VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2023-2024)

B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

CURRICULUM AND SYLLABUS

(2023-2024 Admitted Students)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.

- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.

- To foster vibrant outreach programs for industry, research organizations, academia and society.

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School of Computer Science and Engineering

B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.

2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

3. Graduates will function in their profession with social awareness and responsibility.

4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

5. Graduates will be successful in pursuing higher studies in engineering or management.

6. Graduates will pursue career paths in teaching or research.

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PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data

PO_05: Having an ability to use techniques, skills, resources and modern engineering tools necessary for engineering practice

PO_06: Having problem solving ability- solving social issues and engineering problems

PO_07: Having adaptive thinking and adaptability

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working in teams

PO_10: Having a good working knowledge of communicating in English

PO_11: Having a good cognitive load management [discriminate and filter the available data] skills

PO_12: Having interest in lifelong learning

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School of Computer Science and Engineering

B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Design and develop intelligent automated systems applying mathematical, analytical, programming and operational skills to solve real world problems.

2. Apply machine learning techniques, software tools to conduct experiments, interpret data and to solve complex problems.

3. Implement engineering solutions for the benefit of society by the use of Artificial Intelligence and Machine Learning.

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CREDIT STRUCTURE

Category-wise Credit distribution

Category	Credits
Foundation Core Courses	53
Basic Sciences and Mathematics	24
Engineering Sciences	14
Humanities, Social Sciences and Management (HSM)	15
Discipline-linked Engineering Science Courses	12
Discipline Core Courses	47
Specialization Elective Courses	21
Open Elective Courses	09
Project and Internship	09
Total Graded Credit Requirement	151
Non Graded Credit Requirement	11

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CURRICULUM

B.Tech. (CSE) - AI and ML - (2023)

CREDIT INFO		
S.no	**Catagory**	**Credits**
1	Foundation Core	53
2	Discipline-linked Engineering Sciences	12
3	Discipline Core	47
4	Specialization Elective	21
5	Projects and Internship	9
6	Open Elective	9
7	Bridge Course	0
8	Non-graded Core Requirement	11
Total Credits		162

Foundation Core

sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BCHY101L	Engineering Chemistry	Theory Only	1.0	3	0	0	0	3.0
2	BCHY101P	Engineering Chemistry Lab	Lab Only	1.0	0	0	2	0	1.0
3	BCSE101E	Computer Programming: Python	Embedded Theory and Lab	1.0	1	0	4	0	3.0
4	BCSE102L	Structured and Object-Oriented Programming	Theory Only	1.0	2	0	0	0	2.0
5	BCSE102P	Structured and Object-Oriented Programming Lab	Lab Only	1.0	0	0	4	0	2.0
6	BCSE103E	Computer Programming: Java	Embedded Theory and Lab	1.0	1	0	4	0	3.0
7	BEEE102L	Basic Electrical and Electronics Engineering	Theory Only	1.0	3	0	0	0	3.0
8	BEEE102P	Basic Electrical and Electronics Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
9	BENG101L	Technical English Communication	Theory Only	1.0	2	0	0	0	2.0
10	BENG101P	Technical English Communication Lab	Lab Only	1.0	0	0	2	0	1.0
11	BENG102P	Technical Report Writing	Lab Only	1.0	0	0	2	0	1.0
12	BFLE200L	B.Tech. Foreign Language - 2021	Basket	1.0	0	0	0	0	2.0
13	BHSM200L	B.Tech. HSM Elective - 2021	Basket	1.0	0	0	0	0	3.0
14	BMAT101L	Calculus	Theory Only	1.0	3	0	0	0	3.0
15	BMAT101P	Calculus Lab	Lab Only	1.0	0	0	2	0	1.0
16	BMAT102L	Differential Equations and Transforms	Theory Only	1.0	3	1	0	0	4.0
17	BMAT201L	Complex Variables and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0
18	BMAT202L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0
19	BMAT202P	Probability and Statistics Lab	Lab Only	1.0	0	0	2	0	1.0
20	BPHY101L	Engineering Physics	Theory Only	1.0	3	0	0	0	3.0
21	BPHY101P	Engineering Physics Lab	Lab Only	1.0	0	0	2	0	1.0
22	BSTS101P	Quantitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5
23	BSTS102P	Quantitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5
24	BSTS201P	Qualitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5
25	BSTS202P	Qualitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5

Discipline-linked Engineering Sciences									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BECE102L	Digital Systems Design	Theory Only	1.0	3	0	0	0	3.0
2	BECE102P	Digital Systems Design Lab	Lab Only	1.0	0	0	2	0	1.0
3	BECE204L	Microprocessors and Microcontrollers	Theory Only	1.0	3	0	0	0	3.0
4	BECE204P	Microprocessors and Microcontrollers Lab	Lab Only	1.0	0	0	2	0	1.0
5	BMAT205L	Discrete Mathematics and Graph Theory	Theory Only	1.0	3	1	0	0	4.0

Discipline Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCSE202L	Data Structures and Algorithms	Theory Only	1.0	3	0	0	0	3.0
2	BCSE202P	Data Structures and Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
3	BCSE203E	Web Programming	Embedded Theory and Lab	1.0	1	0	4	0	3.0
4	BCSE204L	Design and Analysis of Algorithms	Theory Only	1.0	3	0	0	0	3.0
5	BCSE204P	Design and Analysis of Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
6	BCSE205L	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0
7	BCSE301L	Software Engineering	Theory Only	1.0	3	0	0	0	3.0
8	BCSE301P	Software Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
9	BCSE302L	Database Systems	Theory Only	1.0	3	0	0	0	3.0
10	BCSE302P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0
11	BCSE303L	Operating Systems	Theory Only	1.0	3	0	0	0	3.0
12	BCSE303P	Operating Systems Lab	Lab Only	1.0	0	0	2	0	1.0
13	BCSE304L	Theory of Computation	Theory Only	1.0	3	0	0	0	3.0
14	BCSE305L	Embedded Systems	Theory Only	1.0	3	0	0	0	3.0
15	BCSE306L	Artificial Intelligence	Theory Only	1.0	3	0	0	0	3.0
16	BCSE307L	Compiler Design	Theory Only	1.0	3	0	0	0	3.0
17	BCSE307P	Compiler Design Lab	Lab Only	1.0	0	0	2	0	1.0
18	BCSE308L	Computer Networks	Theory Only	1.0	3	0	0	0	3.0
19	BCSE308P	Computer Networks Lab	Lab Only	1.0	0	0	2	0	1.0
20	BCSE309L	Cryptography and Network Security	Theory Only	1.0	3	0	0	0	3.0
21	BCSE309P	Cryptography and Network Security Lab	Lab Only	1.0	0	0	2	0	1.0

Specialization Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCSE209L	Machine Learning	Theory Only	1.0	3	0	0	0	3.0
2	BCSE209P	Machine Learning Lab	Lab Only	1.0	0	0	2	0	1.0
3	BCSE332L	Deep Learning	Theory Only	1.0	3	0	0	0	3.0

Specialization Elective									
4	BCSE332P	Deep Learning Lab	Lab Only	1.0	0	0	2	0	1.0
5	BCSE416L	Game Programming	Theory Only	1.0	3	0	0	0	3.0
6	BCSE416P	Game Programming Lab	Lab Only	1.0	0	0	2	0	1.0
7	BCSE417L	Machine Vision	Theory Only	1.0	3	0	0	0	3.0
8	BCSE417P	Machine Vision Lab	Lab Only	1.0	0	0	2	0	1.0
9	BCSE418L	Explainable Artificial Intelligence	Theory Only	1.0	2	0	0	0	2.0
10	BCSE419L	Speech and Language Processing	Theory Only	1.0	3	0	0	0	3.0
11	BCSE419P	Speech and Language Processing lab	Lab Only	1.0	0	0	2	0	1.0
12	BCSE427L	Cognitive Robotics	Theory Only	1.0	2	0	0	0	2.0
13	BCSE427P	Cognitive Robotics Lab	Lab Only	1.0	0	0	2	0	1.0
14	BCSE428L	Autonomous Drones	Theory Only	1.0	2	0	0	0	2.0
15	BCSE428P	Autonomous Drones Lab	Lab Only	1.0	0	0	2	0	1.0

Projects and Internship									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BCSE399J	Summer Industrial Internship	Project	1.0	0	0	0	0	1.0
2	BCSE497J	Project - I	Project	1.0	0	0	0	0	3.0
3	BCSE498J	Project - II / Internship	Project	1.0	0	0	0	0	5.0
4	BCSE499J	One Semester Internship	Project	1.0	0	0	0	0	14.0

Open Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BHUM201L	Mass Communication	Theory Only	1.0	3	0	0	0	3.0
2	BHUM202L	Rural Development	Theory Only	1.0	3	0	0	0	3.0
3	BHUM203L	Introduction to Psychology	Theory Only	1.0	3	0	0	0	3.0
4	BHUM204L	Industrial Psychology	Theory Only	1.0	3	0	0	0	3.0
5	BHUM205L	Development Economics	Theory Only	1.0	3	0	0	0	3.0
6	BHUM206L	International Economics	Theory Only	1.0	3	0	0	0	3.0
7	BHUM207L	Engineering Economics	Theory Only	1.0	3	0	0	0	3.0
8	BHUM208L	Economics of Strategy	Theory Only	1.0	3	0	0	0	3.0
9	BHUM209L	Game Theory	Theory Only	1.0	3	0	0	0	3.0
10	BHUM210E	Econometrics	Embedded Theory and Lab	1.0	2	0	2	0	3.0
11	BHUM211L	Behavioral Economics	Theory Only	1.0	3	0	0	0	3.0
12	BHUM212L	Mathematics for Economic Analysis	Theory Only	1.0	3	0	0	0	3.0
13	BHUM213L	Corporate Social Responsibility	Theory Only	1.0	3	0	0	0	3.0
14	BHUM214L	Political Science	Theory Only	1.0	3	0	0	0	3.0
15	BHUM215L	International Relations	Theory Only	1.0	3	0	0	0	3.0
16	BHUM216L	Indian Culture and Heritage	Theory Only	1.0	3	0	0	0	3.0

Open Elective									
17	BHUM217L	Contemporary India	Theory Only	1.0	3	0	0	0	3.0
18	BHUM218L	Financial Management	Theory Only	1.0	3	0	0	0	3.0
19	BHUM219L	Principles of Accounting	Theory Only	1.0	3	0	0	0	3.0
20	BHUM220L	Financial Markets and Institutions	Theory Only	1.0	3	0	0	0	3.0
21	BHUM221L	Economics of Money, Banking and Financial Markets	Theory Only	1.0	3	0	0	0	3.0
22	BHUM222L	Security Analysis and Portfolio Management	Theory Only	1.0	3	0	0	0	3.0
23	BHUM223L	Options , Futures and other Derivatives	Theory Only	1.0	3	0	0	0	3.0
24	BHUM224L	Fixed Income Securities	Theory Only	1.0	3	0	0	0	3.0
25	BHUM225L	Personal Finance	Theory Only	1.0	3	0	0	0	3.0
26	BHUM226L	Corporate Finance	Theory Only	1.0	3	0	0	0	3.0
27	BHUM227L	Financial Statement Analysis	Theory Only	1.0	3	0	0	0	3.0
28	BHUM228L	Cost and Management Accounting	Theory Only	1.0	3	0	0	0	3.0
29	BHUM229L	Mind, Embodiment and Technology	Theory Only	1.0	3	0	0	0	3.0
30	BHUM230L	Health Humanities in Biotechnological Era	Theory Only	1.0	3	0	0	0	3.0

Bridge Course									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BENG101N	Effective English Communication	Lab Only	1.0	0	0	4	0	2.0

Non-graded Core Requirement									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCHY102N	Environmental Sciences	Online Course	1.0	0	0	0	0	2.0
2	BCSE101N	Introduction to Engineering	Project	1.0	0	0	0	0	1.0
3	BEXC100N	Extracurricular Activities / Co-Curricular Activities -B.Tech. Programmes	Basket	1.0	0	0	0	0	2.0
4	BHUM101N	Ethics and Values	Online Course	1.0	0	0	0	0	2.0
5	BSSC101N	Essence of Traditional Knowledge	Online Course	1.0	0	0	0	0	2.0
6	BSSC102N	Indian Constitution	Online Course	1.0	0	0	0	0	2.0

BCHY101L	Engineering Chemistry	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To enable students to have fundamental understanding of the basic concepts of different disciplines of chemistry.
2. To provide avenues for learning advanced concepts from school to university
3. To empower students with emerging concepts in applied chemistry to be useful in addressing societal needs
4. To integrate analytical and computational ability with experimental skills to create individuals competent in basic science and its by-product of its application.
5. To offer opportunities to create pathways for self-reliant in terms of knowledge and higher learning

Course Outcomes :

1. Understand the fundamental concepts in organic, inorganic, physical, and analytical chemistry.
2. Analyze the principles of applied chemistry in solving the societal issues.
3. Apply chemical concepts for the advancement of materials.
4. Appreciate the fundamental principles of spectroscopy and the related applications.
5. Design new materials, energy conversion devices and new protective coating techniques.

Module:1	**Chemical thermodynamics and kinetics**	**6 hours**

Laws of thermodynamics - entropy change (selected processes) – spontaneity of a chemical reaction and Gibbs free energy - heat transfer; Kinetics - Concept of activation energy and energy barrier - Arrhenius equation- effect of catalysts (homo and heterogeneous) – Enzyme catalysis (Michaelis-Menten Mechanism).

Module:2	**Metal complexes and organometallics**	**6 hours**

Inorganic complexes - structure, bonding and application; Organometallics — introduction, stability, structure and applications of metal carbonyls, ferrocene and Grignard reagent; Metals in biology (haemoglobin, chlorophyll- structure and property).

Module:3	**Organic intermediates and reaction transformations**	**6 hours**

Organic intermediates - stability and structure of carbocations, carbanions and radicals; Aromatics (aromaticity) and heterocycles (3, 4, 5, 6 membered and fused systems); Organic transformations for making useful drugs for specific disease targets (two examples) and dyes (addition, elimination, substitution and cross coupling reactions).

Module:4	**Energy devices**	**6 hours**

Electrochemical and electrolytic cells — electrode materials with examples (semi-conductors), electrode-electrolyte interface- chemistry of Li ion secondary batteries, supercapacitors; Fuel cells: H_2-O_2 and solid oxide fuel cell (SOFC); Solar cells - photovoltaic cell (silicon based), photoelectrochemical cells and dye-sensitized cells.

Module:5	**Functional materials**	**7 hours**

Oxides of AB, AB_2, ABO_3 type (specific examples); Composites - types and properties; Polymers - thermosetting and thermoplastic polymers – synthesis and application (TEFLON, BAKELITE); Conducting polymers- polyacetylene and effect of doping – chemistry of display devices specific to OLEDs; Nano materials – introduction, bulk *vs* nano (quantum dots), top-down and bottom-up approaches for synthesis, and properties of nano Au.

Module:6	**Spectroscopic, diffraction and microscopic techniques**	**5 hours**

Fundamental concepts in spectroscopic and instrumental techniques; Principle and applications of UV-Visible and XRD techniques (numericals); Overview of various techniques such as AAS, IR, NMR, SEM and TEM.		
Module:7	**Industrial applications**	**7 hours**

Water purification methods - zeolites, ion-exchange resins and reverse osmosis; Fuels and combustion -LCV, HCV, Bomb calorimeter (numericals), anti-knocking agents); Protective coatings for corrosion control: cathodic and anodic protection - PVD technique; Chemical sensors for environmental monitoring - gas sensors; Overview of computational methodologies: energy minimization and conformational analysis.		
Module:8	**Contemporary topics**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture hours:	**45 hours**

Textbook

1.	Theodore E. Brown, H Eugene, LeMay Bruce E. Bursten, Catherine Murphy, Patrick Woodward, Matthew E. Stoltzfus, Chemistry: The Central Science, 2017, 14th edition, Pearson Publishers, 2017. UK

Reference Books

1.	Peter Vollhardt, Neil Schore, Organic Chemistry: Structure and Function, 2018, 8th ed. WH Freeman, London
2.	Atkins' Physical Chemistry: International, 2018, Eleventh edition, Oxford University Press; UK
3.	Colin Banwell, Elaine McCash, Fundamentals for Molecular Spectroscopy, 4th Edition, McGraw Hill, US
4.	Solid State Chemistry and its Applications, Anthony R. West. 2014, 2nd edition, Wiley, UK.
5.	AngÃ¨le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Photovoltaic solar energy: From fundamentals to Applications, 2017, Wiley publishers,
6.	UK. Lawrence S. Brown and Thomas Holme, Chemistry for engineering students, 2018, 4th edition – *Open access version*

Mode of Evaluation: CAT, Written assignment, Quiz and FAT			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BCHY101P	**Engineering Chemistry Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objective

To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcome :

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

1. Understand the importance and hands-on experience on analysis of metal ions by means of experiments.
2. Get practical experience on synthesis and characterization of the organic molecules and nanomaterials in the laboratory.
3. Apply their knowledge in thermodynamic functions, kinetics and molecular geometries through the experiments.

Indicative Experiments	
1.	Thermodynamics functions from EMF measurements : Zinc – Copper system
2.	Determination of reaction rate, order and molecularity of ethylacetate hydrolysis
3.	Colorimetric estimation of Ni^{2+} using conventional and smart phone digital-imaging methods
4.	Laboratory scale preparation of important drug intermediate - para aminophenol for the synthesis for acetaminophen
5.	Magnesium-sea water activated cell — Effect of salt concentration on voltage generation
6.	Analysis of iron in an alloy sample by potentiometry
7.	Preparation of tin oxide by sol- gel method and its characterization
8.	Size dependent colour variation of Cu_2O nanoparticles by spectrophotometer
9.	Determination of hardness of water sample by complexometric titration before and after ion-exchange process
10.	Computational Optimization of molecular geometry using Avogadro software
	Total Laboratory Hours **30 hours**

Mode of assessment: Mode of assessment: Continuous assessment / FAT / Oral examination and others

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BCSE101E	Computer Programming: Python	L	T	P	C
		1	0	4	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide exposure to basic problem-solving techniques using computers.
2. To inculcate the art of logical thinking abilities and propose novel solutions for real world problems through programming language constructs.

Course Outcome

1. Classify various algorithmic approaches, categorize the appropriate data representation, and demonstrate various control constructs.
2. Choose appropriate programming paradigms, interpret and handle data using files to propose solution through reusable modules; idealize the importance of modules and packages.

Module:1	**Introduction to Problem Solving**	**1 hour**

Problem Solving: Definition and Steps, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode.

Module:2	**Python Programming Fundamentals**	**2 hours**

Introduction to python – Interactive and Script Mode – Indentation – Comments – Variables
– Reserved Words – Data Types – Operators and their precedence – Expressions – Built-in Functions – Importing from Packages.

Module:3	**Control Structures**	**2 hours**

Decision Making and Branching: if, if-else, nested if, multi-way if-elif statements – Looping:
while loop, for loop — else clauses in loops, nested loops — break, continue and pass statements.

Module:4	**Collections**	**3 hours**

Lists: Create, Access, Slicing, Negative indices, List methods, List comprehensions – Tuples: Create, Indexing and slicing, Operations on tuples – Dictionary: Create, add, and replace values, Operations on dictionaries — Sets: Creation and operations.

Module:5	**Strings and Regular Expressions**	**2 hours**

Strings: Comparison, Formatting, Slicing, Splitting, Stripping – Regular Expressions: Matching,
Search and replace, Patterns.

Module:6	**Functions and Files**	**3 hours**

Functions – Parameters and Arguments: Positional arguments, Keyword arguments, Parameters
with default values — Local and Global scope of variables — Functions with Arbitrary
arguments – Recursive Functions – Lambda Function. Files: Create, Open, Read, Write, Append and Close – tell and seek methods.

Module:7	**Modules and Packages**	**2 hours**

Built-in modules – User-Defined modules – Overview of Numpy and Pandas packages.

	Total Lecture hours:	**15 hours**

Text Book(s)

1. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 2nd Edition, No starch Press, 2019

Reference Books

1.	Martic C Brown, Python: The Complete Reference, 4th Edition, McGraw Hill Publishers, 2018.			
2.	John V. Guttag, Introduction to computation and programming using python: with applications to understanding data. 2nd Edition, MIT Press, 2016.			
Mode of Evaluation: No separate evaluation for theory component.				
Indicative Experiments				
1.	Problem Analysis Chart, Flowchart and Pseudocode Practices.			
2.	Sequential Constructs using Python Operators, Expressions.			
3.	Branching (if, if-else, nested if, multi-way if-elif statements) and Looping (for, while, nested looping, break, continue, else in loops).			
4.	List, Tuples, Dictionaries & Sets.			
5.	Strings, Regular Expressions.			
6.	Functions, Lambda, Recursive Functions and Files.			
7.	Modules and Packages (NumPy and Pandas)			
Total Laboratory Hours				**60 hours**
Text Book(s)				
1.	Mariano Anaya, Clean Code in Python: Develop maintainable and efficient code, 2nd Edition, Packt Publishing Limited, 2021.			
Reference Books				
1.	Harsh Bhasin, Python for beginners, 1st Edition, New Age International (P) Ltd., 2019,			
	Mode of assessment: Continuous assessments and FAT			
Recommended by Board of Studies		03.07.2021		
Approved by Academic Council		No. 63	Date	23.09.2021

BCSE102L	Structured and Object-Oriented Programming	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart the basic constructs in structured programming and object-oriented programming paradigms.
2. To inculcate the insights and benefits in accessing memory locations by implementing real world problems.
3. To help solving real world problems through appropriate programming paradigms.

Course Outcome

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

1. Understand different programming language constructs and decision-making statements; manipulate data as a group.
2. Recognize the application of modular programming approach; create user defined data types and idealize the role of pointers.
3. Comprehend various elements of object-oriented programing paradigm; propose solutions through inheritance and polymorphism; identify the appropriate data structure for the given problem and devise solution using generic programming techniques.

Module:1	**C Programming Fundamentals**	**2 hours**

Variables - Reserved words — Data Types — Operators — Operator Precedence - Expressions - Type Conversions - I/O statements - Branching and Looping: if, if-else, nested if, if-else ladder, switch statement, goto statement - Loops: for, while and do…while — break and continue statements.

