretical Probability Distributions:** Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson, and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.	10 Hrs
4	**Correlation:** Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.	06 Hrs
5	**Linear Regression Analysis:** Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.	06 Hrs

Text Books:
1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revised and Enlarged Edition, 2016.
2. G. V. Kumbhojkar; Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

4. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2010.

5. G. Haribaskaran; Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.

6. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability And Statistics, Schaum's Outlines, 4th Edition, 2013.

Teaching Scheme		Semester IV Operating Systems	Examination Scheme	
TH	3	CO1: Explain the structure, components, and types of operating systems, including process, memory, file, and I/O management.	CA	20
PR	-		MSE	20
CR	3	CO2: Apply CPU scheduling algorithms and multithreading models to improve process performance and system throughput.	ESE	60
		CO3: Implement process synchronization techniques, and analyze deadlock conditions with appropriate prevention, avoidance, and recovery strategies.		
		CO4: Evaluate memory management schemes, including paging, segmentation, and virtual memory, using various page replacement algorithms.		
		CO5: Analyze file system organization, storage allocation methods, and disk scheduling techniques for efficiency and reliability.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction and Operating System Structures:** Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.	06 Hrs
2	**Processes and CPU Scheduling:** Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.	06 Hrs
3	**Process Synchronization:** The critical-section problem, Critical regions, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.	06 Hrs
4	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement	10 Hrs

algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

5   **File Management:** File Concept, Access methods, File types, File operation,   08 Hrs
Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text/Reference Books:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.
2. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
3. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
4. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
5. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
6. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Teaching Scheme		Semester IV Constitution of India	Examination Scheme	
TH	2	CO1: Explain the historical background, sources, features, and key provisions of the Indian Constitution, including citizenship, fundamental rights, duties, and directive principles.	CA	60
PR	-		MSE	-
CR	AU		ESE	40
		CO2: Describe the structure, roles, and functions of the Union and State governments, and analyze the relationship between the Centre and States.		
		CO3: Interpret the organization and functioning of local self-government institutions and evaluate their role in strengthening grassroots democracy.		
		CO4: Analyze the functions of the Election Commission and other constitutional bodies related to the welfare of marginalized communities and women.		

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction:** Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy.	05 Hrs
2	**Union Government and its Administration:** Structure of the Indian Union: Federalism, Centre- State, relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha.	05 Hrs
3	**State Government and its Administration** Governor: Role and Position, CM and Council of Ministers, State Secretariat: Organisation, Structure and Functions.	04 Hrs
4	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	05 Hrs
5	**Election Commission:** Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	05 Hrs

Text/Reference Books:

1. Sastry, T. S. N., (2005). India and Human Rights: Reflections, Concept Publishing Company India (P Ltd.).
2. Nirmal, C.J., (1999). Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

Teaching Scheme		Semester IV Life of Bharat Ratna Dr. Babasaheb Ambedkar	Examination Scheme	
TH	1	CO1: Analyze the socio-political context of Dr. Ambedkar's era and his role in the Indian freedom struggle and social reform movements.	CA	50
PR	-		MSE	-
CR	1	CO2: Evaluate Dr. Ambedkar's contributions to the framing of the Indian Constitution and his vision for social justice and empowerment.	ESE	-
		CO3: Interpret Dr. Ambedkar's views on Marxism, class struggle, and caste, and assess their relevance to contemporary Indian society and economic policy.		

COURSE CONTENT

Unit No.	Topic	Hours
1	Introduction to the socio-political context of Ambedkar's era, British Colonialism, Indian National Movement, Caste Hierarchy, Untouchability, Social Reform Movements, Role in the Indian freedom struggle.	05 Hrs
2	Contributions to the Constitution of India, Vision for social justice and empowerment.	05 Hrs
3	Dr. Ambedkar and Marxism: An Exploration of His Thoughts on Marxism, Common ground with Marxism, Focus on class struggle, Caste vs. Caste, Primacy of Caste in Indian Society, Economic ideas and policies	05 Hrs

Teaching Scheme		Semester IV Design and Analysis of Algorithm Laboratory	Examination Scheme	
TH	-	**List of Experiments:**	CA	60
PR	2		MSE	-
CR	1		ESE	40

1. Implementation of Binary Search.
2. Implementation of finding maximum and minimum numbers using divide and conquer.
3. Implementation of Merge / Quick sort.
4. Implementation of Selection sort.
5. Implementation of Job Sequencing with deadlines.
6. Program for finding the minimum cost Spanning Tree.
7. Implementation of single-source shortest path.
8. Implementation of all-pairs shortest path.
9. Program for Tree traversal techniques.
10. Program for Graph Traversal Technique.