Module:2	**Arrays and Functions**	**4 hours**

Arrays: One Dimensional array - Two-Dimensional Array – Strings and its operations. User Defined Functions: Declaration – Definition – call by value and call by reference - Types of
Functions - Recursive functions - Storage Classes - Scope, Visibility and Lifetime of Variables.

Module:3	**Pointers**	**4 hours**

Declaration and Access of Pointer Variables, Pointer arithmetic – Dynamic memory allocation – Pointers and arrays - Pointers and functions.

Module:4	**Structure and Union**	**2 hours**

Declaration, Initialization, Access of Structure Variables - Arrays of Structure - Arrays within Structure - Structure within Structures - Structures and Functions — Pointers to Structure -

Module:5	**Overview of Object-Oriented Programming**	**5 hours**

Features of OOP - Classes and Objects - "this" pointer - Constructors and Destructors - Static Data Members, Static Member Functions and Objects - Inline Functions — Call by reference - Functions with default Arguments - Functions with Objects as Arguments - Friend Functions and Friend Classes.

Module:6	**Inheritance**	**5 hours**

Inheritance - Types of Inheritance: Single inheritance, Multiple Inheritance, Multi-level

Inheritance, Hierarchical Inheritance - Multipath Inheritance - Inheritance and constructors.		
Module:7	**Polymorphism**	**4 hours**
Function Overloading - Operator Overloading – Dynamic Polymorphism - Virtual Functions - Pure virtual Functions - Abstract Classes.		
Module:8	**Generic Programming**	**4 hours**
Function templates and class templates, Standard Template Library.		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Herbert Schildt, C: The Complete Reference, 4th Edition, McGraw Hill Education, 2017
2.	Herbert Schildt, C++: The Complete Reference, 4th Edition, McGraw Hill Education, 2017.
Reference Books	
1.	Yashavant Kanetkar, Let Us C: 17th Edition, BPB Publicaitons, 2020.
2.	Stanley Lippman and Josee Lajoie, C++ Primer, 5th Edition, Addison-Wesley publishers, 2012.

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT / Project.			
Recommended by Board of Studies	03.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BCSE102P	Structured and Object-Oriented Programming Lab	L	T	P	C
		0	0	4	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart the basic constructs in structured programming and object-oriented programming paradigms.
2. To inculcate the insights and benefits in accessing memory locations by implementing real world problems.
3. To solve real world problems through appropriate programming paradigms.

Course Outcome

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

1. Understand different programming language constructs and decision-making statements; manipulate data as a group.
2. Recognize the application of modular programming approach; create user defined data types and idealize the role of pointers.
3. Comprehend various elements of object-oriented programing paradigm; propose solutions through inheritance and polymorphism; identify the appropriate data structure for the given problem and devise solution using generic programming techniques.

Indicative Experiments

1.	Programs using basic control structures, branching and looping
2.	Experiment the use of 1-D, 2-D arrays and strings and Functions
3.	Demonstrate the application of pointers
4.	Experiment structures and unions
5.	Programs on basic Object-Oriented Programming constructs.
6.	Demonstrate various categories of inheritance
7.	Program to apply kinds of polymorphism.
8.	Develop generic templates and Standard Template Libraries.
	Total Laboratory Hours **60 hours**

Text Book(s)

1.	Mariano Anaya, Clean Code in Python: Develop maintainable and efficient code, 2nd Edition, Packt Publishing Limited, 2021.

Reference Book(s)

2.	Harsh Bhasin, Python for beginners, 1st Edition, New Age International (P) Ltd., 2019.

Mode of assessment: Continuous assessments and FAT.

Recommended by Board of Studies	03.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BCSE103E	Computer Programming : Java	L	T	P	C
		1	0	4	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. To introduce the core language features of Java and understand the fundamentals of Object -Oriented programming in Java.
2. To develop the ability of using Java to solve real world problems.

Course Outcome:

At the end of this course, students should be able to:

1. Understand basic programming constructs; realize the fundamentals of Object Orientated Programming in Java; apply inheritance and interface concepts for enhancing code reusability.
2. Realize the exception handling mechanism; process data within files and use the data structures in the collection framework for solving real world problems.

Module:1	**Java Basics**	**2 hours**

OOP Paradigm - Features of Java Language - JVM - Bytecode - Java program structure – Basic programming constructs - data types - variables – Java naming conventions – operators.

Module:2	**Looping Constructs and Arrays**	**2 hours**

Control and looping constructs - Arrays – one dimensional and multi-dimensional – enhanced for loop – Strings - Wrapper classes.

Module:3	**Classes and Objects**	**2 hours**

Class Fundamentals – Access and non-access specifiers - Declaring objects and assigning object reference variables – array of objects – constructors and destructors – usage of "this" and "static" keywords.

Module:4	**Inheritance and Polymorphism**	**3 hours**

Inheritance – types –- use of "super" – final keyword - Polymorphism – Overloading and Overriding - abstract class – Interfaces.

Module:5	**Packages and Exception Handling**	**2 hours**

Packages: Creating and Accessing - Sub packages.
Exception Handling - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - User defined exceptions.

Module:6	**IO Streams and Files**	**2 hours**

Java I/O streams – FileInputStream & FileOutputStream – FileReader & FileWriter-
DataInputStream & DataOutputStream – BufferedInputStream & BufferedOutputStream – PrintOutputStream - Serialization and Deserialization.

Module:7	**Collection Framework**	**2 hours**

Generic classes and methods - Collection framework: List and Map.

	Total Lecture hours:	**15 hours**

Text Book(s)

1.	Y. Daniel Liang, "Introduction to Java programming" - comprehensive version-11th Edition, Pearson publisher, 2017.

Reference Books

1.	Herbert Schildt , The Complete Reference -Java, Tata McGraw-Hill publisher, 10th Edition, 2017.
2	Cay Horstmann,"Big Java", 4th edition, John Wiley & Sons publisher, 5th edition, 2015
3	E.Balagurusamy, "Programming with Java", Tata McGraw-Hill publishers, 6th edition, 2019

Mode of Evaluation: No separate evaluation for theory component.			
Indicative Experiments			
1.	Programs using sequential and branching structures.		
2.	Experiment the use of looping, arrays and strings.		
3.	Demonstrate basic Object-Oriented programming elements.		
4.	Experiment the use of inheritance, polymorphism and abstract classes.		
5.	Designing packages and demonstrate exception handling.		
6.	Demonstrate the use of IO streams, file handling and serialization.		
7.	Program to discover application of collections.		
	Total Laboratory Hours	**60 hours**	
Text Book(s)			
1.	Marc Loy, Patrick Niemeyer and Daniel Leuck, Learning Java, O'Reilly Media, Inc., 5th Edition, 2020.		
Reference Books			
1.	Dhruti Shah, 100+ Solutions in Java: A Hands-On Introduction to Programming in Java, BPB Publications, 1st Edition, 2020.		
Mode of assessment: Continuous assessments and FAT			
Recommended by Board of Studies		03.07.2021	
Approved by Academic Council	No. 63	Date	23.09.2021

Course Code	Course Title	L	T	P	C
BEEE102L	Basic Electrical and Electronics Engineering	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Familiarize with various laws and theorems to solve electric and electronic circuits
2. Provide an overview on working principle of machines
3. Excel the concepts of semiconductor devices, op-amps and digital circuits

Course Outcomes

On completion of the course, the students will be able to:

1. Evaluate DC and AC circuit parameters using various laws and theorems
2. Comprehend the parameters of magnetic circuits
3. Classify and compare various types of electrical machines and its applications
4. Design basic combinational circuits in digital system
5. Analyze the characteristics and applications of semiconductor devices

Module:1	**DC Circuits**	**7 hours**

Basic circuit elements and sources; Ohms law; Kirchhoff's laws; Series and Parallel connection of circuit elements; Star-delta transformation; Mesh current analysis; Node voltage analysis; Theorems: Thevenin's, Maximum power transfer and Superposition theorem.

Module:2	**AC Circuits**	**8 hours**

Alternating voltages and currents, RMS, average, maximum values, Single Phase RL, RC, RLC series circuits, Power in AC circuits, Power Factor, Three phase balanced systems, Star and delta Connections, Electrical Safety, Fuses and Earthing.

Module:3	**Magnetic Circuits**	**7 hours**

Magnetic field; Toroidal core: Flux density, Flux linkage; Magnetic circuit with airgap; Reluctance in series and parallel circuits; Self and mutual inductance; Transformer: turn ratio determination.

Module:4	**Electrical Machines**	**7 hours**

Construction, working principle and applications of DC Machines, Transformers, Three phase Induction motors, synchronous generators, single phase induction motors, special machines stepper motor, universal motor and BLDC motor.

Module:5	**Digital Systems**	**7 hours**

Binary arithmetic; Number base conversion; Boolean algebra: simplification of Boolean functions using K-maps; Logic gates; Design of basic combinational circuits: adders, multiplexers, de-multiplexers.

Module:6	**Semiconductor Devices and Applications**	**7 hours**

Characteristics: PN junction diode, Zener diode, BJT, MOSFET; Applications: Rectifier, Voltage regulator, Operational amplifier.

Module:7	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books

1. Allan R. Hambley, "Electrical Engineering -Principles & Applications", 2019, 6th Edition, Pearson Education
2. V. D. Toro, Electrical Engineering Fundamentals, 2nd edition. PHI, 2014

Reference Books

1. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition.

	Pearson, 2012			
2	DP Kothari & Nagrath, “Basic Electric Engineering”, 2019, Tata McGraw Hill			
Recommended by Board of Studies		28-05-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

Course code	Course Title	L	T	P	C
BEEE102P	Basic Electrical and Electronics Engineering Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objective

1. Design and solve the fundamental electrical and electronics circuits

Course Outcomes

1. Identify appropriate method of solving the fundamental electrical and electronics circuits
2. Design and conduct experiments on electrical and electronics circuits

	Experiments (Indicative)
1	Verification of Kirchoff's law
2	Verification of Maximum Power Transfer Theorem
3	Staircase wiring circuit layout for multi storage building
4	Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars.
5	Measurement of Earth resistance using Megger
6	Sinusoidal steady state response of RLC circuits
7	Three phase power measurement for ac loads
8	Design of half-adder and full-adder digital circuits
9	Synthesis of 8x1 multiplexer and 1x8 de-multiplexers
10	Characteristics of PN diode and acts as switch
11	Realization of single-phase rectifier
12	Design of regulated power supply using Zener diode.
13	Characteristics of MOSFET
14	Characteristics of BJT
15	Measurement of energy using single-phase energy meter
16	Measurement of power in a 1-phase circuit by using CTs and PTs

Total Laboratory Hours	**30 hours**

Mode of assessment: Continuous assessment, FAT			
Recommended by Board of Studies	28-05-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

BENG101L	Technical English Communication	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives:

1. To develop LSRW skills for effective communication in professional situations
2. To enhance knowledge of grammar and vocabulary for meaningful communication
3. To understand information from diverse texts for effective technical communication

Course Outcomes:

1. Use grammar and vocabulary appropriately while writing and speaking
2. Apply the concepts of communication skills in formal and informal situations
3. Demonstrate effective reading and listening skills to synthesize and draw intelligent inferences
4. Write clearly and significantly in academic and general contexts

Module:1	**Introduction to Communication**	**4 hours**

Nature and Process - Types of communication: Intra-personal, Interpersonal, Group-verbal and non-verbal communication / Cross-cultural Communication - Communication Barriers and Essentials of good communication - Principles of Effective Communications

Module:2	**Grammatical Aspects**	**4 hours**

Sentence Pattern - Modal Verbs - Concord (SVA) - Conditionals - Error detection

Module:3	**Written Correspondence**	**4 hours**

Job Application Letters - Resume Writing - Statement of Purpose

Module:4	**Business Correspondence**	**4 hours**

Business Letters: Calling for Quotation, Complaint & Sales Letter – Memo - Minutes of Meeting - Describing products and processes

Module:5	**Professional Writing**	**4 hours**

Paraphrasing & Summarizing - Executive Summary - Structure and Types of Proposal – Recommendations

Module:6	**Team Building & Leadership Skills**	**4 hours**

Principles of Leadership - Team Leadership Model - Negotiation Skills - Conflict Management

Module:7	**Research Writing**	**4 hours**

Interpreting and Analysing a research article - Approaches to Review Paper Writing - Structure of a research article - Referencing

Module:8	**Guest Lecture from Industry and R&D organizations**	**2 hours**

Contemporary Issues

	Total Lecture hours:	**30 hours**

Text Book(s)

1. Raman, Meenakshi & Sangeeta Sharma. (2015). *Technical Communication: Principles and Practice*, (3rd Edition). India: Oxford University Press.

Reference Books

1. Taylor, Shirley & Chandra .V. (2010). *Communication for Business A Practical Approach* 4th Edition. India: Pearson Longman.
2. Kumar, Sanjay & Pushpalatha. (2018). *English Language and Communication Skills for Engineers.* India: Oxford University Press.
3. Koneru Aruna. (2020*). English Language Skills for Engineers.* India: McGraw Hill Education.
4. Rizvi, M. Ashraf. (2018). *Effective Technical Communication* 2nd Edition. Chennai: McGraw Hill Education.
5. Mishra, Sunitha & Muralikrishna,C. (2014). *Communication Skills for Engineers*. India: Pearson Education.

6.	Watkins, P. (2018). *Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers*. India: Cambridge University Press.		
Mode of Evaluation : CAT / Assignment / Quiz / FAT / Group Discussion			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BENG101P	Technical English Communication Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. To use appropriate grammatical structures in professional communication
2. To improve English communication skills for better employability
3. To enhance meaningful communication skills in writing and public speaking

Course Outcomes:

1. Demonstrate professional rhetoric and articulate ideas effectively
2. Interpret material on technology and deliver eloquent presentations
3. Apply receptive and productive skills in real life situations and develop workplace communication

Indicative Experiments

1.	**Grammar & Vocabulary** Error Detection **Activity:** -Worksheets
2.	**Listening to Narratives** Interviews of eminent personalities & Ted Talks **Activity:** Listening Comprehension / Summarising
3.	**Video Resume** SWOT Analysis & digital resume techniques **Activity:** Preparing a digital résumé for mock interview
4.	**Product & Process Description** Describing and Sequencing **Activity:** Demonstration of product and process
5.	**Mock Meetings** Types of meetings and meeting etiquette **Activity: Conduct of meetings and drafting minutes of the meeting**
6.	**Reading research article** Scientific and Technical articles **Activity:** Writing Literature review
7.	**Analytical Reading** Case Studies on Communication, Team Building and Leadership **Activity:** Group Discussion
8.	**Presentations** Preparing Conference/Seminar paper **Activity:** Individual/ Group presentations
9.	**Intensive Listening** Scientific documentaries **Activity:** Note taking and Summarising
10.	**Interview Skills** Interview questions and techniques **Activity:** Mock Interviews

Total Laboratory Hours | **30 hours**

Mode of Assessment: Continuous Assessment / FAT / Written Assignments / Quiz/ Oral Presentation and Group Activity.

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BENG102P	Technical Report Writing	L	T	P	C
		0	0	2	1
Pre-requisite	Technical English Communication	**Syllabus version**			
		1.0			

Course Objectives:

1. To augment specific writing skills for preparing technical reports
2. To think critically, evaluate, analyse general and complex technical information
3. To acquire proficiency in writing and presenting reports

Course Outcomes:

1. Write error free sentences using appropriate grammar, vocabulary and style
2. Synthesize information and concepts in preparing reports
3. Demonstrate the ability to write and present reports on diverse topics

Indicative Experiments

1.	**Advanced Grammar, Vocabulary and Editing** Usage of Tenses - Adjectives and Adverbs - Jargon vs Technical Vocabulary – Abbreviations - Mechanics of Editing: Punctuation and Proof Reading **Activity:** Worksheets
2.	**Research and Analyses** Synchronise Technical Details from Newspapers - Magazines - Articles and e-content **Activity:** Writing introduction and literature review
3.	**Systematisation of Information** Techniques to Converge Objective-Oriented data in Diverse Technical Reports **Activity:** Preparing Questionnaire
4.	**Data Visualisation** Interpreting Data - Graphs - Tables- Charts - Imagery - lnfographics **Activity:** Transcoding
5.	**Introduction to Reports** Meaning - Definition - Purpose - Characteristics and Types of Reports **Activity:** Worksheets on Types of reports
6.	**Structure of Reports** Title- Preface- Acknowledgement - AbstracUSummary- Introduction - Materials and Methods- Results- Discussion - Conclusion - Suggestions/Recommendations **Activity:** Identifying the structure of report
7.	**Report Writing** Data Collection - Draft an Outline and Organize Information **Activity:** Drafting reports
8.	**Supplementary Texts** Appendix- Index- Glossary- References- Bibliography - Notes **Activity:** Organizing supplementary texts
9.	**Review of Final Reports** Structure- Content- Style - Layout and Referencing **Activity:** Examining clarity and coherence in final reports
10.	**Presentation** Presenting Technical Reports **Activity:** Planning, creating and digital presentation of reports
	Total Laboratory Hours **30 hours**

Mode of Assessment: Continuous Assessment / FAT / Written Assignments / Quiz/ Oral Presentation and Group Activity.

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Approved by Academic Council	No. 63

BMAT101L	Calculus	L	T	P	C
		3	0	0	3
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. Enhance to use technology to model the physical situations into mathematical problems, experiment, interpret results, and verify conclusions.

Course Outcomes

At the end of the course the student should be able to:
1. Apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. Evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
3. Evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
4. Use special functions to evaluate various types of integrals.
5. Understand gradient, directional derivatives, divergence, curl, Green's, Stokes and Gauss Divergence theorems.

Module:1	**Single Variable Calculus**	**8 hours**

Differentiation- Extrema on an Interval Rolle's Theorem and the Mean value theorem-Increasing and decreasing functions.-First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution.

Module:2	**Multivariable Calculus**	**5 hours**

Functions of two variables-limits and continuity-partial derivatives –total differential-Jacobian and its properties.

Module:3	**Application of Multivariable Calculus**	**5 hours**

Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module:4	**Multiple integrals**	**8 hours**

Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Module:5	**Special Functions**	**6 hours**

Beta and Gamma functions–interrelation between beta and gamma functions-evaluation of multiple integrals using gamma and beta functions. Dirichlet's integral -Error functions complementary error functions.

Module:6	**Vector Differentiation**	**5 hours**

Scalar and vector valued functions — gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials. Statement of vector identities-simple problems.

Module:7	**Vector Integration**	**6 hours**

Line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems -verification and evaluation of vector integrals using them.

Module:8	**Contemporary Topics**	**2 hours**

Guest lectures from Industry and, Research and Development Organizations

	Total Lecture hours:	**45 hours**

Text Book

1. George B.Thomas, D.Weir and J. Hass, Thomas Calculus, 2014, 13th edition, Pearson

Reference Books				
1.	Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India			
2.	B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers			
3.	John Bird, Higher Engineering Mathematics, 2017, 6th Edition, Elsevier Limited.			
4.	James Stewart, Calculus: Early Transcendental, 2017, 8th edition, Cengage Learning.			
5.	K.A.Stroud and Dexter J. Booth, Engineering Mathematics, 2013, 7th Edition, Palgrave Macmillan.			
Mode of Evaluation: CAT, Assignment, Quiz and FAT				
Recommended by Board of Studies		24.06.2021		
Approved by Academic Council		No. 63	Date	23.09.2021

BMAT101P	**Calculus Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To familiarize with the basic syntax, semantics and library functions of MATLAB which serves as a tool not only in calculus but also many courses in engineering and sciences
2. To visualize mathematical functions and its related properties.
3. To evaluate single and multiple integrals and understand it graphically.

Course Outcomes

At the end of the course the student should be able to:

1. Demonstrate MATLAB code for challenging problems in engineering
2. Using plots/displays, interpret and illustrate elementary mathematical functions and procedures.

Indicative Experiments	
1.	Introduction to MATLAB through matrices and general Syntax
2.	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB
3.	Evaluating Extremum of a single variable function
4.	Understanding integration as Area under the curve
5.	Evaluation of Volume by Integrals (Solids of Revolution)
6.	Evaluating maxima and minima of functions of two variables
7.	Applying Lagrange multiplier optimization method
8.	Evaluating Volume under surfaces
9.	Evaluating triple integrals
10.	Evaluating gradient, curl and divergence
11.	Evaluating line integrals in vectors
12.	Applying Green's theorem to real world problems
	Total Laboratory Hours **30 hours**

Text Book

1.	Brian H. Hahn, Daniel T. Valentine, Essential MATLAB for Engineers and Scientists, Academic Press, 7th edition, 2019.

Reference Books

1.	Amos Gilat, MATLAB: An Introduction with Applications, Wiley, 6/e, 2016.
2	Maritn Brokate, Pammy Manchanda, Abul Hasan Siddiqi, Calculus for Scientists and Engineers, Springer, 2019

Mode of assessment: DA and FAT

Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BMAT102L	Differential Equations and Transforms	L	T	P	C
		3	1	0	4
Pre-requisite	**BMAT101L, BMAT101P**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart the knowledge of Laplace transform, an important transform techniques for Engineers which requires knowledge of integration.
2. Presenting the elementary notions of Fourier series, this is vital in practical harmonic analysis.
3. Enriching the skills in solving initial and boundary value problems.
4. Impart the knowledge and application of difference equations and the Z-transform in discrete systems that are inherent in natural and physical processes.

Course Outcomes

At the end of the course the student should be able to:

1. Find solution for second and higher order differential equations, formation and solving partial differential equations.
2. Understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution.
3. Employ the tools of Fourier series and Fourier transforms.
4. Know the techniques of solving differential equations and partial differential equations.
5. Know the Z-transform and its application in population dynamics and digital signal processing.

Module:1	**Ordinary Differential Equations (ODE)**	**6 hours**

Second order non- homogenous differential equations with constant coefficients- Differential equations with variable coefficients- method of undetermined coefficients-method of Variation of parameters-Solving Damped forced oscillations and LCR circuit theory problems.

Module:2	**Partial Differential Equations (PDE)**	**5 hours**

Formation of partial differential equations – Singular integrals — Solutions of standard types of first order partial differential equations – Lagrange's linear equation-Method of separation of variables

Module:3	**Laplace Transform**	**7 hours**

Definition- Properties of Laplace transform-Laplace transform of standard functions - Laplace transform of periodic functions-Unit step function-Impulse function. Inverse Laplace transform-Partial fractions method and by Convolution theorem..

Module:4	**Solution to ODE and PDE by Laplace transform**	**7 hours**

Solution of ODE's – Non-homogeneous terms involving Heaviside function, Impulse function - Solving Non-homogeneous system using Laplace transform - solution to First order PDE by Laplace transform.

Module:5	**Fourier Series**	**6 hours**

Fourier series - Euler's formulae- Dirichlet's conditions - Change of interval - Half range series – RMS value – Parseval's identity.

Module:6	**Fourier Transform**	**6 hours**

Complex Fourier transform - properties - Relation between Fourier and Laplace Transforms- Fourier sine and cosine transforms – Parseval's identity- Convolution Theorem and simple applications to solve PDE.

Module:7	**Z-Transform**	**6 hours**

Definition of Z-transform and Inverse Z-transform - Standard functions - Partial fractions and

convolution method. Difference equation - first and second order difference equations with constant coefficients - solution of simple difference equations using Z-transform.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours: **Total Tutorial hours :**	**45 hours** **15 hours**

Text Book(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, John Wiley India.
2. B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.

Reference Books

1. Michael D. Greenberg, Advanced Engineering Mathematics, 2006, 2nd Edition, Pearson Education, Indian edition.
2. A First Course in Differential Equations with Modelling Applications, Dennis Zill, 2018, 11th Edition, Cengage Publishers.

Mode of Evaluation: CAT, written assignment, Quiz, FAT

Recommended by Board of Studies	24-06-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BMAT201L	Complex Variables and Linear Algebra	L	T	P	C
		3	1	0	4
Pre-requisite	**BMAT102L**	**Syllabus version**			
		1.0			

Course Objectives

1. To present comprehensive, compact, and integrated treatment of one of the most important branches of applied mathematics namely Complex variables to the engineers and the scientists.
2. To present comprehensive, compact, and integrated treatment of another most important branches of applied mathematics namely Linear Algebra to the engineers and the scientists.
3. To provide students with a framework of the concepts that will help them to analyse deeply about many complex problems.

Course Outcomes

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

1. Construct analytic functions and find complex potential of fluid flow and electric fields.
2. Find the image of straight lines by elementary transformations and to express analytic functions in power series.
3. Evaluate real integrals using techniques of contour integration.
4. Use the power of inner product and norm for analysis.
5. Use matrices and transformations for solving engineering problems.

Module:1	**Analytic Functions**	**7hours**

Complex variable - Analytic functions and Cauchy — Riemann equations; Laplace equation and Harmonic functions; Construction of Harmonic conjugate and analytic functions; Applications of analytic functions to fluid-flow and electric field problems.

Module:2	**Conformal and Bilinear transformations**	**7 hours**

Conformal mapping - Elementary transformations; Translation, Magnification, Rotation, Inversion; Exponential and Square transformations ($w = e^z$, z^2); Bilinear transformation; Cross-ratio-Images of the regions bounded by straight lines under the above transformations;

Module:3	**Complex Integration**	**7 hours**

Functions given by Power Series - Taylor and Laurent series-Singularities - Poles — Residues; Integration of a complex function along a contour; Statements of Cauchy-Goursat theorem-Cauchy's integral formula-Cauchy's residue theorem-Evaluation of real integrals-Indented contour integral.

Module:4	**Vector Spaces**	**6 hours**

Vector space – subspace; linear combination - span - linearly dependent – Independent – bases; Dimensions; Finite dimensional vector space. Row and column spaces; Rank and nullity.

Module:5	**Linear Transformations**	**6 hours**

Linear transformations – Basic properties; Invertible linear transformation; Matrices of linear transformations; Vector space of linear transformations; Change of bases; Similarity.

Module:6	**Inner Product Spaces**	**5 hours**

Dot products and inner products; Lengths and angles of vectors; Matrix representations of inner products; Gram - Schmidt — Orthogonalization.

Module:7	**Matrices and System of Equations**	**5 hours**

Eigenvalues and Eigen vectors; Properties of Eigenvalues and Eigen vectors; Cayley- Hamilton theorem; System of linear equations; Gaussian elimination and Gauss Jordan methods.

Module:8	**Contemporary issues:**	**2 hours**

	Total Lecture hours: **Total Tutorial hours :**	**45 hours** **15 hours**

Text Book(s)

1. G. Dennis Zill, Patrick D. Shanahan, A first course in complex analysis with applications, 2013, 3rd Edition, Jones and Bartlett Publishers Series in Mathematics.
2. Jin Ho Kwak, Sungpyo Hong, Linear Algebra, 2004, Second edition, Springer.

Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, John Wiley & Sons (Wiley student Edition).
2. Michael, D. Greenberg, Advanced Engineering Mathematics, 2006, 2nd Edition, Pearson Education.
3. Bernard Kolman, David, R. Hill, Introductory Linear Algebra - An applied first course, 2011, 9th Edition Pearson Education.
4. Gilbert Strang, Introduction to Linear Algebra, 2015, 5th Edition, Cengage Learning
5. B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.

Mode of Evaluation: Digital Assignments(Solutions by using soft skill), Quiz, Continuous Assessments, Final Assessment Test.

Recommended by Board of Studies	24-06-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BMAT202L	Probability and Statistics	L	T	P	C
		3	0	0	3
Pre-requisite	**BMAT101L, BMAT101P**	**Syllabus version**			
		1.0			

Course Objectives :

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyze distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Course Outcome :

At the end of the course the student should be able to:

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.

Module:1	**Introduction to Statistics**	**6 hours**

Statistics and data analysis; Measures of central tendency; Measure of Dispersion, Moments-Skewness-Kurtosis (Concepts only).

Module:2	**Random variables**	**8 hours**

Random variables- Probability mass function, distribution and density functions-Joint probability distribution and Joint density functions; Marginal, Conditional distribution and Density functions- Mathematical expectation and its properties- Covariance, Moment generating function.

Module:3	**Correlation and Regression**	**4 hours**

Correlation and Regression — Rank Correlation; Partial and Multiple correlation; Multiple regression.

Module:4	**Probability Distributions**	**7 hours**

Binomial distribution; Poisson distributions; Normal distribution; Gamma distribution; Exponential distribution; Weibull distribution.

Module:5	**Hypothesis Testing-I**	**4 hours**

Testing of hypothesis –Types of errors - Critical region, Procedure for testing of hypothesis- Large sample tests- Z test for Single Proportion- Difference of Proportion- Mean and difference of means.

Module:6	**Hypothesis Testing-II**	**9 hours**

Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance — One way-Two way-Three way classifications - CRD-RBD- LSD.

Module:7	**Reliability**	**5 hours**

Basic concepts- Hazard function-Reliabilities of series and parallel systems- System

Reliability - Maintainability-Preventive and repair maintenance- Availability.		
Module:8	**Contemporary Issues**	**2 hours**
	Total lecture hours:	**45 hours**

Text Book:

1. R. E. Walpole, R. H. Myers, S. L. Mayers, K. Ye, Probability and Statistics for engineers and scientists, 2012, 9th Edition, Pearson Education.

Reference Books

1. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, 2016, 6th Edition, John Wiley & Sons.
2. E. Balagurusamy, Reliability Engineering, 2017, Tata McGraw Hill, Tenth reprint.
3. J. L. Devore, Probability and Statistics, 2012, 8th Edition, Brooks/Cole, Cengage Learning.
4. R. A. Johnson, Miller Freund's, Probability and Statistics for Engineers, 2011, 8th edition, Prentice Hall India.
5. Bilal M. Ayyub, Richard H. McCuen, Probability, Statistics and Reliability for Engineers and Scientists, 2011, 3rd edition, CRC press.

Mode of Evaluation: Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

Recommended by Board of Studies	24-06-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BMAT202P	**Probability and Statistics Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**BMAT101L, BMAT101P**	**Syllabus version**			
		1.0			

Course Objectives:

1. To enable the students for having experimental knowledge of basic concepts of statistics using R programming.
2. To study the relationship of real-time data and decision making through testing methods using R.
3. To make students capable to do experimental research using statistics in various engineering problems.

Course Outcomes:

At the end of the course the student should be able to:

1. Demonstrate R programming for statistical data.
2. Carry out appropriate analysis of statistical methods through experimental techniques using R.

Indicative Experiments

1.	Introduction: Understanding Data types; importing/exporting data	Total Laboratory hours: 30
2.	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations	
3.	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination	
4.	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficients of determination	
5.	Fitting the probability distributions: Binomial distribution	
6.	Normal distribution, Poisson distribution	
7.	Testing of hypothesis for one sample mean and proportion from real time problems	
8.	Testing of hypothesis for two sample means and proportion from real time problems	
9.	Applying the t-test for independent and dependent samples	
10.	Applying Chi-square test for goodness of fit test and Contingency test to real dataset	
11.	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design, Latin square Design	

Text Book

1. Statistical analysis with R by Joseph Schmuller, John wiley and sons Inc., New Jersey 2017.

Reference Books:

1. The Book of R: A First course in Programming and Statistics, by Tilman M Davies, William Pollock, 2016.
2. R for Data Science, by Hadley Wickham and Garrett Grolemund, O' Reilly Media Inc., 2017.

Mode of assessment: Continuous assessment, FAT / Oral examination and others

Recommended by Board of Studies	24-06-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BPHY101L	Engineering Physics	L	T	P	C
		3	0	0	3
Pre-requisite	**12th of equivalent**	**Syllabus version**			
		1.0			

Course Objectives

1. To explain the dual nature of radiation and matter.
2. To apply Schrödinger's equation to solve finite and infinite potential problems and apply quantum ideas at the nanoscale.
3. To understand the Maxwell's equations for electromagnetic waves and apply the concepts to semiconductors for engineering applications.

Course Outcome

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

1. Comprehend the phenomenon of waves and electromagnetic waves.
2. Understand the principles of quantum mechanics.
3. Apply quantum mechanical ideas to subatomic domain.
4. Appreciate the fundamental principles of a laser and its types.
5. Design a typical optical fiber communication system using optoelectronic devices.

Module:1	**Introduction to waves**	**7 hours**

Waves on a string - Wave equation on a string (derivation) - Harmonic waves- reflection and transmission of waves at a boundary - Standing waves and their eigenfrequencies - waves with dispersion - Superposition of waves and Fourier method (qualitative) - Wave packet - phase velocity and group velocity.

Module:2	**Electromagnetic waves**	**7 hours**

Physics of divergence - gradient and curl - surface and volume integral - Maxwell Equations (Qualitative) - Continuity equation for current densities - Displacement current - Electromagnetic wave equation in free space - Plane electromagnetic waves in free space - Hertz's experiment.

Module:3	**Elements of quantum mechanics**	**7 hours**

Need for Quantum Mechanics: Idea of Quantization (Planck and Einstein) - Compton effect (Qualitative) — de Broglie hypothesis - justification of Bohr postulate - Davisson-Germer experiment - Wave function and probability interpretation - Heisenberg uncertainty principle - Gedanken experiment (Heisenberg's microscope) - Schrödinger wave equation (time dependent and time independent).

Module:4	**Applications of quantum mechanics**	**6 hours**

Eigenvalues and eigenfunction of particle confined in one dimensional box - Basics of nanophysics - Quantum confinement and nanostructures - Tunnel effect (qualitative) and scanning tunneling microscope.

Module:5	**Lasers**	**6 hours**

Laser characteristics - spatial and temporal coherence - Einstein coefficients and their significance - Population inversion - two, three and four level systems - Pumping schemes - threshold gain coefficient - Components of a laser - He-Ne, Nd:YAG and CO_2 lasers and their engineering applications.

Module:6	**Propagation of EM waves in optical fibers**	**5 hours**

Introduction to optical fiber communication system - light propagation through fibers - Acceptance angle - Numerical aperture - V-parameter - Types of fibers — Attenuation - Dispersion-intermodal and intramodal. Application of fiber in medicine - Endoscopy.

Module:7	**Optoelectronic devices**	**5 hours**

Introduction to semiconductors - direct and indirect bandgap — p-n junction, Sources: LED and laser diode, Photodetectors: PN and PIN

Module:8	**Contemporary Topics**	**2 hours**

Guest lectures from Industry and, Research and Development Organisations

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	H. D. Young and R. A. Freedman, University Physics with Modern Physics, 2020, 15th Edition, Pearson, USA.
2.	D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011, Pearson, USA
Reference Books	
1.	H. J. Pain, The Physics of vibrations and waves, 2013, 6th Edition, Wiley Publications, India.
2.	R. A. Serway, J. W. Jewett, Jr, Physics for Scientists and Engineers with Modern Physics, 2019, 10th Edition, Cengage Learning, USA.
3.	K. Krane, Modern Physics, 2020, 4th Edition, Wiley Edition, India.
4.	M.N.O. Sadiku, Principles of Electromagnetics, 2015, 6th Edition, Oxford University Press, India.
5.	W. Silfvast, Laser Fundamentals, 2012, 2nd Edition, Cambridge University Press, India.

Mode of Evaluation: Written assignment, Quiz, CAT and FAT			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BPHY101P	**Engineering Physics Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**12th or equivalent**	**Syllabus version**			
		1.0			

Course Objectives

To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcome

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

1. Comprehend the dual nature of radiation and matter by means of experiments.
2. Get hands-on experience on the topics of quantum mechanical ideas in the laboratory.
3. Apply low power lasers in optics and optical fiber related experiments.

Indicative Experiments	
1.	To determine the dependence of fundamental frequency with the length and tension of a stretched string using sonometer.
2.	To determine the characteristics of EM waves using Hertz experiment
3.	To determine the wavelength of laser source (He-Ne laser and diode lasers of different wavelengths) using diffraction grating
4.	To demonstrate the wave nature of electron by diffraction through graphite sheet
5.	To determine the Planck's constant using electroluminescence process
6.	To numerically demonstrate the discrete energy levels and the wavefunctions using Schrödinger equation (e.g., particle in a box problem can be given as an assignment)
7.	To determine the refractive index of a prism using spectrometer (angle of prism will be given)
8.	To determine the efficiency of a solar cell
9.	To determine the acceptance angle and numerical aperture of an optical fiber
10.	To demonstrate the phase velocity and group velocity (simulation)
	Total Laboratory Hours **30 hours**

Mode of assessment: Continuous assessment / FAT / Oral examination

Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BSTS101P	Quantitative Skills Practice I	L	T	P	C
		0	0	3	1.5
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. To enhance the logical reasoning skills of the students and help them improve problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

Course Outcomes:

1. Exhibit sound knowledge to solve problems of Quantitative Aptitude
2. Demonstrate ability to solve problems of Logical Reasoning
3. Display the ability to tackle questions of Verbal Ability

Module:1	**Logical Reasoning**	**5 hours**

Word group categorization questions
Puzzle type class involving students grouping words into right group orders of logical sense
Cryptarithmetic

Module:2	**Data arrangements and Blood relations**	**6 hours**

Linear Arrangement - Circular Arrangement - Multi-dimensional Arrangement - Blood Relations

Module:3	**Ratio and Proportion**	**6 hours**

Ratio - Proportion - Variation - Simple equations - Problems on Ages - Mixtures and alligations

Module:4	**Percentages, Simple and Compound Interest**	**6 hours**

Percentages as Fractions and Decimals - Percentage Increase / Decrease - Simple Interest - Compound Interest - Relation Between Simple and Compound Interest

Module:5	**Number System**	**6 hours**

Number system- Power cycle - Remainder cycle - Factors, Multiples - HCF and LCM

Module:6	**Essential grammar for Placement**	**7 hours**

- Prepositions
- Adjectives and Adverbs
- Tense
- Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerunds and Infinitives
- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Module:7	**Reading Comprehension for Placement**	**3 hours**

Types of questions - Comprehension strategies - Practice exercises

Module:8	**Vocabulary for Placement**	**6 hours**

Exposure to questions related to Synonyms – Antonyms – Analogy - Confusing words - Spelling correctness

	Total Lecture hours:	**45 hours**

Text Book(s)

1. SMART. (2018). *Place Mentor* 1st (Ed.). Chennai: Oxford University Press.

2.	Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations* 3rd (Ed.). New Delhi: S. Chand Publishing.

3.	FACE. (2016). *Aptipedia Aptitude Encyclopedia* 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). *Aptimithra*,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.
Reference Books	
1.	Sharma Arun. (2016). *Quantitative Aptitude*, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.
Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)	
Recommended by Board of Studies	28.06.2021
Approved by Academic Council	No. 63 Date 23.09.2021

BSTS102P	Quantitative Skills Practice II	L	T	P	C
		0	0	3	1.5
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. Help to trigger the students' logical thinking skills and apply it in real-life scenarios
2. Learn to deploy the strategies of solving quantitative ability problems
3. To expand the verbal ability of students
4. Assist to run the gamut of employability skills

Course Outcomes:

1. Become proficient in interacting and using decision making models effectively
2. Help to understand the given concepts expressly to deliver an impactful presentation
3. Acquire knowledge of solving quantitative aptitude and verbal ability questions effortlessly

Module:1	**Logical Reasoning puzzles - Advanced**	**2 hours**

Advanced puzzles:

- Sudoku
- Mind-bender style word statement puzzles
- Anagrams
- Rebus puzzles

Module:2	**Logical connectives, Syllogism and Venn diagrams**	**2 hours**

Logical Connectives - Advanced Syllogisms - 4, 5, 6 and other multiple statement problems - Challenging Venn Diagram questions: Set theory

Module:3	**Permutation, Combination and Probability - Advanced**	**4 hours**

Fundamental Counting Principle- Permutation and Combination - Computation of Permutation - Advanced problems - Circular Permutations - Computation of Combination - Advanced problems -Advanced probability

Module:4	**Quantitative Aptitude**	**6 hours**

Logarithms, Progressions, Geometry and Quadratic equations - Advanced

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Concepts followed by advanced questions of CAT level

Module:5	**Image interpretation**	**2 hours**

Image interpretation: Methods - Exposure to image interpretation questions through brainstorming and practice

Module:6	**Critical Reasoning - Advanced**	**3 hours**

Concepts of Critical Reasoning - Exposure to advanced questions of GMAT level

Module:7	**Recruitment Essentials**	**8 hours**

Mock interviews

Cracking other kinds of interviews

Skype/ Telephonic interviews
Panel interviews
Stress interviews

Guesstimation

1. Best methods to approach Guesstimation questions
2. Practice with impromptu interview on Guesstimation questions

Case studies/ situational interview

1. Scientific strategies to answer case study and situational interview questions
2. Best ways to present cases
3. Practice on presenting cases and answering situational interviews asked in recruitment rounds

Module:8	**Problem solving and Algorithmic skills**	**18 hours**
Logical methods to solve problem statements in Programming - Basic algorithms introduced		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	SMART. (2018). *Place Mentor* 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations* 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). *Aptipedia Aptitude Encyclopedia* 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). *Aptimithra*,1st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.

Reference Books

1.	Sharma Arun. (2016). *Quantitative Aptitude*, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

Course Code	Course Title	L	T	P	C
BSTS201P	Qualitative Skills Practice - I	0	0	3	1.5
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To enhance the logical reasoning skills of students and improve problem-solving abilities
2. To strengthen the ability of solving quantitative aptitude problems
3. To enrich the verbal ability of the students for academic purposes

Course Outcomes:

1. Become experts in solving problems of quantitative Aptitude
2. Learn to defend and critique concepts of logical reasoning
3. Integrate and display verbal ability effectively

Module:1	**Lessons on excellence**	**2 hours**

Skill introspection - Skill acquisition - consistent practice

Module:2	**Thinking Skill**	**6 hours**

- Problem Solving
- Critical Thinking
- Lateral Thinking

Rebus puzzles, and word-link builder questions

Module:3	**Logical Reasoning**	**6 hours**

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Module:4	**Sudoku puzzles**	**3 hours**

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Module:5	**Attention to detail**	**3 hours**

Picture and word driven Qs to develop attention to detail as a skill

Module:6	**Quantitative Aptitude**	**14 hours**

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions		
Module:7	**Verbal Ability**	**6 hours**
Grammar challenge A practice paper with sentence based and passage-based questions on grammar discussed - Nouns and Pronouns, Verbs, Subject-Verb Agreement, Pronoun-Antecedent Agreement, Punctuations **Verbal reasoning**		
Module:8	**Recruitment Essentials**	**5 hours**
Looking at an engineering career through the prism of an effective resume • Importance of a resume - the footprint of a person's career achievements • Designing an effective resume • An effective resume vs. a poor resume • Skills you must build starting today the requisite? • How does one build skills **Impression Management** Getting it right for the interview: • Grooming, dressing • Body Language and other non-verbal signs • Displaying the right behaviour		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	SMART. (2018). *Place Mentor* 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations* 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). *Aptipedia Aptitude Encyclopedia* 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). *Aptimithra,*1st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.
Reference Books	
1.	Sharma Arun. (2016). *Quantitative Aptitude*, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)

Recommended by Board of Studies	28-06-2021		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BSTS202P	Qualitative Skills Practice - II	0	0	3	1.5
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To apply critical thinking skills to related to their subject matter
2. To demonstrate competency in verbal, quantitative and reasoning aptitude
3. To produce good written skills for effective communication

Course Outcomes:

1. Apply critical thinking skills to problems solving related to their subject matter
2. Demonstrate competency in verbal, quantitative and reasoning aptitude
3. Display good written skills for use in academic and professional scenarios

Module:1	Logical Reasoning	5 hours

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

Module:2	Data interpretation and Data sufficiency - Advanced	5 hours

- Advanced Data Interpretation and Data Sufficiency questions of CAT level
- Multiple chart problems
- Caselet problems

Module:3	Time and work– Advanced	5 hours

- Work with different efficiencies
- Pipes and cisterns: Multiple pipe problems
- Work equivalence
- Division of wages
- Advanced application problems with complexity in calculating total work

Module:4	Time, Speed and Distance - Advanced	5 hours

- Relative speed
- Advanced Problems based on trains
- Advanced Problems based on boats and streams
- Advanced Problems based on races

Module:5	Profit and loss, Partnerships and averages - Advanced	5 hours

- Partnership
- Averages
- Weighted average
- Advanced problems discussed

Module:6	Number system - Advanced	4 hours

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:7	**Verbal Ability**	**13hours**

Sentence Correction - Advanced

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

Exposure to RCs of the level of GRE/ GMAT relating to a wide variety of subjects

Module:8	**Writing skills for Placement**	**3 hours**

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

	Total Lecture hours:	**45 hours**

Text Book(s)

1.	SMART. (2018). *Place Mentor* 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations* 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). *Aptipedia Aptitude Encyclopedia* 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). *Aptimithra,*1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.