Teaching Scheme	Semester IV Modern Indian Languages (A) Marathi		Examination Scheme	
TH	2		CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	मराठीचा उगम आणि विकास: मराठीचा उगम आणि विकास, मराठी भाषेवर संत परंपरेचा प्रभाव- ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास, मराठीत बखरी लेखन व इतिहास दर्शन, आधुनिक मराठी आणि सुधारणा चळवळी- टिळक, फुले, आणि आगरकर यांचे योगदान.	02 Hrs
2	स्वातंत्र्यानंतरची मराठी भाषा: महाराष्ट्र राज्य निर्मिती व मराठीचा अधिकृत दर्जा, डिजिटल युगातील मराठी भाषा : ब्लॉग, सोशल मीडिया आणि ई-साहित्य, मराठी भाषा संरक्षणासाठी उपाययोजना, शिक्षण व्यवस्थेतील मराठीचा वापर, जागतिक स्तरावर मराठी भाषेचा प्रभाव.	02 Hrs
3	मराठी लेखनाचे नियम आवण व्याकरण: संधि, वाक्यप्रकार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी वाक्य इ.), विरामचिन्हे आणि त्यांचे उपयोग, शुद्धलेखन, समानार्थी शब्द (पर्यायवाची शब्द), विरुद्धार्थी शब्द.	02 Hrs
4	लेखन कौशल्य: लेखन कौशल्याचा परिचय, लेखन कौशल्याचे महत्व आणि आवश्यकता ▪ पत्रलेखन ▪ निबंध लेखन ▪ वृत्तलेखन (वृत्तपत्रीय लेखन) ▪ इतिवृत लेखन ▪ सारांश लेखन	02 Hrs
5	भाषांतर (मराठीतून इंग्रजी आणि इंग्रजीतून मराठी): भाषांतराचा मूलभूत परिचय- भाषांतराची व्याख्या आणि स्वरूप, महत्त्व आणि उपयोग, भाषांतराचे प्रकार इ. ▪ पारिभाषिक शब्दावली, मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.	02 Hrs

Text / Reference Books:
1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन, मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
3. "अनुवाद सिद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)
4. मराठी भाषा आणि साहित्याचा इतिहास – वि.का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

Teaching Scheme	Semester IV Modern Indian Languages (B) Hindi	Examination Scheme	
TH 2		CA	20
PR -		MSE	20
CR 2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	हिंदी भाषा का उद्भि और स्रोत: ▪ हिंदी भाषा की उत्पत्ति और स्वरूप ▪ संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास ▪ हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खडी बोली, भोजपुरी, राजस्थानी आदी) ▪ हिंदी पर फारसी, अरॅबी और अंग्रेजी भाषा का प्रभाव.	02 Hrs
2	स्वातंत्र्योत्तर काल में हिंदी भाषा ▪ प्रशासन, शिक्षा और संचार माध्यमों में हिंदी की भूमिका ▪ राजभाषा के रूप में हिंदी – संवैधानिक स्थिति और व्यावहारिक उपयोग ▪ हिंदी की वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति ▪ प्रशासन और संचार माध्यमों में हिंदी	02 Hrs
3	हिंदी भाषा लेखन के नियम और व्याकरण ▪ वर्णमाला ▪ शब्द-भेद ▪ संधि ▪ वाक्य रचना ▪ वर्तनी ▪ उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया ▪ विराम चिन्हों का प्रयोग ▪ पर्यायवाची शब्द ▪ विलोम शब्द.	02 Hrs
4	लेखन कौशल ▪ पत्र लेखन ▪ प्रतिवेदन (रिपोर्ट) लेखन ▪ विज्ञप्ति, नोटिस और परिपत्र लेखन निबंध लेखन ▪ सार लेखन.	02 Hrs
5	अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी) अनुवाद : सिद्धांत और परंपरा, अनुवाद : क्षेत्र, प्रकार, पारिभाषीक शब्दावली, अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद	02 Hrs

Text / Reference Books:
1. "हिंदी भाषा का उद्भव और विकास" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
2. "हिंदी भाषा का इतिहास" – डॉ. रामविलास शर्मा (राजकमल प्रकाशन)
3. "भारत में राजभाषा हिंदी" – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा पररषद)
4. "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
5. "हिंदी लेखन कौशल" – डॉ. रमेश गुप्ता (सातहत्य भवन)
6. "अनुवाद विज्ञान और सिद्धांत" – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

Teaching Scheme		Semester IV Modern Indian Languages (C) Sanskrit	Examination Scheme	
TH	2		CA	20
PR	-		MSE	20
CR	2		ESE	60

COURSE CONTENT

Unit No.	Topic	Hours
1	**Introduction to Sanskrit:** Importance and history of Sanskrit, Sanskrit alphabets (Varnamala), Swaras (Vowels), Vyanjanas (Consonants), Pronunciation and script (Devanagari).	02 Hrs
2	**Basic Grammar:** Nouns, pronouns, Grammatical numbers, Grammatical genders, Grammatical person, Verbs, Tenses, Sandhi (Combination of letters), Karaka (Case system) – Nominative, Accusative, Instrumental, etc., Vibhakti (Declensions of nouns and pronouns), Linga (Gender: Masculine, Feminine, Neuter), Vakya Rachana (Sentence construction).	02 Hrs
3	**Simple Vocabulary and Sentence Formation:** Basic words and their meanings (nature, family, animals, objects, etc.), Greetings and basic conversational phrases, Formation of simple sentences	02 Hrs
4	**Selected Sanskrit Shlokas and Subhashitas:** Recitation and meaning of simple verses from Bhagavad Gita, Hitopadesha, or Panchatantra, Common proverbs (Subhashitas)	02 Hrs
5	**Reading and Writing Practice:** Reading simple Sanskrit texts, Writing small paragraphs in Sanskrit	02 Hrs

Teaching Scheme		Semester IV Python Programming	Examination Scheme	
TH	1	**Course Objectives:**	CA	60
PR	2	1. Understand algorithms, data structures, and core programming concepts while setting up Python and running your first programs.Work with variables, operations, control flow, functions, strings, and file handling to create interactive and robust applications.	MSE	-
CR	2		ESE	40
		2. Apply object-oriented programming principles and efficiently use Python's built-in collections like lists, tuples, sets, and dictionaries.		
		3. Use SQLite and SQL queries to store, retrieve, and manage data, including practical projects like spidering Twitter and joining multiple tables.		

COURSE CONTENT

Unit No.	Topic	Hours
1	Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.	02 Hrs
2	Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments, Statements, Expressions. Strings: String processing. Exception handling, Basic input/output, handling files.	02 Hrs
3	Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.	04 Hrs
4	Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.	04 Hrs

Text/Reference Books:
1. Michael Urban and Joel Murach, Murach's Python Programming, Murach's Publication, 2016
2. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
3. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
4. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
5. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.

6. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
7. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

Teaching Scheme		Semester IV Operating Systems Laboratory	Examination Scheme	
TH	-	**List of Experiments:**	CA	60
PR	2		MSE	–
CR	1		ESE	40

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit, and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers, and systems administration of different operating systems.
15. Writing utilities and OS performance tuning

Teaching Scheme	Semester III Seminar	Examination Scheme
TH -		CA 60
PR 2		MSE –
CR 1		ESE 40

Guidelines:

1. Choose a topic related to your course, recent technological advancement, or emerging research area.
2. Select a topic that genuinely interests you so that you can invest time and effort in understanding and presenting it.
3. Avoid selecting overly common or outdated topics. Instead, try to find a niche or unexplored aspect of a broader subject.
4. Ensure availability of sufficient resources such as research papers, technical documentation, books, and online references.
5. The selected topic must be approved by the seminar guide or course coordinator before proceeding further.
6. Seminar Report Writing in LaTeX
7. Presentation Guidelines:
   - Use 12–15 slides for a 10–15 minute presentation.
   - Maintain clarity and visual appeal: minimal text, use diagrams and bullet points.
   - Be prepared for a brief Q&A session after your presentation.