Reference Books

1.	Sharma Arun. (2016). *Quantitative Aptitude*, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)			
Recommended by Board of Studies	28-06-2021		
Approved by Academic Council	No. 68	Date	19-12-2022

Discipline-linked Engineering Sciences

Course Code	Course Title	L	T	P	C
BECE102L	Digital Systems Design	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Provide an understanding of Boolean algebra and logic functions.
2. Develop the knowledge of combinational and sequential logic circuit design.
3. Design and model the data path circuits for digital systems.
4. Establish a strong understanding of programmable logic.
5. Enable the student to design and model the logic circuits using Verilog HDL.

Course Outcome

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

1. Optimize the logic functions using and Boolean principles and K-map.
2. Model the Combinational and Sequential logic circuits using Verilog HDL.
3. Design the various combinational logic circuits and data path circuits.
4. Analyze and apply the design aspects of sequential logic circuits.
5. Analyze and apply the design aspects of Finite state machines.
6. Examine the basic architectures of programmable logic devices.

Module:1	Digital Logic	8 hours

Boolean Algebra: Basic definitions, Axiomatic definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Simplification of Boolean functions. Gate-Level Minimization: The Map Method (K-map up to 4 variable), Product of Sums and Sum of Products Simplification, NAND and NOR Implementation. Logic Families: Digital Logic Gates, TTL and CMOS logic families.

Module:2	Verilog HDL	5 hours

Lexical Conventions, Ports and Modules, Operators, Dataflow Modelling, Gate Level Modelling, Behavioural Modeling, Test Bench.

Module:3	Design of Combinational Logic Circuits	8 hours

Design Procedure, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Decoders, Encoders, Multiplexers, De-multiplexers, Parity generator and checker, Applications of Decoder, Multiplexer and De-multiplexer. Modeling of Combinational logic circuits using Verilog HDL.

Module:4	Design of data path circuits	6 hours

N-bit Parallel Adder/Subtractor, Carry Look Ahead Adder, Unsigned Array Multiplier, Booth Multiplier, 4-Bit Magnitude comparator. Modeling of data path circuits using Verilog HDL.

Module:5	Design of Sequential Logic Circuits	8 hours

Latches, Flip-Flops - SR, D, JK & T, Buffer Registers, Shift Registers - SISO, SIPO, PISO, PIPO, Design of synchronous sequential circuits: state table and state diagrams, Design of counters: Modulo-n, Johnson, Ring, Up/Down, Asynchronous counter. Modeling of sequential logic circuits using Verilog HDL.

Module:6	Design of FSM	4 hours

Finite state Machine(FSM):Mealy FSM and Moore FSM , Design Example : Sequence detection, Modeling of FSM using Verilog HDL.		
Module:7	**Programmable Logic Devices**	**4 hours**
Types of Programmable Logic Devices: PLA, PAL, CPLD, FPGA Generic Architecture.		

Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	M. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL and System Verilog, 2018, 6th Edition, Pearson Pvt. Ltd.
Reference Books	
1.	Ming-Bo Lin, Digital Systems Design and Practice: Using Verilog HDL and FPGAs, 2015, 2nd Edition, Create Space Independent Publishing Platform.
2.	Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2009, 2nd edition, Prentice Hall of India Pvt. Ltd.
3.	Stephen Brown and ZvonkoVranesic, Fundamentals of Digital Logic with Verilog Design, 2013, 3rd Edition, McGraw-Hill Higher Education.
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test	

Recommended by Board of Studies	14-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BECE102P	**Digital Systems Design Lab**	**0**	**0**	**2**	**1**
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objective

- To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcome

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

1. Design, simulate and synthesize combinational logic circuits, data path circuits and sequential logic circuits using Verilog HDL.
2. Design and implement FSM on FPGA.
3. Design and implement small digital systems on FPGA.

Indicative Experiments

1.	Characteristics of Digital ICs, Realization of Boolean expressions	**2 hours**
2.	Design and Verilog modeling of Combinational Logic circuits	**4 hours**
3.	Design and Verilog modeling of various data path elements - Adders	**2 hours**
4.	Design and Verilog modeling of various data path elements - Multipliers	**2 hours**
5.	Implementation of combinational circuits – (FPGA / Trainer Kit)	**2 hours**
6.	Implementation of data path circuit - (FPGA / Trainer Kit)	**2 hours**
7.	Design and Verilog modeling of simple sequential circuits like Counters and Shift registers	**2 hours**
8.	Design and Verilog modeling of complex sequential circuits	**2 hours**
9.	Implementation of Sequential circuits - (FPGA / Trainer Kit)	**2 hours**
10.	Design and Verilog modeling of FSM based design – Serial Adder	**2 hours**
11.	Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine	**4 hours**
12.	Design of ALU	**4 hours**
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test			
Recommended by Board of Studies	14-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

BCSE103E	Computer Programming : Java	L	T	P	C
		1	**0**	**4**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. To introduce the core language features of Java and understand the fundamentals of Object -Oriented programming in Java.
2. To develop the ability of using Java to solve real world problems.

Course Outcome:

At the end of this course, students should be able to:

1. Understand basic programming constructs; realize the fundamentals of Object Orientated Programming in Java; apply inheritance and interface concepts for enhancing code reusability.
2. Realize the exception handling mechanism; process data within files and use the data structures in the collection framework for solving real world problems.

Module:1	**Java Basics**	**2 hours**

OOP Paradigm - Features of Java Language - JVM - Bytecode - Java program structure – Basic programming constructs - data types - variables – Java naming conventions – operators.

Module:2	**Looping Constructs and Arrays**	**2 hours**
Control and looping constructs - Arrays – one dimensional and multi-dimensional – enhanced for loop – Strings - Wrapper classes.		
Module:3	**Classes and Objects**	**2 hours**
Class Fundamentals – Access and non-access specifiers - Declaring objects and assigning object reference variables – array of objects – constructors and destructors – usage of "this" and "static" keywords.		
Module:4	**Inheritance and Polymorphism**	**3 hours**
Inheritance – types –- use of "super" – final keyword - Polymorphism – Overloading and Overriding - abstract class – Interfaces.		
Module:5	**Packages and Exception Handling**	**2 hours**
Packages: Creating and Accessing - Sub packages. Exception Handling - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - User defined exceptions.		
Module:6	**IO Streams and Files**	**2 hours**
Java I/O streams – FileInputStream & FileOutputStream – FileReader & FileWriter- DataInputStream & DataOutputStream – BufferedInputStream & BufferedOutputStream – PrintOutputStream - Serialization and Deserialization.		
Module:7	**Collection Framework**	**2 hours**
Generic classes and methods - Collection framework: List and Map.		
	Total Lecture hours:	**15 hours**

Text Book(s)	
1.	Y. Daniel Liang, "Introduction to Java programming" - comprehensive version-11th Edition, Pearson publisher, 2017.
Reference Books	
1.	Herbert Schildt , The Complete Reference -Java, Tata McGraw-Hill publisher, 10th Edition, 2017.
2	Cay Horstmann,"Big Java", 4th edition, John Wiley & Sons publisher, 5th edition, 2015
3	E.Balagurusamy, "Programming with Java", Tata McGraw-Hill publishers, 6th edition, 2019

Mode of Evaluation: No separate evaluation for theory component.

Indicative Experiments

1.	Programs using sequential and branching structures.
2.	Experiment the use of looping, arrays and strings.
3.	Demonstrate basic Object-Oriented programming elements.
4.	Experiment the use of inheritance, polymorphism and abstract classes.
5.	Designing packages and demonstrate exception handling.
6.	Demonstrate the use of IO streams, file handling and serialization.
7.	Program to discover application of collections.
	Total Laboratory Hours **60 hours**

Text Book(s)	
1.	Marc Loy, Patrick Niemeyer and Daniel Leuck, Learning Java, O'Reilly Media, Inc., 5th Edition, 2020.
Reference Books	
1.	Dhruti Shah, 100+ Solutions in Java: A Hands-On Introduction to Programming in Java, BPB Publications, 1st Edition, 2020.

Mode of assessment: Continuous assessments and FAT

Recommended by Board of Studies		03.07.2021	
Approved by Academic Council	No. 63	Date	23.09.2021

Course Code	Course Title	L	T	P	C
BECE204L	Microprocessors and Microcontrollers	3	0	0	3
Pre-requisite	BECE102L	Syllabus version			
		1.0			

Course Objectives:

1. To acquaint students with architectures of Intel microprocessors, microcontroller and ARM processors.
2. To familiarize the students with assembly language programming in 8051 microcontroller and ARM processor.
3. To interface peripherals and I/O devices with the 8051 microcontroller.

Course Outcome:

At the end of the course, the student should be able to

1. Comprehend the various microprocessors including Intel Pentium Processors
2. Infer the architecture and Programming of Intel 8086 Microprocessor.
3. Comprehend the architectures and programming of 8051 microcontroller.
4. Deploy the implementation of various peripherals such as general purpose input/ output, timers, serial communication, LCD, keypad and ADC with 8051 microcontroller
5. Infer the architecture of ARM Processor
6. Develop the simple application using ARM processor.

Module:1	Overview of Microprocessors	3 hours

Introduction to Microprocessors, 8-bit/16-bit Microprocessor, Overview of Intel Pentium, I (i3, i5, i7) Series Processor.

Module:2	Microprocessor Architecture and Interfacing: Intel x86	8 hours

16-bit Microprocessor: 8086 - Architecture and Addressing modes, Memory Segmentation, Instruction Set, Assembly Language Processing, Programming with DOS and BIOS function calls, minimum and maximum mode configuration, Programmable Peripheral Interface (8255), Programmable Timer Controller (8254), Memory Interface to 8086.

Module:3	Microcontroller Architecture: Intel 8051	7 hours

Microcontroller 8051 - Organization and Architecture, RAM-ROM Organization, Machine
Cycle, Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional, Assembly programming.

Module:4	Microcontroller 8051 Peripherals	5 hours

I/O Ports, Timers-Counters, Serial Communication and Interrupts.

Module:5	I/O interfacing with Microcontroller 8051	7 hours

LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface.

Module:6	ARM Processor Architecture	5 hours

ARM Design Philosophy; Overview of ARM architecture; States [ARM, Thumb, Jazelle]; Registers, Modes; Conditional Execution; Pipelining; Vector Tables; Exception handling.

Module:7	**ARM Instruction Set**	**8 hours**
ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI Instruction, Loading instructions, conditional Execution, Assembly Programming.		
Module:8	**Contemporary issues**	**2 hours**

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	A.K. Ray, K.M. Bhurchandi, Advanced Microprocessor and Peripherals, 2012, 2nd Edition, Tata McGraw-Hill, India.	
2.	Mohammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2014, 2nd Edition, Pearson, India.	
Reference Books		
1.	Muhammad Ali Mazidi, ARM Assembly Language Programming & Architecture: 1, 2016, 2nd Edition, Microdigitaled.com	
2.	A. Nagoor Kani, 8086 Microprocessors and its Applications, 2017, Second Edition, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, India.	
3.	Joseph Yiu, The Definitive Guide to ARM® Cortex®-M0 and Cortex-M0+ Processors, 2015, 2nd Edition, Elsevier Science & Technology, UK	
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test		
Recommended by Board of Studies	14-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course Code	Course Title	L	T	P	C
BECE204P	Microprocessors and Microcontrollers Lab	0	0	2	1
Pre-requisite	BECE102L	Syllabus version			
		1.0			

Course Objectives

1. To familiarize the students with assembly language programming using microprocessor and microcontroller.
2. To familiarize the students with Embedded C language programming using microcontroller.
3. To interface peripherals and I/O devices with the microcontroller and microprocessor.

Course Outcome

Student will be able to

1. Showcase the skill, knowledge and ability of programming microcontroller and microprocessor using its instruction set.
2. Expertise with microcontroller and interfaces including general purpose input/ output, timers, serial communication, LCD, keypad and ADC.

Indicative Experiments [Experiments using 8086/8051/ARM]

1	Assembly language programming of Arithmetic/logical operations.	**6 hours**
2	Assembly language programming of memory operations.	**4 hours**
3	Assembly language programming/ Embedded C programming for interfacing the peripherals: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	**10 hours**
4	Hardware implementation of peripheral interfacing: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	**10 hours**
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	14-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

BMAT205L	Discrete Mathematics and Graph Theory	L	T	P	C
		3	1	0	4
Pre-requisite	**NIL**	**Syllabus Version**			
		1.0			

Course Objectives:

1. To address the challenges of the relevance of lattice theoryand algebraic structures to computer science and engineering problems.
2. To use Counting techniques, in particular recurrence relations to computer science problems.
3. To understand the concepts of graph theory and related algorithm concepts.

Course Outcomes:

At the end of this course, students are expected to

1. Learn proof techniques and concepts of inference theory
2. Use algebraic structures in applications
3. Counting techniques in engineering problems.
4. Use lattice and Boolean algebra properties in Digital circuits.
5. Solve Science and Engineering problems using Graph theory.

Module:1	**Mathematical Logic**	**7 hours**

Statements and Notation-Connectives–Tautologies-Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus - Predicate Calculus - Inference Theory of the Predicate Calculus

Module:2	**Algebraic Structures**	**6 hours**

Semigroups and Monoids - Groups – Subgroups – Lagrange's Theorem Homomorphism – Properties-Group Codes.

Module:3	**Counting Techniques**	**6 hours**

Basics of counting - Pigeonhole principle - Permutations and combinations - Inclusion-exclusion principle - Recurrence relations - Solving recurrence relations - Generating functions-Solution to recurrence relations.

Module:4	**Lattices and Boolean algebra**	**6 hours**

Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices – Boolean algebra-Properties of Boolean Algebra-Boolean functions.

Module:5	**Fundamentals of Graphs**	**6hours**

Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms

Module:6	**Trees, Fundamental circuits, Cut sets**	**6 hours**

Trees – properties of trees – distance and centres in tree – Spanning trees – Spanning tree algorithms- Tree traversals- Fundamental circuits and cut-sets

Module:7	**Graph colouring, covering, Partitioning**	**6 hours**

Bipartite graphs - Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
	Total Tutorial hours:	**15 hours**

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017.
2. Graph theory with application to Engineering and Computer Science, NarasingDeo,

Prentice Hall India 2016.			
Reference Books:			
1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019. 2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018. 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017. 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017. 5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017. 6.Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.			
Mode of Evaluation: CAT, Quizzes, Digital Assignments, FAT			
Recommended by Board of Studies	15.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Discipline Core

BCSE202L	Data Structures and Algorithms	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart basic concepts of data structures and algorithms.
2. To differentiate linear, non-linear data structures and their operations.
3. To comprehend the necessity of time complexity in algorithms.

Course Outcomes

On completion of this course, students should be able to:

1. Understand the fundamental analysis and time complexity for a given problem.
2. Articulate linear, non-linear data structures and legal operations permitted on them.
3. Identify and apply suitable algorithms for searching and sorting.
4. Discover various tree and graph traversals.
5. Explicate hashing, heaps and AVL trees and realize their applications.

Module:1	**Algorithm Analysis**	**8 hours**

Importance of algorithms and data structures - Fundamentals of algorithm analysis: Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth - Algorithm efficiency – best case, worst case, average case - Analysis of non-recursive and recursive algorithms - Asymptotic analysis for recurrence relation: Iteration Method, Substitution Method, Master Method and Recursive Tree Method.

Module:2	**Linear Data Structures**	**7 hours**

Arrays: 1D and 2D array- Stack - Applications of stack: Expression Evaluation, Conversion of Infix to postfix and prefix expression, Tower of Hanoi – Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue) - Applications – List: Singly linked lists, Doubly linked lists, Circular linked lists- Applications: Polynomial Manipulation.

Module:3	**Searching and Sorting**	**7 hours**

Searching: Linear Search and binary search – Applications.
Sorting: Insertion sort, Selection sort, Bubble sort, Counting sort, Quick sort, Merge sort - Analysis of sorting algorithms.

Module:4	**Trees**	**6 hours**

Introduction - Binary Tree: Definition and Properties - Tree Traversals- Expression Trees:- Binary Search Trees - Operations in BST: insertion, deletion, finding min and max, finding the k^{th} minimum element.

Module:5	**Graphs**	**6 hours**

Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's - Single Source Shortest Path: Dijkstra's Algorithm.

Module:6	**Hashing**	**4 hours**

Hash functions - Separate chaining - Open hashing: Linear probing, Quadratic probing, Double hashing - Closed hashing - Random probing – Rehashing - Extendible hashing.

Module:7	**Heaps and AVL Trees**	**5 hours**

Heaps - Heap sort- Applications -Priority Queue using Heaps. AVL trees: Terminology, basic operations (rotation, insertion and deletion).

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Mark A. Weiss, Data Structures & Algorithm Analysis in C++, 4th Edition, 2013, Pearson Education.

Reference Books	
1.	Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft, Data Structures and Algorithms, 1983, Pearson Education.
2.	Horowitz, Sahni and S. Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2nd Edition, Universities Press.
3.	Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, 2009, 3rd Edition, MIT Press.

Mode of Evaluation: CAT, Assignment, Quiz and FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE202P	Data Structures and Algorithms Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart basic concepts of data structures and algorithms.
2. To differentiate linear, non-linear data structures and their operations.
3. To comprehend the necessity of time complexity in algorithms.

Course Outcomes

On completion of this course, students should be able to:
1. Apply appropriate data structures to find solutions to practical problems.
2. Identify suitable algorithms for solving the given problems.

Indicative Experiments

1.	Implementation of stack data structure and its applications
2.	Implementation of queue data structure and its applications
3.	Implementation linked list and its application
4.	Implementation of searching algorithms
5.	Implementation of sorting algorithms
6.	Binary Tree Traversal implementation
7.	Binary Search Tree implementation
8.	Graph Traversal – Depth First Search and Breadth First Search algorithm
9.	Minimum Spanning Tree – Prim's and Kruskal's algorithm
10.	Single Source Shortest Path Algorithm - Dijkstra's algorithm
	Total Laboratory Hours 30 hours

Text Book

1.	Mark A. Weiss, Data Structures & Algorithm Analysis in C++, 2013, 4th Edition, Pearson.

Reference Books

1.	Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft, Data Structures and Algorithms, 1983, Pearson Education.
2.	Horowitz, Sahni and S. Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2nd Edition, Universities Press.
3.	Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, 2009, 3rd Edition, MIT Press.

Mode of assessment: Continuous assessments and FAT.

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Course Code	Course Title	L	T	P	C
BCSE203E	Web Programming	1	0	4	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To convey the Internet and Its Application in Real world.
2. To introduce the fundamentals of web programming through HTML and CSS.
3. To establish the application of Javascript in designing interactive web pages.
4. To investigate various elements of ReactJS and design user interfaces to deploy in the real time.

Course Outcomes

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

1. Apply various elements of HTML and CSS.
2. Design interactive web pages using JavaScript.
3. Create Dynamic Web Applications using ReactJS.
4. Deploy and host web applications in Local Servers or Cloud platforms.

Module:1	Introduction	2 hours

World wide web and its evolution - E-mail, Telnet, FTP, E–commerce, Cloud Computing, Video conferencing - Internet service providers, IP Address, URL, Domain Name Servers - Web Browsers, Search Engine -Web Server vs Application Server.

Module:2	Hypertext Markup Language	2 hours

HTML Tags, Structure, HTML Coding Conventions - Block Elements, Text Elements, Code-Related Elements, Character References - Lists, Images, section, article, and aside Elements - nav and a Elements - header and footer Elements.

Module:3	Cascading Style Sheets	2 hours

CSS Overview - CSS Rules, CSS Syntax and Style - Class Selectors, ID Selectors, span and div Elements - Cascading, style Attribute, style Container, External CSS Files - CSS Properties: Color Properties, Font Properties, line-height Property, Text Properties, Border Properties. Element Box, padding Property, margin Property - Hosting a Website and GIT.

Module:4	JavaScript	3 hours

Hello World Web Page - Buttons, Functions, Variables, Identifiers - Assignment Statements and Objects - Document Object Model, Forms: form Element, Controls, Text Control Accessing a Form's Control Values, reset and focus Methods – Event Handler Attributes: onchange, onmouseover, onmouseout.

Module:5	Advanced JavaScript	2 hours

While Loop, External JavaScript Files, do Loop, Radio Buttons, Checkboxes, for Loop - fieldset and legend Elements- Manipulating CSS with JavaScript- Using z-index to Stack Elements-Textarea Controls - Pull-Down Menus- List Boxes- Canvas and Drawing - Event Handler and Listener.

Module:6	ReactJS	2 hours

React Environment Setup - ReactJS Basics - React JSX - React Components: React Component API - React Component Life Cycle - React Constructors - React Dev Tools - React Native vs ReactJS.

Module:7	Advanced ReactJS	2 hours

React Dataflow: React State - React Props - React Props Validation - Styling React - Hooks and Routing - Deploying React - Case Studies for building dynamic web applications.

	Total Lecture hours:	15 hours

Text Book(s)

1. Dean, J., Web Programming with HTML5, CSS, and JavaScript. Jones & Bartlett Learning, 2018.

2.	Minnick, C. Beginning ReactJS foundations building user interfaces with ReactJS: An Approachable Guide, OReillly, 2022.
Reference Books	
1.	Harvey M Deitel, Paul J Deitel and Tem R Nieto, Internet and World Wide Web How to Program, Pearson, 6th Edition, 2020.
2.	Rebah, H.B., Boukthir, H. and Chedebois, A., Website Design and Development with HTML5 and CSS3. John Wiley & Sons, 2022.
Mode of Evaluation: Written Assignment, Quiz.	
Indicative Experiments	
1.	Explore various terminologies related to Internet (ISP, Email, Telnet, FTP, Web browsers, Search Engines)
2.	Experiment the use of basic HTML elements.
3.	Demonstrate the applications of Lists, Tables, Images, Section, article and aside elements.
4.	Investigate the various components of CSS.
5.	Develop web pages using HTML and various elements of CSS.
6	Designing simple dynamic webpages using Javascript.
7.	Build web pages using While Loop, External JavaScript Files, do Loop, Radio Buttons, Checkboxes, for Loop - fieldset and legend Elements.
8.	Manipulating CSS with JavaScript- Using z-index to Stack Elements-Textarea Controls - Pull-Down Menus- List Boxes- Canvas and Drawing - Event Handler and Listener.
9.	React Environment Setup - ReactJS Basics - React JSX - React Components: React Component API.
10.	Understand React Component Life Cycle and apply React Constructors - React Dev Tools - React Native vs ReactJS.
11.	Envisage React Dataflow: React State - React Props - React Props Validation - Styling React - Hooks and Routing.
12.	Deploying React - Case Studies for building dynamic web applications.
Total Laboratory Hours	**60 hours**
Text Book	
1.	Laura Lemay, Rafe Colburn and Jennifer Kyrnin, Mastering HTML, CSS and Javascript Web Publishing, BPB Publication, 1st Edition, 2016.
Reference Books	
1.	Alex Banks and Eve Porcello, Learning React: Functional Web Development with React and Redux, O'Reilly Publishers, 1st Edition, 2017.
Mode of assessment: Continuous Assessments, FAT	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council | No. 67	Date | 08-08-2022

BCSE204L	Design and Analysis of Algorithms	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide mathematical foundations for analyzing the complexity of the algorithms
2. To impart the knowledge on various design strategies that can help in solving the real world problems effectively
3. To synthesize efficient algorithms in various engineering design situations

Course Outcomes

On completion of this course, student should be able to:

1. Apply the mathematical tools to analyze and derive the running time of the algorithms
2. Demonstrate the major algorithm design paradigms.
3. Explain major graph algorithms, string matching and geometric algorithms along with their analysis.
4. Articulating Randomized Algorithms.
5. Explain the hardness of real-world problems with respect to algorithmic efficiency and learning to cope with it.

Module:1	**Design Paradigms: Greedy, Divide and Conquer Techniques**	**6 hours**

Overview and Importance of Algorithms - Stages of algorithm development: Describing the problem, Identifying a suitable technique, Design of an algorithm, Derive Time Complexity, Proof of Correctness of the algorithm, Illustration of Design Stages - Greedy techniques: Fractional Knapsack
Problem, and Huffman coding - Divide and Conquer: Maximum Subarray, Karatsuba faster integer multiplication algorithm.

Module:2	**Design Paradigms: Dynamic Programming, Backtracking and Branch & Bound Techniques**	**10 hours**

Dynamic programming: Assembly Line Scheduling, Matrix Chain Multiplication, Longest Common Subsequence, 0-1 Knapsack, TSP- Backtracking: N-Queens problem, Subset Sum, Graph Coloring- Branch & Bound: LIFO-BB and FIFO BB methods: Job Selection problem, 0-1 Knapsack Problem

Module:3	**String Matching Algorithms**	**5 hours**

Naïve String-matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, Suffix Trees.

Module:4	**Graph Algorithms**	**6 hours**

All pair shortest path: Bellman Ford Algorithm, Floyd-Warshall Algorithm - Network Flows: Flow Networks, Maximum Flows: Ford-Fulkerson, Edmond-Karp, Push Re-label Algorithm – Application of Max Flow to maximum matching problem

Module:5	**Geometric Algorithms**	**4 hours**

Line Segments: Properties, Intersection, sweeping lines - Convex Hull finding algorithms: Graham's Scan, Jarvis' March Algorithm.

Module:6	**Randomized algorithms**	**5 hours**

Randomized quick sort - The hiring problem - Finding the global Minimum Cut.

Module:7	**Classes of Complexity and Approximation Algorithms**	**7 hours**

The Class P - The Class NP - Reducibility and NP-completeness – SAT (Problem Definition and statement), 3SAT, Independent Set, Clique, Approximation Algorithm – Vertex Cover, Set Cover and Travelling salesman

Module:8	**Contemporary Issues**	**2 hours**

		Total Lecture hours:	**45 hours**

Text Book	
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.

Reference Books	
1.	Jon Kleinberg and EvaTardos, Algorithm Design, Pearson Education, 1st Edition, 2014.
2.	Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press, 1995 (Online Print – 2013)
3.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1st Edition, Pearson Education, 2014.

Mode of Evaluation: CAT, Written assignments, Quiz, FAT.			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE204P	**Design and Analysis of Algorithms Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide mathematical foundations for analyzing the complexity of the algorithms
2. To impart the knowledge on various design strategies that can help in solving the real world problems effectively
3. Synthesize efficient algorithms in various engineering design situations

Course Outcome

On completion of this course, student should be able to:
1. Demonstrate the major algorithm design paradigms.
2. Explain major graph algorithms, string matching and geometric algorithms along with their analysis.

Indicative Experiments

1.	Greedy Strategy : Activity Selection & Huffman coding
2.	Dynamic Programming : ALS, Matrix Chain Multiplication , Longest Common Subsequence, 0-1 Knapsack
3.	Divide and Conquer : Maximum Subarray and Karatsuba faster integer multiplication algorithm
4.	Backtracking: N-queens
5.	Branch and Bound: Job selection
6	String matching algorithms : Naïve, KMP and Rabin Karp,suffix trees
7	MST and all pair shortest path algorithms
8	Network Flows : Ford –Fulkerson and Edmond - Karp
9	Intersection of line segments &Finding Convexhull, Finding closest pair of points
10	Polynomial time algorithm for verification of NPC problems
11	Approximation and Randomized algorithms
	Total Laboratory Hours | 30 Hours

Text Book

1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.

Reference Books

1.	Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education, 1st Edition, 2014.
2.	Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press, 1995 (Online Print – 2013)
3.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1st Edition, Pearson Education, 2014.

Mode of assessment: Continuous assessments, FAT.

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE205L	Computer Architecture and Organization	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus Version**			
		1.0			

Course Objectives

1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer and to impart the knowledge of data representation in binary and to understand the implementation of arithmetic algorithms in a typical computer.
2. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machine level programming.
3. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. And explore various alternate techniques for improving the performance of a processor.

Course Outcomes

On completion of this course, student should be able to:

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machine with different capabilities. Recognize different instruction formats and addressing modes. Validate efficient algorithm for fixed point and floating point arithmetic operations.
2. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
3. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
4. Assess the performance of IO and external storage systems. Classify parallel machine models. Analyze the pipeline hazards and solutions.

Module:1	**Introduction To Computer Architecture and Organization**	**5 Hours**

Overview of Organization and Architecture –Functional components of a computer: Registers and register files - Interconnection of components - Overview of IAS computer function - Organization of the von Neumann machine - Harvard architecture - CISC & RISC Architectures.

Module:2	**Data Representation and Computer Arithmetic**	**5 Hours**

Algorithms for fixed point arithmetic operations: Multiplication (Booths, Modified Booths), Division (restoring and non-restoring) - Algorithms for floating point arithmetic operations - Representation of nonnumeric data (character codes).

Module:3	**Instruction Sets and Control Unit**	**9 Hours**

Computer Instructions: Instruction sets, Instruction Set Architecture, Instruction formats, Instruction set categories - Addressing modes - Phases of instruction cycle – ALU - Data- path and control unit: Hardwired control unit and Micro programmed control unit - Performance metrics: Execution time calculation, MIPS, MFLOPS.

Module:4	**Memory System Organization and Architecture**	**7 Hours**

Memory systems hierarchy: Characteristics, Byte Storage methods, Conceptual view of memory cell - Design of scalable memory using RAM's- ROM's chips - Construction of larger size memories - Memory Interleaving - Memory interface address map- Cache memory: principles, Cache memory management techniques, Types of caches, caches misses, Mean

memory access time evaluation of cache.		
Module:5	**Interfacing and Communication**	**5 Hours**
I/O fundamentals: handshaking, buffering, I/O Modules - I/O techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access, Direct Cache Access - Interrupt structures: Vectored and Prioritized-interrupt overhead - Buses: Synchronous and asynchronous - Arbitration.		
Module:6	**Subsystems**	**5 Hours**
External storage systems: Solid state drivers - Organization and Structure of disk drives: Electronic- magnetic and optical technologies - Reliability of memory systems - Error detecting and error correcting systems - RAID Levels - I/O Performance		
Module:7	**High Performance Processors**	**7 Hours**
Classification of models - Flynn's taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD) - Pipelining: Two stages, Multi stage pipelining, Basic performance issues in pipelining, Hazards, Methods to prevent and resolve hazards and their drawbacks - Approaches to deal branches - Superscalar architecture: Limitations of scalar pipelines, superscalar versus super pipeline architecture, superscalar techniques, performance evaluation of superscalar architecture - performance evaluation of parallel processors: Amdahl's law, speed-up and efficiency.		
Module:8	**Contemporary Issues**	**2 Hours**
	Total Lecture Hours	**45 Hours**

Text Book(s)	
1	David A. Patterson and John L. Hennessy, Computer Organization and Design -The Hardware / Software Interface 6th Edition, Morgan Kaufmann, 2020
Reference Book(s)	
1	Computer Architecture and Organization-Designing for Performance, William Stallings, Tenth edition, Pearson Education series, 2016
2	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.
Mode of Evaluation: CAT, Written Assignments, Quiz and FAT.	

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE301L	Software Engineering	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To introduce the essential Software Engineering concepts.
2. To impart concepts and skills for performing analysis, design ,develop, test and evolve efficient software systems of various disciplines and applications
3. Tomake familiar about engineering practices, standards and metrics for developing software components and products.

Course Outcomes

On completion of this course, student should be able to:

1. Apply and assess the principles of various process models for the software development.
2. Demonstrate various software project management activities that include planning , Estimations, Risk assessment and Configuration Management
3. Perform Requirements modelling and apply appropriate design and testing heuristics to produce quality software systems.
4. Demonstrate the complete Software life cycle activities from requirements analysis to maintenance using the modern tools and techniques.
5. Escalate the use of various standards and metrics in evaluating the process and product.

Module:1	**Overview Of Software Engineering**	**6 hours**

Nature of Software, Software Engineering, Software process, project, product, Process Models Classical Evolutionary models, Introduction to Agility - Agile Process-Extreme programming - XP Process – Principles of Agile Software Development framework - Overview of System Engineering

Module:2	**Introduction To Software Project Management**	**6 hours**

Planning, Scope, Work break-down structure, Milestones, Deliverables, Cost and Estimates - (Human Resources, Time-scale, Costs), Risk Management, RMMM Plan, CASE TOOLS, Agile Project Management, Managing team dynamics and communication, Metrics and Measurement

Module:3	**Modelling Requirements**	**8 hours**

Software requirements and its types, Requirements Engineering process, Requirement Elicitation, System Modeling – Requirements Specification and Requirement Validation, Requirements Elicitation techniques, Requirements management in Agile.

Module:4	**Software Design**	**8 hours**

Design concepts and principles - Abstraction - Refinement - Modularity Cohesion coupling, Architectural design, Detailed Design Transaction Transformation, Refactoring of designs, Object oriented Design User-Interface Design

Module:5	**Validation And Verification**	**7 hours**

Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection and Auditing – Regression Testing – Mutation Testing - Object oriented testing - Testing Web based System - Mobile App testing – Mobile test Automation and tools – DevOps Testing – Cloud and Big Data Testing

Module:6	**Software Evolution**	**4 hours**

Software Maintenance, Types of Maintenance, - Software Configuration Management – Overview – SCM Tools. Re-Engineering, Reverse Engineering, Software Reuse		
Module:7	**Quality Assurance**	**4 hours**
Product and Process Metrics, Quality Standards Models ISO, TQM, Six-Sigma, Process improvement Models: CMM & CMMI. Quality Control and Quality Assurance - Quality Management - Quality Factors - Methods of Quality Management		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Ian Somerville, Software Engineering, 10th Edition, Addison-Wesley, 2015
Reference Books	
1.	Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 10th edition, McGraw Hill Education, 2019
2.	William E. Lewis , Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017

Mode of Evaluation: CAT, Written assignment, Quiz, FAT.			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE301P	Software Engineering Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To introduce the essential Software Engineering concepts.
2. To impart concepts and skills for performing analysis, design ,develop, test and evolve efficient software systems of various disciplines and applications
3. To make familiar about engineering practices, standards and metrics for developing software components and products.

Course Outcome

On completion of this course, student should be able to:

1. Demonstrate the complete Software life cycle activities from requirements analysis to maintenance using the modern tools and techniques.

Indicative Experiments	
1.	Analysis and Identification of the suitable process models
2.	Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based) and Estimations
3.	Requirement modelling using Entity Relationship Diagram(Structural Modeling)
4.	Requirement modelling using Context flow diagram, DFD (Functional Modeling)
5.	Requirement modelling using State Transition Diagram (Behavioral Modeling)
6.	OO design – Use case Model, Class Model
7.	OO design – Interaction Models
8.	OO design – Package, Component and deployment models
9.	Design and demonstration of test cases. Functional Testing and Non- Functional Testing (using any open source tools)
10.	Story Boarding and User Interface design Modelling
	Total Laboratory Hours 30 hours

Text Book(s)

1.	Ian Somerville, Software Engineering, 10th Edition, Addison-Wesley, 2015

Reference Books

1.	Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 10th edition, McGraw Hill Education, 2019
2.	William E. Lewis, Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017

Mode of assessment: Continuous assessments, FAT.

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE302L	Database Systems	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To understand the concepts of File system and structure of the database; Designing an Entity-Relationship model for a real-life application and Mapping a database schema from the ER model.
2. To differentiate various normal forms, evaluate relational schemas for design qualities and optimize a query.
3. To impart the working methodologies of transaction management, understand concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management.

Course Outcomes

On completion of this course, student should be able to:

1. Comprehend the role of database management system in an organization and design the structure and operation of the relational data model.
2. Develop a database project depending on the business requirements, considering various design issues.
3. List the concepts of indexing and accessing methods.
4. Explain the concept of a database transaction processing and comprehend the concept of database facilities including concurrency control, backup and recovery.
5. Review the fundamental view on unstructured data and describe other emerging database technologies.

Module:1	**Database Systems Concepts and Architecture**	**4 hours**

Need for database systems – Characteristics of Database Approach – Advantages of using DBMS approach - Actors on the Database Management Scene: Database Administrator - Classification of database management systems - Data Models - Schemas and Instances - Three-Schema Architecture - The Database System Environment - Centralized and Client/Server Architectures for DBMSs – Overall Architecture of Database Management Systems

Module:2	**Relational Model and E-R Modeling**	**6 hours**

Relational Model: Candidate Keys, Primary Keys, Foreign Keys - Integrity Constraints - Handling of Nulls - Entity Relationship Model: Types of Attributes, Relationships, Structural Constraints, Relational model Constraints – Mapping ER model to a relational schema – Extended ER Model - Generalization – Specialization – Aggregations.

Module:3	**Relational Database Design**	**6 hours**

Database Design – Schema Refinement - Guidelines for Relational Schema - Functional dependencies - Axioms on Functional Dependencies- Normalization: First, Second and Third Normal Forms - Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form - Join dependency and Fifth Normal form

Module:4	**Physical Database Design and Query Processing**	**8 hours**

File Organization - Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing - B+ Tree Indexing – Hashing Techniques: Static and Dynamic Hashing – Relational Algebra - Translating SQL Queries into Relational Algebra - Query Processing – Query Optimization: Algebraic Query Optimization, Heuristic query optimization Rules, Join Query Optimization using Indexing and Hashing - Tuple Relational Calculus.

Module:5	**Transaction Processing and Recovery**	**8 hours**

Introduction to Transaction Processing – Transaction concepts: ACID Properties of Transactions, Transaction States - Serial and Serializable Schedules - Schedules based on recoverability – Schedules based on Serializability - Conflict Serializabilty - Recovery Concepts: Log Based Recovery Protocols, Recovery based on deferred update, Recovery techniques based on immediate update – Shadow Paging Algorithm		
Module:6	**Concurrency Control In Transaction Processing**	**8 hours**
Concurrent Transactions – Lost Update Problem - Concurrency Control Techniques: Time Stamp Based Protocols, Thomas Write Rule, Lock Based Protocols, Lock Compatibility Matrix, - Two-Phase Locking Protocol - Lock Conversions - Graph Based Protocols for Concurrency Control - Tree Protocol for Concurrency Control – Deadlocks Based on Locks in Transactions – Deadlock Handling Techniques – Transaction Deadlock Detection Techniques – Transaction Deadlock Prevention Techniques – Multi-Granularity Locking for avoiding Transaction Deadlocks		
Module:7	**NOSQL Database Management**	**3 hours**
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data bases: Key-value data stores, Columnar families, Document databases, Graph databases		
Module:8	**Contemporary Issues**	**2 Hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2016
Reference Books	
1.	A. Silberschatz, H. F. Korth & S. Sudarshan, Database System Concepts, McGraw Hill, 7th Edition 2019.
2.	Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4th Edition, 2018
3.	C.J.Date, A.Kannan, S.Swamynathan," An Introduction to Database Systems", Pearson, Eighth Edition, 2006.
4.	Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021

Mode of Evaluation: CAT, Written assignments, Quiz and FAT.			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE302P	Database Systems Lab	L	T	P	C
		0	0	2	1
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives

1. Basic ability to understand the concepts of File system and structure of the database; Designing an Entity-Relationship model for a real-life application and Mapping a database schema from the ER model.
2. Differentiate various normal forms, evaluate relational schemas for design qualities and optimize a query.
3. Explain the working methodologies of transaction management and give a solution during a transaction failure. Understand the basic concepts on concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management.

Course Outcome

On completion of this course, student should be able to:

1. Design the structure and operation of the relational data model.
2. Examine the data requirements of the real world and design a database management system.

Indicative Experiments	
1.	Data Definition and Data Manipulation Language
2.	Constraints
3.	Single row functions
4.	Operators and group functions
5.	Sub query, views and joins
6.	High Level Language Extensions - Procedures, Functions, Cursors and Triggers
	Total Laboratory Hours 30 hours

Text Book

1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2016

Reference Books

1.	A. Silberschatz, H. F. Korth & S. Sudarshan, Database System Concepts, McGraw Hill, 7th Edition 2019.
2.	Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4th Edition, 2018
3.	C.J.Date, A.Kannan, S.Swamynathan," An Introduction to Database Systems", Pearson, Eighth Edition, 2006.
4.	Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021

Mode of assessment: Continuous assessments, FAT

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE303L	Operating Systems	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To introduce the operating system concepts, designs and provide skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Course Outcomes

On completion of this course, student should be able to:

1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
2. Design scheduling algorithms to compute and compare various scheduling criteria.
3. Apply and analyze communication between inter process and synchronization techniques.
4. Implement page replacement algorithms, memory management problems and segmentation.
5. Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS.

Module:1	**Introduction**	**3 hours**

Introduction to OS: Functionality of OS - OS design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, resources - Influence of security, networking, and multimedia.

Module:2	**OS Principles**	**4 hours**

System calls, System/Application Call Interface – Protection: User/Kernel modes - Interrupts -Processes - Structures (Process Control Block, Ready List etc.), Process creation, management in Unix – Threads: User level, kernel level threads and thread models.

Module:3	**Scheduling**	**9 hours**

Processes Scheduling - CPU Scheduling: Pre-emptive, non-pre-emptive - Multiprocessor scheduling – Deadlocks - Resource allocation and management - Deadlock handling mechanisms: prevention, avoidance, detection, recovery.

Module:4	**Concurrency**	**8 hours**

Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson's solution, Bakery algorithm, synchronization hardware) - Semaphores – Classical synchronization problems, Monitors: Solution to Dining Philosophers problem – IPC in Unix, Multiprocessors and Locking - Scalable Locks - Lock-free coordination.

Module:5	**Memory Management**	**7 hours**

Main memory management, Memory allocation strategies, Virtual memory: Hardware support for virtual memory (caching, TLB) – Paging - Segmentation - Demand Paging - Page Faults - Page Replacement -Thrashing - Working Set.

Module:6	**Virtualization and File System Management**	**6 hours**

Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.

Module:7	**Storage Management, Protection and Security**	**6 hours**

Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication -

System protection: Access matrix – Capability based systems - OS: performance, scaling, future directions in mobile OS.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book		
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 2018, 10th Edition, Wiley, United States.	
Reference Books		
1.	Andrew S. Tanenbaum, "Modern Operating Systems", 2016, 4th Edition, Pearson, United Kingdom.	
2.	William Stallings, "Operating Systems: Internals and Design Principles", 2018, 9th Edition, Pearson, United Kingdom.	
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT		
Recommended by Board of Studies	04-03-2022	
Approved by Academic Council	No. 65	Date 17-03-2022

BCSE303P	Operating Systems Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To introduce the operating system concepts, designs and provide skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Course Outcome

On completion of this course, student should be able to:

1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
2. Design scheduling algorithms to compute and compare various scheduling criteria.
3. Apply and analyze communication between inter process and synchronization techniques.
4. Implement page replacement algorithms, memory management problems and segmentation.
   Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS.

Indicative Experiments

1.	Study of Basic Linux Commands
2.	Implement your own bootloader program that helps a computer to boot an OS.
3.	Shell Programming (I/O, Decision making, Looping, Multi-level branching)
4.	Creating child process using fork () system call, Orphan and Zombie process creation
5.	Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin)
6.	Implement process synchronization using semaphores / monitors.
7.	Simulation of Banker s algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately
8.	Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading
9.	Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms
10.	Page Replacement Algorithms FIFO, LRU and Optimal
11.	Implement a file locking mechanism.
12.	Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report)
	Total Laboratory Hours 30 hours

Text Book

1.	Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK.

Reference Books

1.	Love, Robert, "Linux System Programming: talking directly to the kernel and C library", 2013, 2nd Edition, O'Reilly Media, Inc, United States.
2.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 2018, 10th Edition, Wiley, United States.

Mode of Assessment: Continuous Assessments, FAT

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE304L	Theory of Computation	L	T	P	C
		3	0	0	3
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. Types of grammars and models of automata.
2. Limitation of computation: What can be and what cannot be computed.
3. Establishing connections among grammars, automata and formal languages.

Course Outcome

On completion of this course, student should be able to:
1. Compare and analyse different computational models
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Identify limitations of some computational models and possible methods of proving them.
4. Represent the abstract concepts mathematically with notations.

Module:1	**Introduction to Languages and Grammars**	**4 hours**
Recall on Proof techniques in Mathematics - Overview of a Computational Models - Languages and Grammars - Alphabets - Strings - Operations on Languages, Overview on Automata		
Module:2	**Finite State Automata**	**8 hours**
Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) - NFA with epsilon transitions – NFA without epsilon transition, conversion of NFA to DFA, Equivalence of NFA and DFA – minimization of DFA		
Module:3	**Regular Expressions and Languages**	**7 hours**
Regular Expression - FA and Regular Expressions: FA to regular expression and regular expression to FA - Pattern matching and regular expressions - Regular grammar and FA - Pumping lemma for regular languages - Closure properties of regular languages		
Module:4	**Context Free Grammars**	**7 hours**
Context-Free Grammar (CFG) – Derivations - Parse Trees - Ambiguity in CFG - CYK algorithm – Simplification of CFG – Elimination of Useless symbols, Unit productions, Null productions - Normal forms for CFG: CNF and GNF - Pumping Lemma for CFL - Closure Properties of CFL		
Module:5	**Pushdown Automata**	**5 hours**
Definition of the Pushdown automata - Languages of a Pushdown automata – Power of Non-Deterministic Pushdown Automata and Deterministic pushdown automata		
Module:6	**Turing Machine**	**6 hours**
Turing Machines as acceptor and transducer - Multi head and Multi tape Turing Machines – Universal Turing Machine - The Halting problem - Turing-Church thesis		
Module:7	**Recursive and Recursively Enumerable Languages**	**6 hours**
Recursive and Recursively Enumerable Languages, Language that is not Recursively Enumerable (RE) – computable functions – Chomsky Hierarchy – Undecidable problems - Post's Correspondence Problem		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, India 2008. ISBN: 978-8131720479

Reference Books

1.	Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016. ISBN: 978-9384323219		
2.	K. Krithivasan and R. Rama, "Introduction to Formal Languages, Automata and Computation", Pearson Education, 2009. ISBN: 978-8131723562		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE305L	Embedded Systems	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To expose students to various challenges and constraints of special purpose computing systems in terms of resources and functional requirements.
2. To introduce students to various components of typical embedded systems viz., sensors and actuators, data converters, UART etc., their interfacing, programming environment for developing any smart systems and various serial communication protocols for optimal components interfacing and communication.
3. To make students understand the importance of program modeling, optimization techniques and debugging tools for product development and explore various solutions for real time scheduling issues in terms of resources and deadline.

Course Outcomes

On completion of this course, students should be able to:

1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces.
2. To summaries the functionality of any special purpose computing system, and to propose smart solutions to engineering challenges at the prototype level.
3. To examine the working principle and interface of typical embedded system components, create programme models, apply various optimization approaches including simulation environment and demonstration using debugging tools.
4. To evaluate the working principle of serial communication protocols and their proper use, as well as to analyze the benefits and drawbacks of real-time scheduling algorithms and to recommend acceptable solutions for specific challenges.

Module:1	**Introduction**	**5 hours**
Overview of Embedded Systems, Design challenges, Embedded processor technology, Hardware Design, Micro-controller architecture -8051, PIC, and ARM.		
Module:2	**I/O Interfacing Techniques**	**8 hours**
Memory interfacing, A/D, D/A, Timers, Watch-dog timer, Counters, Encoder & Decoder, UART, Sensors and actuators interfacing.		
Module:3	**Architecture of Special Purpose Computing System**	**6 hours**
ATM, Handheld devices, Data Compressor, Image Capturing Devices–Architecture and Requirements, Challenges & Constraints of special purpose computing system.		
Module:4	**Programming Tools**	**7 hours**
Evolution of embedded programming tools, Modelling programs, Code optimization, Logic analyzers, Programming environment.		
Module:5	**Real Time Operating System**	**8 hours**
Classification of Real time system, Issues & challenges in RTS, Real time scheduling schemes- EDF-RMS & Hybrid techniques, eCOS, POSIX, Protothreads.		
Module:6	**Embedded Networking Protocols**	**5 hours**
Inter Integrated Circuits (I2C), Controller Area Network, Embedded Ethernet Controller, RS232, Bluetooth, Zigbee, Wifi.		
Module:7	**Applications of Embedded Systems**	**4 hours**
Introduction to embedded system applications using case studies – Role in Agriculture sector, Automotive electronics, Consumer Electronics, Industrial controls, Medical Electronics.		
Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**45 hours**
Text Book		
1.	Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Fourth Edition, Morgan Kaufman Publishers, 2016.	
Reference Books		
1.	Embedded Systems Architecture, Programming and Design, by Raj Kamal, McGraw Hill Education, 3e, 2015.	
2.	Embedded System Design A Unified Hardware/Sofware Introduction, by Vahid G Frank and Givargis Tony, John Wiley & Sons, 2009.	
Mode of Evaluation: CAT, written assignment, Quiz, FAT.		
Recommended by Board of Studies	04-03-2022	
Approved by Academic Council	No. 65	Date 17-03-2022

BCSE306L	Artificial Intelligence	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart artificial intelligence principles, techniques and its history.
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
3. To develop intelligent systems by assembling solutions to concrete computational problems

Course Outcomes

On completion of this course, student should be able to:

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems
4. Analyse and illustrate how search algorithms play a vital role in problem-solving

Module:1	**Introduction**	**6 hours**

Introduction- Evolution of AI, State of Art -Different Types of Artificial Intelligence- Applications of AI-Subfields of AI-Intelligent Agents- Structure of Intelligent Agents-
Environments

Module:2	**Problem Solving based on Searching**	**6 hours**

Introduction to Problem Solving by searching Methods-State Space search, Uninformed Search Methods – Uniform Cost Search, Breadth First Search- Depth First Search-Depth-limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search

Module 3	**Local Search and Adversarial Search**	**5 hours**

Local Search algorithms – Hill-climbing search, Simulated annealing, Genetic Algorithm, Adversarial Search: Game Trees and Minimax Evaluation, Elementary two-players games: tic-tac-toe, Minimax with Alpha-Beta Pruning.

Module:4	**Logic and Reasoning**	**8 hours**

Introduction to Logic and Reasoning -Propositional Logic-First Order Logic-Inference in First Order Logic- Unification, Forward Chaining, Backward Chaining, Resolution.

Module:5	**Uncertain Knowledge and Reasoning**	**5 hours**

Quantifying Uncertainty- Bayes Rule -Bayesian Belief Network- Approximate Inference in Bayesian networks

Module:6	**Planning**	**7 hours**

Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning and acting in Nondeterministic domains – Sensor-less Planning, Multiagent planning

Module:7	**Communicating, Perceiving and Acting**	**6 hours**

Communication-Fundamentals of Language -Probabilistic Language Processing -Information Retrieval- Information Extraction-Perception-Image Formation- Object Recognition.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1.	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd Edition, Prentice Hall.

Reference Books			
1.	K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer, 2020.		
2	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd Edition, MIT Press.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE307L	Compiler Design	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide fundamental knowledge of various language translators.
2. To make students familiar with lexical analysis and parsing techniques.
3. To understand the various actions carried out in semantic analysis.
4. To make the students get familiar with how the intermediate code is generated.
5. To understand the principles of code optimization techniques and code generation.
6. To provide foundation for study of high-performance compiler design.

Course Outcomes

1. Apply the skills on devising, selecting, and using tools and techniques towards compiler design
2. Develop language specifications using context free grammars (CFG).
3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems.
4. Constructing symbol tables and generating intermediate code.
5. Obtain insights on compiler optimization and code generation.

Module:1	**INTRODUCTION TO COMPILATION AND LEXICAL ANALYSIS**	**7 hours**

Introduction to LLVM - Structure and Phases of a Compiler-Design Issues-Patterns- Lexemes-Tokens-Attributes-Specification of Tokens-Extended Regular Expression- Regular expression to Deterministic Finite Automata (Direct method) - Lex - A Lexical Analyzer Generator.

Module:2	**SYNTAX ANALYSIS**	**8 hours**

Role of Parser- Parse Tree - Elimination of Ambiguity – Top Down Parsing - Recursive Descent Parsing - LL (1) Grammars – Shift Reduce Parsers- Operator Precedence Parsing - LR Parsers, Construction of SLR Parser Tables and Parsing- CLR Parsing- LALR Parsing.

Module:3	**SEMANTICS ANALYSIS**	**5 hours**

Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation - Syntax Directed Translation Schemes - Implementation of L-attributed Syntax Directed Definition.

Module:4	**INTERMEDIATE CODE GENERATION**	**5 hours**

Variants of Syntax trees - Three Address Code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.

Module:5	**CODE OPTIMIZATION**	**6 hours**

Loop optimizations- Principal Sources of Optimization -Introduction to Data Flow Analysis - Basic Blocks - Optimization of Basic Blocks - Peephole Optimization- The DAG Representation of Basic Blocks -Loops in Flow Graphs - Machine Independent Optimization- Implementation of a naïve code generator for a virtual Machine- Security checking of virtual machine code.

Module:6	**CODE GENERATION**	**5 hours**

Issues in the design of a code generator- Target Machine- Next-Use Information - Register Allocation and Assignment- Runtime Organization- Activation Records.

Module:7	**PARALLELISM**	**7 hours**

Parallelization- Automatic Parallelization- Optimizations for Cache Locality and Vectorization- Domain Specific Languages-Compilation- Instruction Scheduling and Software Pipelining- Impact of Language Design and Architecture Evolution on Compilers-

Static Single Assignment		
Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, techniques, & tools, 2007, Second Edition, Pearson Education, Boston.	
Reference Books		
1.	Watson, Des. A Practical Approach to Compiler Construction. Germany, Springer International Publishing, 2017.	

Mode of Evaluation: CAT, Quiz, Written assignment and FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE307P	**Compiler Design Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite		**Syllabus version**			
		1.0			

Course Objectives

1. To provide fundamental knowledge of various language translators.
2. To make students familiar with phases of compiler.
3. To provide foundation for study of high-performance compiler design.

Course Outcome

1. Apply the skills on devising, selecting and using tools and techniques towards compiler design
2. Develop language specifications using context free grammars (CFG).
3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems.
4. Constructing symbol tables and generating intermediate code.
5. Obtain insights on compiler optimization and code generation.

Indicative Experiments	
1.	Implementation of LEXR using LLVM.
2.	Implementation of handwritten parser using LLVM
3.	Generating code with the LLVM backend.
4.	Defining a real programming language.
5.	Write a recursive descent parser for the CFG language and implement it using LLVM.
6.	Write a LR parser for the CFG language and implement it in the using LLVM.
7.	Intro to Flex and Bison Modify the scanner and parser so that terminating a statement with "; b" instead of ";" results in the output being printed in binary.
8.	Using LLVM-style RTTI for the AST and Generating IR from the AST.
9.	Converting types from an AST description to LLVM types.
10.	Emitting assembler text and object code.
	Total Laboratory Hours **30 hours**

Mode of assessment: CAT, FAT

Text Book(s)

1	Learn LLVM 12: A beginner's guide to learning LLVM compiler tools and core libraries with C++

Reference Books

1.	Watson, Des. A Practical Approach to Compiler Construction. Germany, Springer International Publishing, 2017.

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE308L	Computer Networks	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
3. To identify the suitable application layer protocols for specific applications and its respective security mechanisms.

Course Outcomes

On completion of this course, student should be able to:

1. Interpret the different building blocks of Communication network and its architecture.
2. Contrast different types of switching networks and analyze the performance of network
3. Identify and analyze error and flow control mechanisms in data link layer.
4. Design sub-netting and analyze the performance of network layer with various routing protocols.
5. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism.

Module:1	**Networking Principles and Layered Architecture**	**6 hours**

Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)

Module:2	**Circuit and Packet Switching**	**7 hours**

Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)

Module:3	**Data Link Layer**	**8 hours**

Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – IEEE Standards(IEEE802.3 (Ethernet), IEEE802.11(WLAN))- RFID- Bluetooth Standards

Module:4	**Network Layer**	**8 hours**

IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format

Module:5	**Routing Protocols**	**6 hours**

Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer

Module:6	**Transport Layer**	**5 hours**

TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters

Module:7	**Application layer**	**3 hours**

Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1.	Behrouz A. Forouzan, Data communication and Networking, 5th Edition, 2017,

	McGraw Hill Education.
Reference Books	
1.	James F. Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach, 6th Edition, 2017, Pearson Education.
2.	William Stallings, "Data and Computer Communication", 10th Edition, 2017, Pearson, United Kingdom.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE308P	Computer Networks Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
3. To identify the suitable application layer protocols for specific applications and its respective security mechanisms

Course Outcome

On completion of this course, student should be able to:

1. Interpret the different building blocks of Communication network and its architecture.
2. Contrast different types of switching networks and analyze the performance of network
3. Identify and analyze error and flow control mechanisms in data link layer.
4. Design sub-netting and analyze the performance of network layer with various routing protocols.
5. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism.

Indicative Experiments	
1.	Study of Basic Network Commands, Demo session of all networking hardware and Functionalities
2.	Error detection and correction mechanisms
3.	Flow control mechanisms
4.	IP addressing Classless addressing
5.	Observing Packets across the network and Performance Analysis of Routing protocols
6.	Socket programming(TCP and UDP) - Some challenging experiments can be given on Socket programming
7.	Simulation of unicast routing protocols
8.	Simulation of Transport layer Protocols and analysis of congestion control techniques in network
9.	Develop a DNS client server to resolve the given host name or IP address
	Total Laboratory Hours 30 hours

Text book

1 W.Richard Stevens, Uix Network Programming, 2ndEdition, Pearson Education, 2015.

Mode of assessment: Continuous assessment, FAT

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE309L	Cryptography and Network Security	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To explore the concepts of basic number theory and cryptographic techniques.
2. To impart concept of Hash and Message Authentication, Digital Signatures and authentication protocols.
3. To reveal the basics of transport layer security, Web Security and various types of System Security.

Course Outcomes

On completion of this course, students should be able to:

1. To know the fundamental mathematical concepts related to security.
2. To understand concept of various cryptographic techniques.
3. To apprehend the authentication and integrity process of data for various applications
4. To know fundamentals of Transport layer security, web security, E-Mail Security and IP Security

Module:1	**Fundamentals of Number Theory**	**5 hours**

Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing: Fermats and Eulers theorem, Chinese Reminder theorem, Discrete Logarithms.

Module:2	**Symmetric Encryption Algorithms**	**7 hours**

Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA, Block Cipher Operation, Random Bit Generation and RC4

Module:3	**Asymmetric Encryption Algorithm and Key Exchange**	**8 hours**

Asymmetric key cryptographic techniques: principles, RSA, ElGamal, Elliptic Curve cryptography, Homomorphic Encryption and Secret Sharing, Key distribution and Key exchange protocols, Diffie-Hellman Key Exchange, Man-in-the-Meddle Attack

Module:4	**Message Digest and Hash Functions**	**5 hours**

Requirements for Hash Functions, Security of Hash Functions, Message Digest (MD5), Secure Hash Function (SHA),Birthday Attack, HMAC

Module:5	**Digital Signature and Authentication Protocols**	**7 hours**

Authentication Requirements, Authentication Functions, Message Authentication Codes, Digital Signature Authentication, Authentication Protocols, Digital Signature Standards, RSA Digital Signature, Elgamal based Digital Signature, Authentication Applications: Kerberos, X.509 Authentication Service, Public Key Infrastructure (PKI)

Module:6	**Transport Layer Security and IP Security**	**4 hours**

Transport-Layer Security, Secure Socket Layer(SSL),TLS, IP Security: Overview: IP Security Architecture, Encapsulating Payload Security

Module:7	**E-mail, Web and System Security**	**7 hours**

Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME, Web Security: Web Security Considerations, Secure Electronic Transaction Protocol
Intruders, Intrusion Detection, Password Management, Firewalls: Firewall Design Principles, Trusted Systems.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1.	Cryptography and Network Security-Principles and Practice, 8th Edition, by Stallings

	William, published by Pearson, 2020		
Reference Books			
1.	Cryptography and Network Security, 3rd Edition, by Behrouz A Forouzan and Depdeep Mukhopadhyay, published by McGrawHill, 2015		
Mode of Evaluation: CAT, written assignment, Quiz, and FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE309P	**Cryptography and Network Security Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. Understand various Private and Public Key cryptographic algorithms.
2. To learn about hash functions and digital signature algorithms
3. Acquire knowledge in various network security models

Course Outcome

On completion of this course, students should be able to:

1. Implement various cipher techniques without using standard cryptographic library functions
2. Develop the various hash functions and digital signature algorithms for different applications
3. Develop various secured networking-based application

Indicative Experiments

1.	Consider a sender and receiver who need to exchange data confidentially using symmetric encryption. Write program that implements DES encryption and decryption using a 64 bit key size and 64 bit block size
2.	Consider a sender and receiver who need to exchange data confidentially using symmetric encryption. Write program that implements AES encryption and decryption using a 64/128/256 bits key size and 64 bit block size.
3	Develop an chipper scheme by using RSA
4.	Develop a MD5 hash algorithm that finds the Message Authentication Code (MAC)
5	Find a Message Authentication Code (MAC) for given variable size message by using SHA-128 and SHA-256 Hash algorithm Measure the Time consumptions for varying message size for both SHA-128 and SHA-256.
6	Develop the Digital Siganture standard(DSS)for verifying the legal communicating parties
7	Design a Diffie Hellman multiparty key exchange protocol and perform Man-in-the-Middle Attack.
8	Develop a simple client and server application using SSL socket communication
9	Develop a simple client server model using telnet and capture the packets transmitted with tshark Analyze the pcap file and get the transmitted data (plain text) using any packet capturing library. Implement the above scenario using SSH and observe the data
10	Develop a web application that implements JSON web token
	Total Laboratory Hours 30 hours

Mode of assessment: Continuous Assessment, FAT

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Specialization Elective

Course code	Course Title	L	T	P	C
BCSE209L	Machine Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To teach the theoretical foundations of various learning algorithms.
2. To train the students better understand the context of supervised and unsupervised learning through real-life examples.
3. To understand the need for Reinforcement learning in real – time problems.
4. Apply all learning algorithms over appropriate real-time dataset.
5. Evaluate the algorithms based on corresponding metrics identified.

Course Outcomes

At the end of this course, student will be able to:

1. Understand, visualize, analyze and preprocess the data from a real-time source.
2. Apply appropriate algorithm to the data.
3. Analyze the results of algorithm and convert to appropriate information required for the real — time application.
4. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment.

Module:1	Introduction to Machine Learning and Pre-requisites	4 hours
Introduction to Machine Learning – Learning Paradigms – PAC learning – Version Spaces – Role of Machine Learning in Artificial Intelligence applications		
Module:2	**Supervised Learning – I**	**7 hours**
Linear and Non-Linear examples – Multi–Class & Multi-Label classification – Linear Regression – Multiple Linear Regression – Naïve Bayes Classifier – Decision Trees – ID3 – CART — Error bounds.		
Module:3	**Supervised Learning – II**	**8 hours**
K-NN classifier – Logistic regression – Perceptron – Single layer & Multi-layer – Support Vector Machines – Linear & Non-linear – Metrics & Error Correction.		
Module:4	**Unsupervised Learning**	**9 hours**
Clustering basics (Partitioned, Hierarchical and Density based) - K-Means clustering – K-Mode clustering – Self organizing maps – Expectation maximization – Principal Component Analysis – Kernel PCA – tSNE (t-distributed stochastic neighbor embedding) - Metrics & Error Correction.		
Module:5	**Ensemble Learning**	**5 hours**
Bias – Variance Tradeoff – Bagging and Boosting (Random forests, Adaboost, XG boost inclusive) – Metrics & Error Correction.		
Module:6	**Machine Learning in Practice**	**3 hours**
Class Imbalance – SMOTE – One Class SVM – Optimization of hyper parameters.		
Module:7	**Reinforcement Learning (RL)**	**8 hours**
Basics of RL – RL Framework – Markov Decision Process – Exploration Vs Exploitation - Polices, Value Functions and Bellman Equations – Solution Methods – Q-learning.		
Module:8	**Contemporary Issues**	**1 hours**

	Total Lecture hours:	**45 Hours**
Text Book(s)		
1	Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India,	
	Third Edition 2014.	
2	Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2nd edition, Richard S. Sutton and Andrew G. Barto, A Bradford Book; 2018, ISBN 978-0262039246	
Reference Books		
1	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.	
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.	
3	Charu C. Aggarwal, "Data Classification Algorithms and Applications" , CRC Press, 2014.	
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT		
Recommended by Board of Studies	09-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE209P	Machine Learning Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To teach the theoretical foundations of various learning algorithms.
2. To train the students better understand the context of supervised and unsupervised learning through real-life examples.
3. To understand the need for Reinforcement learning in real – time problems.
4. Apply all learning algorithms over appropriate real-time dataset.
5. Evaluate the algorithms based on corresponding metrics identified.

Course Outcome

At the end of this course, student will be able to:

1. Understand, visualize, analyze and preprocess the data from a real-time source.
2. Apply appropriate algorithm to the data.
3. Analyze the results of algorithm and convert to appropriate information required for the real ― time application.
4. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment.

Indicative Experiments

1.	Linear & Multiple Linear Regression	2 hours
2.	Naïve Bayes classifier	2 hours
3.	Decision trees – ID3 & CART	4 hours
4.	Logistic regression	2 hours
5.	Support Vector Machines – Linear & Non-linear	2 hours
6.	Single & Multi-layer Perceptron	4 hours
7.	K-NN, K-Means & K-mode clustering	2 hours
8.	Random – forest	2 hours
9.	Adaboost, XGboost	4 hours
10.	Principal component analysis	2 hours
11.	Self – Organizing maps	2 hours
12.	Q-Learning	2 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1	Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
2	Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2nd edition, Richard S. Sutton and Andrew G. Barto, A Bradford Book; 2018, ISBN 978-0262039246

References Books:

1	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
3	Charu C. Aggarwal, "Data Classification Algorithms and Applications" , CRC Press, 2014.

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE332L	Deep Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Introduce major deep neural network frameworks and issues in basic neural networks
2. To solve real world applications using Deep learning

Course Outcomes

At the end of this course, student will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and apply suitable deep learning approaches for given application.
3. Design and develop custom Deep-nets for human intuitive applications
4. Design of test procedures to assess the efficiency of the developed model.
5. To understand the need for Reinforcement learning in real – time problems.

Module:1	Introduction to neural networks and deep neural networks	7 hours

Neural Networks Basics - Functions in Neural networks – Activation function, Loss function - Function approximation - Classification and Clustering problems - Deep networks basics - Shallow neural networks – Activation Functions – Gradient Descent – Back Propagation – Deep Neural Networks – Forward and Back Propagation – Parameters - Hyperparameters

Module:2	Convolution neural networks	6 hours

Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, InceptionNet and others

Module:3	Improving deep neural networks	8 hours

Mini-batch Gradient Descent – Exponential Weighted Averages – Gradient Descent with Momentum — RMSProp and Adam Optimization — Hyperparameter tuning — Batch Normalization – Softmax Regression – Softmax classifier – Deep Learning Frameworks – Data Augmentation - Under-fitting Vs Over-fitting

Module:4	Recurrent networks	6 hours

Recurrent Neural Networks - Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders - Bidirectional Encoder Representations from Transformers (BERT)

Module:5	Recursive neural networks	6 hours

Long-Term Dependencies - Echo State Networks - Long Short-Term Memory and Other Gated RNNs - Optimization for Long-Term Dependencies - Explicit Memory

Module:6	Advanced Neural networks	6 hours

Transfer Learning – Transfer Learning Models – Generative Adversarial Network and their variants – Region based CNN – Fast RCNN - You Only Look Once – Single shot detector

Module:7	Deep reinforcement learning	5 hours

Deep Reinforcement Learning – Q-Learning – Deep Q-Learning – Policy Gradients - Advantage Actor Critic (A2C) and Asynchronous Advantage Actor Critic (A3C) — Model based Reinforcement Learning - Challenges

Module:8	Contemporary issues	1 hours

	Total Lecture hours:	**45 Hours**

Text Book(s)			
1.	Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017		
2	Neural Networks and Deep Learning, Michael Nielsen,, Determination Press		
Reference Books			
1.	Deep Learning Step by Step with Python, N D Lewis, 2016		
2.	Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017		
3	Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Umberto Michelucci, Apress, 2018.		
4	Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE332P	Deep Learning Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Introduce major deep neural network frameworks and issues in basic neural networks
2. To solve real world applications using Deep learning.

Course Outcomes

At the end of this course, student will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and apply suitable deep learning approaches for given application.
3. Design and develop custom Deep-nets for human intuitive applications
4. Design of test procedures to assess the efficiency of the developed model.

To understand the need for Reinforcement learning in real — time problems.

Indicative Experiments

1.	Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras • Google Colaboratory - Cloning GitHub repository, Upload Data, Importing Kaggle's dataset, Basic File operations • Implementing Perceptron, • Digit Classification : Neural network to classify MNIST dataset	10 hours
2.	Hyper parameter tuning and regularization practice - • Multilayer Perceptron (BPN) • Mini-batch gradient descent,	4 hours
3.	Convolution Neural Network application using Tensorflow and Keras, • Classification of MNIST Dataset using CNN • Face recognition using CNN	4 hours
4.	Object detection using Transfer Learning of CNN architectures	2 hours
5.	Image denoising (Fashion dataset) using Auto Encoders • Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising)	2 hours
6.	Text processing, Language Modeling using RNN	2 hours
7.	Transfer Learning models for classification problems	2 hours
8.	Sentiment Analysis using LSTM	2 hours
9.	Image generation using GAN	2 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017
2	Neural Networks and Deep Learning, Michael Nielsen,, Determination Press

Reference Books

1.	Deep Learning Step by Step with Python, N D Lewis, 2016

2.	Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017		
3	Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Umberto Michelucci, Apress, 2018.		
4	Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.		
Mode of Evaluation: CAT / Mid-Term Lab/ FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE416L	Game Programming	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide an in-depth introduction to technologies and techniques currently used in the game industry
2. To understand game design and development
3. To understand the processes, mechanics, issues in game design, and game engine development
4. To understand modeling, techniques, handling situations, and logic
5. To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive & immersive game application.

Course Outcomes:

1. Design, develop, test, evaluate, debug, and modify code to meet design specifications for games.
2. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends.
3. Create and document the games by applying programming concepts using various tools to meet requirements of the current marketplace.

Module:1	Introduction to Game Programming & Game engine architecture	5 Hours

Overview of game programming, Structure of a typical game team, game industry- game engine history- Real Time Game Architecture, Engine Support: Subsystem Start-Up and Shut-Down, Memory Management, Containers and Strings

Module:2	Basics of 2D & 3D Graphics and Mathematics in Gaming & Rendering engine	6 Hours

2D Graphics: Sprites, Tiled Images and Backgrounds - 3D Graphics: 3D Graphics Pipeline, 3D Math, Coordinates and Coordinate Systems, Quaternion Mathematics, Transformations & Geometry - Rendering Pipeline

Module:3	Lighting and Texturing Effects in game environment	7 Hours

Ray Tracing, Lighting in Computer Graphics, Types of Light Sources, Light Models - Materials: Lambert Diffuse, Phong -Bump Mapping - Lighting Technique: Point Lights, Bloom - Shadows in Games: Real-Time Versus Preprocessed Shadows - Types of Shadows - Texture mapping techniques - Special Effects: Blurring, Particle Systems, Weapon Effects

Module:4	Game Physics	5 hours

Basic Newtonian Mechanics- Forces: Gravitational Force, Friction, Centripetal Force - Energy: Kinetic Energy, Potential Energy - Basic Kinematics: The Relationship Between Force, Acceleration, Velocity and Location - Rigid Body Motion and Collision

Module:5	Artificial Intelligence in Game for move prediction and optimization	7 Hours

Games for Artificial Intelligence, Game AI Panoram; AI Methods: Tree Search, Evolutionary Computation, Supervised Learning & Reinforcement Learning.

Module:6	Virtual and Augmented Reality	7 Hours

Immersive reality application areas - Entertainment, Education, Training, Medical, Industrial, Military. VR: Position and Motion Trackers - Magnetic, Mechanical and Ultrasonic Trackers - Navigation and Manipulation Interfaces; AR: Selection of AR Platform, Integrating Hardware and Software , Optical & Inertial Calibration — Tracking — AR Computer Vision

Module:7	**Game Design & Management**	**6 Hours**
Game design, Differing game types, modes, and perspectives, scripting, audio engineering, Sound and Music, level design; Game project management, Game design documentation, Rapid prototyping and game testing		
Module:8	**Contemporary Issues**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019
2.	Palmer G. Physics for game programmers. Berkeley: Apress; 2005
3	Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer
References Books:	
1	Sherrod A. Game Graphic Programming. Cengage Learning; 2008.
2	McShaffry M. Game coding complete. Nelson Education; 2014
3	Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering
4	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013
5	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE416P	Game Programming Lab	0	0	2	1
Prerequisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide an in-depth introduction to technologies and techniques currently used in the game industry
2. To understand game design and development
3. To understand the processes, mechanics, issues in game design, and game engine development
4. To understand modeling, techniques, handling situations, and logic
5. To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive game application.

Course Outcome

At the end of this course, student will be able to:

1. Classify different Sensors & Actuators based on various physical phenomena and learn various sensor calibration techniques
2. Select the relevant sensors and actuators to design real-time data acquisition from ambience via case studies

Indicative Experiments

1.	Game engines - UNITY Basics/ Unreal/ Scratch, etc.,	2 Hours
2.	Model Creation – Unity/ MAYA	4 Hours
3.	2D Game environment	2 Hours
4.	3D Game environment	2 Hours
5.	Create a game environment to apply different types of light effects.	2 Hours
6.	Create a physics based game play to realize all basic Newtonian effects	2 Hours
7.	Create a Tile map based Game environment	2 Hours
8.	Apply Multiple Levels for any of the Games developed	2 Hours
9.	AI as Player	2 Hours
10.	AI as Non Player Character (NPC) – Navigation Mesh creation	2 Hours
11.	Create a racing game	2 Hours
12.	Create a board game using AR/VR	4 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019
2.	Palmer G. Physics for game programmers. Berkeley: Apress; 2005
3.	Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer

Reference Books

1.	Sherrod A. Game Graphic Programming. Cengage Learning; 2008.
2.	McShaffry M. Game coding complete. Nelson Education; 2014
3.	Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering
4.	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013
5.	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009

Mode of Evaluation: CAT / Mid-Term Lab/ FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE417L	Machine Vision	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To enhance and restore the images acquired from cameras
2. To educate in taking the individual steps that leads to final inspection result based on the acquired image data.
3. To analyze the real-world problems and provide solutions to automated visual inspection

Course Outcomes

At the end of this course, student will be able to:

1. Understand the basics of how an image is processed
2. Enhance, Analyze and segment the image using algorithms
3. To interpret the image and transform it using the mathematical knowledge
4. Extract the features from the image and represent using morphological operations
5. Apply the concept in understanding the scene and process the background part of the image

Module:1	Basics of Image Processing	4 hours

Image Formation Physics, Image Digitization – Sampling and Quantization, Digital Image Properties, Color Image, Color spaces/ conversions, Cameras

Module:2	Preprocessing and Image Enhancement	8 hours

Image enhancement methods: Contrast Adjustment-Histogram Manipulation-Image Smoothening-Image Sharpening; Image Enhancement using Linear Filters – Ideal Low Pass Filter - Gaussian Filter — Ideal Noise Reduction using non linear filters-Geometric Rectification using Bilinear Interpolation-Suppression of in homogeities using Homomorphic Filtering

Module:3	Image Analysis and Segmentation	8 hours

Thresholding - Edge detection- Edge Based Segmentation – Region Based Segmentation- Active Contour Models — Graph Based segmentation - Image Analysis- invariant feature - Image transforms

Module:4	Mathematical Morphology and Texture Description Image Invariant feature	8 hours

Skeletons and object marking — Morphological Segmentation — Statistical Texture Description — Co-occurrence matrices — Local Binary Patterns — Syntactic Texture
Description Methods - Object Measurement - Counting -Visual inspection tasks regarding textures

Module:5	Wavelet Transform and Multi-resolution Analysis/ image transforms	5 hours

Image transforms - Frequency domain transformations - FFT's — Haar Wavelet - Multiresolution analysis - Scale-invariant features

Module:6	Motion Analysis	6 hours

Optical Flow — Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - stereo mapping-image fusion

Module:7	Scene Analysis	4 hours

Detection of known objects by linear filters - Detection of unknown objects - The Hough transform for the detection of lines - Corner detection - image tagging

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4th Edition, Cengage Learning, USA
2.	Jurgen Beyerer, Fernando Puente Leon, Christian Frese,"Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer
3.	AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press
Reference Books	
1.	Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE417P	Machine Vision Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To enhance the image using various image enhancement methods
2. To segment the image and extract the features
3. To track object from the extracted video frame to support visual inspection process

Course Outcome

At the end of this course, student will be able to:

1. To identify the required operations that helps to segment an object from an enhanced image
2. To apply various techniques to analyze and extract features that helps in visual inspection and classification

Indicative Experiments

1.	Program to display different types of images from different color models	3 hours
2.	To perform histogram equalization on the image.	3 hours
3.	Program to perform the edge detection process and extract edges from the input image	5 hours
4.	Program to perform segmentation, extract and display the segmented region	7 hours
	Program to analyze and describe the segmented region	3 hours
5.	Program to detect an object from the input frame	3 hours
6.	Program to track the object between two frames from image/video	3 hours
7.	program to demonstrate to understand a scene and generate caption	3 hours
8.	Program to classify defective object from the correct object	3 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications

Reference Books

1.	S.Sridhar, Digital Image Processing, First Edition, Oxford Press
2.	S. Jayaraman, S.Esakirajan, T.Veerakumar , "Digital Image Processing", TMH First Edition, 2009

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE418L	**Explainable Artificial Intelligence**	**2**	**0**	**0**	**2**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To familiarize concepts related to Explainable Artificial Intelligence (XAI) and interpretable methods, with emphasis on how to build a trustworthy AI system.
2. To understand the performance of a machine learning model and its ability to produce explainable and interpret able predictions.

Course Outcomes

At the end of this course, student will be able to:

1. Understand the methods and terminologies involved in Explainable AI,
2. Differentiate the methods used in XAI and apply suitable XAI Models or approaches for given application.
3. Design and develop XAI use cases for real time applications.
4. Design of test procedures to assess the efficiency of the developed model

Module:1	**Introduction to Explainable Artificial Intelligence**	**4 hours**

Fundamentals of XAI - Categorization of XAI - Taxonomy of XAI methods for Machine Learning - Machine Learning Interpretability - Causal Model Induction - Causality learning - XAI techniques and limitations.

Module:2	**Interpretability**	**5 hours**

Difference between Interpretability and Explainability - Interpretability methods to explain Black-Box Model - Scope of Interpretability - Apply interpretability on Regression, Logistic regression, Generalized Additive Models, Decision Tree - Neural network interpretation - Evaluation of Interpretability

Module:3	**Deep Explanation**	**4 hours**

Attention Mechanisms - Modular Networks - Feature Identification - Learn to Explain - Feature Visualization - Deep Visualization- gradcam and Activation maps - Sensitivity analysis -

Module:4	**XAI Models**	**5 hours**

Ante-hoc Explainability (AHE) models - Post-hoc Explainability (PHE) models - Interactive Machine Learning (IML) - Black Box Explanation through Transparent Approximation (BETA) models - Hybrid Models.

Module:5	**XAI Methods**	**5 hours**

XAI Techniques - Local Interpretable Model-Agnostic Explanations (LIME) - Understanding Mathematical representation of LIME - Shapley Additive exPlanations (SHAP) - Diverse Counterfactual Explanations (DiCE) - Layer wise Relevance Propagation (LRP).

Module:6	**Trust and acceptance**	**3 hours**

Metrics to evaluate XAI, Trustworthy Explainability Acceptance, Power Quality Disturbance (PQD) classification, Methods for measuring human intelligence. Evaluating AI system.

Module:7	**Building Trustworthy Model with Explainable AI**	**3 hours**

Medical diagnosis- Making AI Decisions Trustworthy for Physicians and Patients — Sales predictions on the house sale.

Module:8	**Recent Trends**	**1 hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1.	Molnar, Christoph. "Interpretable machine learning. A Guide for Making Black Box Models Explainable", 2019. https://christophm.github.io/interpretable-ml-book/.		
2	Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning, Uday Kamath: John Liu, Springer, ISBN 9783030833558		
Reference Books			
1.	Tim Miller Explanation in Artificial Intelligence: Insight from Social Science, https://arxiv.org/abs/1706.07269		
2.	A Guide for making black-box machine learning models https://christophm.github.io/interpretable-ml-book/		
3	Explainable AI: A Review of Machine Learning Interpretability Methods https://www.mdpi.com/1099-4300/23/1/18		
4	Lötsch, J.; Kringel, D.; Ultsch, A. Explainable Artificial Intelligence (XAI) in Biomedicine: Making AI Decisions Trustworthy for Physicians and Patients. BioMedInformatics 2022, 2, 1-17. https://doi.org/10.3390/biomedinformatics2010001		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE419L	Speech and Language Processing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Be competent with fundamental concepts for natural language processing and automatic speech recognition
2. To understand technologies involved in developing speech and language applications.
3. To demonstrate the use of deep learning for building applications in speech and natural language processing

Course Outcomes

At the end of this course, student will be able to:

1. Describe the importance of different NLP modules in Text processing and fundamentals of speech production
2. Describe ways to represent speech and text
3. Demonstrate the working of sequence models for text
4. Use signal processing techniques to analyze/represent the speech signal
5. Execute trials of speech/language systems

Module:1	Introduction to Natural Language Processing	7 hours

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational & Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics:
Word Level Semantics and Thematic roles.

Module:2	Text Preprocessing & Feature Representation	8 hours

Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fasttext.

Module:3	Applications of NLP-1	6 hours

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models.

Module:4	Applications of NLP-2	4 hours

Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

Module:5	Introduction to Speech Processing	6 hours

Fundamentals of speech production – Perception of sound – Vocal tract model - Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis.

Module:6	Feature Representaion of Speech Signal	4 hours

Mel Frequency Cepstral Coeffecients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

Module:7	Automatic Speech and Speaker Recognition	8 hours

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model
-- CNN based speech recognition - RNN language Models — Evaluation metrics, Speaker

recognition model — Alexa/Google assistant based application development.		
Module:8	Contemporary issues	**2 hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)				
1.	Dan Jurafsky, James H. Martin “Speech and Language Processing”, Draft of 3rd Edition,Prentice Hall 2022.			
2.	Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.			
Reference Books				
1.	Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.			
2.	Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.			
3.	Ben Gold, Nelson Morgan, Dan Ellis “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, John Wiley & Sons, 2011.			
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT				
Recommended by Board of Studies		09-05-2022		
Approved by Academic Council		No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE419P	Speech and Language Processing Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Be competent with fundamental concepts for natural language processing and automatic speech recognition
2. To understand technologies involved in developing speech and language applications.
3. To demonstrate the use of deep learning for building applications in speech and natural language processing

Course Outcome

At the end of this course, student will be able to:

1. Describe the importance of different NLP modules in text processioning and fundamentals of speech production
2. Describe ways to represent speech and text
3. Demonstrate the working of sequence models for text
4. Use signal processing techniques to analyze/represent the speech signal
5. Execute trials of speech/language systems

Indicative Experiments

1.	Installing various packages for text and Speech Processing: NLTK, Spacy, Speech Recognition etc.	3 Hours
2.	POS Tagging and Parsing using various python packages	2 Hours
3.	Implementation of BOW, topic models for text representation and classification	2 Hours
4.	Implementing N-gram language models for next word prediction	2 Hours
5.	Implementing Word embedding based text classification	2 Hours
6.	Implementing CNN for sentiment analysis	2 Hours
7.	Implementing RNN for Named Entity recognition	2 Hours
8.	Implementing text summarization using deep learning	2 Hours
9.	Implementing chatbot using deep learning	2 Hours
10.	Implementing machine translation using encoder-decoder models	2 Hours
11.	Developing speech recognition system to recognize voice commands	3 Hours
12.	Developing speech recognition system to recognize continuous speech	3 Hours
13.	Implementing CNN based speech recognition using mel spectal images	3 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Delip Rao, Brian McMahan, "Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning", 2019, 1st Edition, O'Reilly Media.

Reference Books

1. Mark Liu, "Make Python Talk: Build Apps with Voice Control and Speech Recognition ", 2021, 1st Edition, No Starch Press.

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BCSE427L	Cognitive Robotics	2	0	0	2
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. To understand the main types of cognitive (vision, motor control, language, social skills) robots and their driving requirements (engineering operations, navigation, cooperation)
2. To understand advanced methods for creating efficient and dynamic cognitive robots.
3. To understand the recent literature, and collectively synthesize, clearly explain and evaluate the state of the art in cognitive robotics.
4. To apply one or more core reasoning methods to create a simple agent that is driven by goals or rewards.

Course Outcomes

After the completion of the course, student will be able to:

1. Understand how our psychology and neuroscience understanding of behavior and intelligence informs the design of robotics models and applications
2. Compare, select and apply different machine learning methods for intelligent behavior in robots.
3. Analyze the methods and software/hardware technologies for robotics research and applications.
4. Discuss the state of the art in cognitive and intelligent robotics models, and how this leads to the design of future robot applications.

Module:1	Introduction	2 hours

Thinking, Cognition, and Intelligence, Defining Intelligence – Embodiment and Its Implications, Synthetic Methodology for Intelligence.

Module:2	Cybernetic View of Robot Cognition and Perception	4 hours

Introduction to the Model of Cognition, Visual Perception, Visual Recognition, Machine Learning, and Robot Cognition.

Module:3	Intelligent System Design, Cognition Development and control	5 hours

Properties of Complete Agents, Agent Design Principle, Developmental Robot Design, Matching brain and Body Dynamics, Artificial Neural Networks (ANN), Fuzzy Logic, Genetic Algorithms and Other Nature Inspired Methods, Optimal Control using ANN, Introduction to CNN.

Module:4	Map Building	5 hours

Introduction, Constructing a 2D World Map, Data Structure for Map Building, Explanation of the Algorithm, An Illustration of Procedure Map Building.

Module:5	Randomized Path Planning	5 hours

Introduction, Representation of the Robot's Environment, Review of configuration spaces, Visibility Graphs, Voronoi diagrams, Potential Fields and Cell

Decomposition, Planning with moving obstacles, Probabilistic Roadmaps, Rapidly exploring random trees, Execution of the Quad tree-Based Path Planner Program.		
Module:6	**Simultaneous Localization and Mapping (SLAM)**	**5 hours**
Problem Definition, Mathematical Basis, Examples: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter, Graph-Based Optimization Techniques, Particle Methods Relation of Paradigms.		
Module:7	**Robot Programming methods**	**3 hours**
Python Robot Programming Methods-: Go-to-Goal Behavior, Avoid-Obstacles Behavior, Hybrid Automata (Behavior State Machine), Follow-Wall Behavior. A Complete Program for autonomous mobile robot.		
Module:8	**Contemporary Issues**	**1 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Patnaik, Srikanta, "Robot Cognition and Navigation – An Experiment with Mobile Robots", Springer Verlag Berlin and Heidelberg, 2007
2.	Howie Choset, Kevin LynchSeth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge, 2005.
3	David Vernon, "Artificial Cognitive Systems: A Primer" ,The MIT Press, 1st Edition,2014
Reference Book(s)	
1.	HoomanSomani, "Cognitive Robotics", CRC Press, 2015
2.	Jared Kroff, "Cognitive Robotics: Intelligent Robotic Systems", Wilford Press, 2016
3.	https://www.toptal.com/robotics/programming-a-robot-an-introductory-tutorial

Recommended by Board of Studies	13-05-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BCSE427P	Cognitive Robotics Lab	0	0	2	1
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. To understand advanced methods for creating efficient and dynamic cognitive robots
2. To apply one or more core reasoning methods to create a simple agent that is driven by goals or rewards

Course Outcomes

After the completion of the course, student will be able to:

1. Understand how our psychology and neuroscience understanding of behavior and intelligence informs the design of robotics models and applications
2. Compare, select and apply different machine learning methods for intelligent behavior in robots.
3. Apply the methods and software/hardware technologies for robotics research and applications.
4. Implement the state of the art in cognitive and intelligent robotics models, and how this leads to the design of future robot applications.

List of Challenging Experiments (Indicative)

1	Introduction to the Python language and Python libraries, including NumPy, SciPy and NXT Python • Introduction to numerical arrays and parallel arithmetic • Introduction to numerical data plotting • • Introduction to numerical regression techniques • Installing Raspbian OS on the Raspberry Pi 3	4 hours
2	Introduction to microcontrollers (32-bit ARM-based devices) in embedded applications used in automobiles and home appliances (such as washing machines, microwave ovens, telephones, and computer system peripherals) • Controlling GPIO pins (e.g., connected to LEDs) on the Raspberry Pi 3 using Python • Controlling motors • Collecting sensor data (such as light-color sensor, touch sensor, infrared proximity sensor and ultrasonic sensor) • Writing and uploading robotic control programs	4 hours
3	Interfacing data acquisition system hardware with computer to measure and control the robotic system.	4 hours
4	Robotic motion and autonomous responses • Path following, solving a Rubix cube, book scanning, and other fun problems	4 hours
5	Machine learning algorithms for neural network pattern recognition	4 hours
6	Extend the deep learning exercises (e.g. Multi-Layer Perceptron (MLP) and/or Convolutional Neural Network (CNN) exercises for image datasets) to optimize the training for robotics (vision) applications.	6 hours
7	SLAM in ROS	4 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Learning Computing with Robots, Deepak Kumar, Institute for Personal Robots in Educaition, June 2008			
Reference Books				
1.	Programming Cognitive Robots, Hector J. Levesque, 2019			
2.	Learning Robotics Using Python, Lentin Joseph, 2015			
3.	https://www.ieee-ras.org/cognitive-robotics/resources (Research Challenges)			
Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).				
Recommended by Board of Studies		13-05-2022		
Approved by Academic Council		No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BCSE428L	Autonomous Drones	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To know the principles of flight and how they apply to robotic drones
2. To know different kinds of airframes and how to assemble a drone.
3. To know the basics of drone design and how to choose the right components.

Course Outcomes

1. Understand the evolution and classification of Drones / Unmanned aerial Vehicle (UAVs)
2. Gain knowledge on UAVs technology side of things (i.e. sensors, platforms, navigation, power source, communication, range, altitude and speed)
3. Illustrate the commercial applications used by various types of drones such as aerial photography, law enforcement surveillance, and border enforcement.
4. Discuss Indian government airspace policy, regulations, and a comparison of other international regulations, and risk factors
5. Realize the emerging technologies being integrated into the drone market including semi-autonomous and autonomous systems for various applications.

Module:1	Introduction to Autonomous Drones	4 hours

History of Drones – Types of drones – Airframe – Batteries – Motors – ESC: Electronic Speed Controller – Propellers.

Module:2	Design Fundamentals	3 hours

Flight Controllers – RC Transmitters – FPV Systems – Telemetry – Timing Gates.

Module:3	Drone Basics	5 hours

Flight Basics – Preflight Checks – Flight Modes – The Maiden Flight – Roll, Pitch, Throttle & Yaw – Key Skills – Simulators – Manual Mode – GPS Autopilot – Intelligent Flight Modes

Module:4	Modelling and Control With MATLAB/Simulink Implementation	5 hours

Quadcopter Project: Quadcopter Physical Characteristics, Vehicle Dynamic, Components, Simulink Modelling.

Module:5	Stability and control	5 hours

Static stability, Dynamic stability, static stability and control, Longitudinal control, stick forces, directional stability and control, roll stability and control.

Module:6	Applications	3 hours

Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, Conservation

Module:7	**Expanding Drones Abilities**	**3 hours**
Add a camera and FPV, Collect more data with other sensors, Altering Speed and Increasing flight times. Building a Quadcopter		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)	
1.	Adam Juniper, "The Complete Guide to Drones", 2nd Edition, ilex.
2.	John Baichtal "Building your own Drones A beginners Guide to Drones, UAVs and ROVs", Que Publishing 2016
3.	Terry Kilby and Belinda Kilby, Make: Getting Started with Drones, First Edition, Maker Media Inc, San Francisco CA, 2016
4.	Robert C.Nelson, "Flight Stability and Automatic control", McGraw-Hill.
5.	https://in.mathworks.com/help/aeroblks/quadcopter-project.html
Reference Books	
1.	A. R. Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", First Edition, CRC Press, 2020

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).

Recommended by Board of Studies	13-05-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BCSE428P	Autonomous Drones Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To gain insight into the basic elements of commercial-off-the-shelf (COTS) drone systems used in civilian missions
2. To introduce unmanned aerial systems (UAS) including drones and autonomous unmanned aerial vehicles (UAV) with sensors

Course Outcomes

At the end of this course, student will be able to:

1. Gain knowledge on UAVs technology side of things (i.e. sensors, platforms, navigation, power source, communication, range, altitude and speed)
2. Illustrate the commercial applications used by various types of drones such as aerial photography, law enforcement surveillance, and border enforcement.

Indicative Experiments

1.	Basic building blocks and 3D Design of a Drone
2.	Making the drone to be stable and fly autonomously with little human intervention
3.	Design a control system architecture that will hover a quadcopter
4.	**Position Control:** To implement a local navigation algorithm through the use of a PID controller.
5.	**Navigation by position:** To implement an autopilot by using the GPS sensor, the IMU, and a position-based PID controller. For this exercise, a simulated 3D world has been designed that contains the quadrotor and five beacons arranged in a cross. The objective is to program the drone to follow a predetermined route visiting the five waypoints in a given sequence. It illustrates the algorithms typically included in commercial autopilots such as ArduPilot or PX4.
6.	**Following an object on the ground:** To implement the logic that allows a quadrotor to follow a moving object on the ground, using a primary color filter in the images and a vision-based PID controller. The drone keeps its altitude and moves only in a 2D plane.
7.	**Searching for people to rescue within a perimeter:** The objective of this exercise is to implement the logic of a global navigation algorithm to sweep a specific area systematically and efficiently, in conjunction with visual face-recognition techniques, to report the location of people for subsequent rescue. The drone behavior is typically implemented as a finite state machine, with several states such as go-to-the-perimeter, explore-inside-the-perimeter, or go-back-home.
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Terry Kilby and Belinda Kilby Make: Getting Started with Drones, First Edition, Maker Media Inc, San Francisco CA, 2016

Reference Books

1.	Mohammad H. Sadraey "Design of Unmanned Aerial Systems" First Edition, John Wiley & Sons, Inc., USA 2020

2.	A. R. Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", First Edition, CRC Press, 2020		
Mode of assessment: Continuous assessment / FAT / Oral examination and others			
Recommended by Board of Studies	13-05-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Projects and Internship

BCSE399J	Summer Industrial Internship	L	T	P	C
		0	0	0	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcome:

1. Demonstrate professional and ethical responsibility.
2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.
3. Develop the ability to engage in research and to involve in life-long learning.
4. Comprehend contemporary issues.

Module Content

Four weeks of work at industry site.
Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE497J	Project - I	L	T	P	C
		0	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

1. Demonstrate professional and ethical responsibility.
2. Evaluate evidence to determine and implement best practice.
3. Mentor and support peers to achieve excellence in practice of the discipline.
4. Work in multi-disciplinary teams and provide solutions to problems that arise in multi- disciplinary work.

Module Content

Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

Can be individual work or a group project, with a maximum of 3 students.

In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

Carried out inside or outside the university, in any relevant industry or research institution.

Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE498J	Project – II / Internship	L	T	P	C
		0	0	0	5
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

1. Formulate specific problem statements for well-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing.
5. Synthesize the results and arrive at scientific conclusions / products / solution.
6. Document the results in the form of technical report / presentation.

Module Content

1. Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: : Assessment on the project - project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Course Code	Course Title	L	T	P	C
BHUM201L	Mass Communication	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the basics of mass communication theories and models
2. To analyze the role of different medium of mass communication
3. To develop perspectives on positive and negative aspects of mass communication on society

Course Outcomes

Upon successful completion of the course students will be able to

1. Explore the basic conceptual knowledge of mass communication.
2. Familiarise the communication models and theories associated with it.
3. Assess the tools of mass communication used for effective communication.
4. Evaluate the impact of mass communication on social institutions.
5. Explain the role of contemporary media towards society.
6. Analyse the impact of mass communication on social problems.

Module:1	Mass Communication	6 hours

Mass Communication: Meaning & definitions, Characteristics, Functions of Mass Communication, Importance, patterns, Techniques of Communication, Formal/informal, verbal / written, downward & upward. Forms of Communication, Barriers of Communication, Communication Process. 7 C's of communication, Factors affecting process of communication.

Module:2	Communication Models	6 hours

Linear communication model. Aristotle's communication model. Laswell's communication model. The Shannon-Weaver communication model. Berlo's S-M-C-R communication model. Interactive communication model. The Osgood-Schramm communication model. The Westleyand Maclean communication model.

Module:3	Communication Theories	7 hours

Theories of Mass Communication: Cognitive Theory, Dissonance Theory, Agenda Setting Theory, Cultivation Theory, Authoritarian Theory, Libertarian Theory, Social Responsibility theory, Soviet communist theory, Magic Bullet theory, Two step flow theory, Uses and Gratification theory. Social Media Integration Theory.

Module:4	Tool of Mass Communication	6 hours

Tools of Mass Communication: Newspapers, Magazines, Radio, TV, Films, Internet, mobiles. Advertising, Public Relations & Public Affairs, Traditional & Folk Media, Media and modernsociety, Media and democracy-Mass Media-Social Media.

Module:5	Mass Communication and Social Institutions	6 hours

Impact on Society: Family, Marriage, Culture, Religion, Economy Health, Education and Polity.

Module:6	Mass Communication and Development	6 hours

Social Development, Rural and Urban Development, Environmental Protection, Gender and Development, Mass Communication and Globalization.

Module:7	Mass Communication and Emerging Issues	6 hours

Pornography – Crime - Juvenile Delinquency - Terrorism – Case Studies - Social media issues - Artificial Intelligence.

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Abhay Chawla (2021), Introduction to Mass Communication, Pearson Publishers.	
2.	Ralph E. Hanson (2016), Mass Communication: Living in a Media World, Sage Publications.	
Reference Books		
1.	Keval J. Kumar (2020), Mass Communication in India, 5th Edition, Jaico Publishing House.	
2.	Terhi Rantanen (2019), Globalization and the Media (4-vol. set) Routledge.	
3.	Prabakar. N (2017), Mass Media and Contemporary Social Issues, Common Wealth Publishers.	
4.	Stanley J Baran (2013), Mass Communication Theory: Foundations, Ferment, and FutureWadsworth Publishing Co Inc.	
5.	Joseph Turow (2022), Media Today: Mass Communication in a Converging World, Routledge.	
6.	D. S. Mehta (2006), Mass Communication and Journalism In India, Allied Publishers.	
Mode of Evaluation: CAT / Quiz / Assignment / FAT		
Recommended by Board of Studies	22-02-2023	
Approved by Academic Council	No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM202L	Rural Development	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To make the students to understand the concepts and approaches to rural development
2. To sensitize students about the role of state and various institutions
3. To assess, interpret and evaluate the various policies and programmes

Course Outcomes

Upon successful completion of the course students will be able to

1. Understand the elementary concepts of rural development.
2. Outline the historical perspectives of rural development.
3. Critically analyse the issues and challenges in the rural society, business and economy.
4. Interpret the role and responsibilities of rural institutions and governance.
5. Apply rural development Planning and management.
6. Design, develop and implement rural centric policies and programmes.

Module:1	Rural Development	4 hours

Definition, Concept, Nature, Elements - Determinants of rural development - Need for rural development in India and components of rural development. Scope of rural development – approaches. Significance of rural development in Indian context.

Module:2	Historical Perspectives of Rural Development	6 hours

History of rural development in India. Pre-colonial and Post-Colonial rural development. Land reform - Green revolution - WTO regimes. MDGs – SDGs - Sustainable rural development.

Module:3	Rural Business	4 hours

Rural small business management - process of Management - meaning organizing - Leading, Co- ordinating, and controlling, Training Programmes for entrepreneurship development, Entrepreneurial motivation and motives for entrepreneurship, Guidelines for entrepreneurship programme.

Module:4	Rural Development Institutions	6 hours

Cooperative Institutions: Types and Working of Rural Cooperatives - Community Based Organizations: Watershed Committees - Village Forest Committees - Role of CBOs in Rural Development - Rural Banking and Credit: Types and sources of rural credit- Training Institutions NIRD & PR, NABARD, RRB, CAPART, FTCs, KVKs.

Module:5	Rural Governance	5 hours

Rural Governance: Panchayat raj - Meaning - Origin – Objectives – PRI's the Gram Panchayats and Power and Functions - Decentralized Governance and Women Empowerment, SHG, and Community Organization. Impact of Decentralized Governance on Rural Development.

Module:6	Issues and Challenges for Rural Development	8 hours

Education and Rural Development – Formal and Non-formal education- Educational facilities in rural areas - Rural Health care - Primary health care – Development of health care services in rural India-Rural Housing: Shelter as a basic requirement - Types of rural houses – Housing as social security – Dimensions of rural housing problems - Sources of Drinking Water – National water Policy, Water Rights: Excess and underutilization of water. Access to

sanitation: Sanitation and environment sanitation. Technology and Innovation in Rural Development. Involvement of youth in Rural Development.		
Module:7	**Rural Development Programs and Policies**	**10 hours**
Rural Development during the Five-year plan period. Major RD Programs in India - CDP, IRDP, MGNREGS, PMAY (IAY), NRLM, TRYSEM - Success and Failures. Rural DevelopmentPolicies: Need for Rural Development policies - Rural Development Legislations and Policies in India - National Forest Policy - National Water Policy - Land Reforms Policy - Agricultural Price Policy - Rural Credit Policy - National Agricultural Policy - National Policy in Cooperatives - National Policy for Farmers.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Tahir Hussain Mary Tahir and Riya Tahir (2020), Fundamentals of Rural Development, Dreamtec Press.
2.	Abdul Azeez NP and S. M. Jawed Akhtar (2016), Rural Development in India: Policiesand Programmes, Kalpaz Publications.
3.	Katar Singh, Anil Shishodia (2019), Rural Development Principles, Policies and Management, 4th Edition, SAGE Publications.
Reference Books	
1.	Krishna Prasada Rao and Suresh Vadranam (2020), Dynamics of sustainable Rural Development: Issues and trends, Raj Publications.
2.	Sujit Kumar Paul (2015), Rural Development: Concept and Recent Approaches, Concept Publishing Company.
3.	Willem Van Eekelen (2020), Rural Development in Practice Evolving Challenges and Opportunities, Routledge Publisher.
4.	Journal of Rural Development, NIRDPR, Hyderabad.
5.	Journal of Economic and Political Weekly.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM203L	Introduction to Psychology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To describe the nature of human behaviour and mental functions
2. To provide knowledge of the concepts of the psychological processes
3. To apply the psychological principles for understanding human behavior

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe the basic concepts of Psychology.
2. Understand the knowledge of the processes of sensation and perception.
3. Acquire an in-depth knowledge of learning, memory, forgetting and decision making.
4. Analyze the importance of motivation and emotions.
5. Apply the theoretical foundations to describe human personality and intelligence.
6. Develop and implement the resilience strategies to promote mental health.

Module:1	Foundations of Psychology	6 hours

Nature of psychology - Neurobiological approach - Behavioural approach - Cognitive approach - Psychoanalytic approach - Humanistic approach - The broad province of contemporarypsychology - Methods of psychology.

Module:2	Sensation and Perception	6 hours

General characteristics of sensation: Absolute thresholds - Difference thresholds – Object perception and perceptual constancies - Organization and perception - Movement perception- Depth perception - Visual coding and pattern recognition - Extra sensory perception.

Module:3	Learning, Memory and Forgetting	6 hours

Classical conditioning - Operant conditioning - Multiple response learning - Cognitive learning – Application of learning theories in organizational setting - Kinds of remembering – Retrieval processes - Nature of forgetting - Improving memory.

Module:4	Motivation and Emotion	6 hours

Physiological bases of motivation: Hunger – Obesity - Thirst - Theories of motivation - Physiological responses in emotion - Theories of emotion - Emotional expression.

Module:5	Personality and Intelligence	6 hours

Social learning approach - Rogers' approach - Self-esteem - Self-regulation - Self-presentation - Assessment of personality - Guilford's model of intelligence - Gardner's theory of multiple intelligence -Test of personality and intelligence related to placement context - Genetic basis and extremes of intelligence - Emotional intelligence.

Module:6	Conflict and Adjustment	6 hours

Understanding conflict - Frustration - Reaction to frustration - Defense Mechanisms - Adjustment - Coping with mal-adjustment.

Module:7	Mental Health	7 hours

Abnormal behaviour - Kinds of stressors - Coping with stress - Anxiety disorders – Depressive disorder – Factors affecting mental health - Enhancing mental health.

Module:8	Contemporary Issues	2 hours

	Total Lecture Hours		**45 hours**
Text Book(s)			
1.	Hilgard, E. R., Atkinson, R. C., & Atkinson, R. L., (2017), Introduction to Psychology,16th Edition, Oxford and IBH.		
Reference Books			
1.	Feldman, S. R., (2021), Understanding Psychology, 15th Edition, McGraw Hill Education.		
2.	Myers, D.G., (2018), Psychology, 12th Edition, Worth Publishers.		
3.	Plotnik, R., & Kouyoumdjian, H., (2018), Introduction to Psychology, 10th Edition, Cengage		
4.	Weiten W. Dunn D. & Hammer E. Y. (2017), Psychology Applied to Modern Life: Adjustment in the 21st Century, 12th Edition, Cengage Learning.		
5.	Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J., (2014), Introduction to Psychology, 7th Edition, McGraw Hill Education.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM204L	Industrial Psychology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the nature, scope and applications of the industrial psychology
2. To Acquire knowledge of the employment selection and appraisal process consideringworkplace wellbeing
3. To be able to take role of employees and managers

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe the utility and research methods used in the Industrial Psychology.
2. Acquire practical knowledge of training and performance evaluation.
3. Understand workplace assessment tools and techniques.
4. Enhance leadership skills and team building.
5. Appraise the issues of equity and inclusion at work place.
6. Analyse and address stress and well-being related issues.

Module:1	Introduction to Industrial Psychology	8 hours

Industrial Psychology-definition – Major Fields - Brief History - Employment of Industrial Psychologists **-** Research Methods – Importance of Research -Process - Statistics, Job Analysis &Job Evaluation.

Module:2	Evaluating the Quality of Performance Measures	7 hours

Total Quality Management – Importance - Identifying Criteria & Validating Tests and Measures, Screening Methods - Intensive Methods.

Module:3	Employees Performance and Evaluation	5 hours

Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.

Module:4	Organisational Fairness and Diversity Management	6 hours

Employee Motivation, Psychological contracting - Satisfaction and Commitment, Diversity, Fairness and Inclusion -Work place Harassment and Vishakha Guidelines.

Module:5	Leadership and Organisational Development	6 hours

Leadership – Styles and Skills, Organizational Climate and Culture, Organizational Development – Factors contributing to organizational development, Current work paradigm.

Module:6	Group Behaviour and Team	6 hours

Group Behaviour: Group dynamic – work dynamic, Teams in Organizations, conflict management – Negotiation and persuasion - The Organization of Work Behaviour.

Module:7	Stress and Well-being	5 hours

Understanding Stress: Types, Sources of stress and demands of life and work, Managing Burnout, Building Resilience and Enhancing well-being at work.

Module:8	Contemporary Issues	2 hours
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Aamodt M. (2016), Industrial/Organizational Psychology: An Applied Approach, 8th Edition, Wadsworth Publishing Co.

Reference Books

1.	Frank J. Landy & Jeffrey M. Conte (2016), Work in the 21st Century: An Introduction to Industrial and Organizational Psychology, 5th Edition, John Wiley & Sons Inc
2.	Paul E. Levy (2017), Industrial/Organizational Psychology: Understanding the Workplace, 5th Edition, Worth Publishers.
3.	Satoris S. Culbertson & Paul M. Muchinsky (2022), Psychology Applied to Work, 13th Edition, Hypergraphic Pr
4.	Ronald E. Riggio (2017), Introduction to Industrial and Organizational Psychology, 6th Edition, Pearson.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM205L	Development Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide students with essential tools and concepts of development economics
2. To equip students to critically evaluate different economic development models
3. To provide students with an understanding of what helps development succeed

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe the central themes and issues of economic development.
2. Differentiate between economic growth and development, major theories and theirmeasurement.
3. Illustrate the significance of agriculture in developing countries, along with poverty andpopulation related issues.
4. Assess the functions of international trade and the importance of foreign aid.
5. Analyse empirical evidence in the pattern of economic development.
6. Develop an understanding of the ongoing sustainable development agenda and its relevance.

Module:1	Development Indicators and Issues	7 hours

The concept of development - Indicators and Issues - Seven dimensions of development - Income, income growth and the Convergence Club - Poverty and hunger - Inequality and inequity - Vulnerability to Poverty - Basic needs: Human Development - Sustainability in the use of natural resources - Quality of life.

Module:2	Impact of Development Policies and Programs	6 hours

Objectives and overview of impact evaluation - methods of impact evaluation - Experimental design - Randomized Controlled Trials (RCTs) - Matching method to construct control groups: propensity score matching - Difference-in-difference method - Regression discontinuity designs - Event analysis and event - severity analysis - Instrumental variable estimation - Qualitative Methods.

Module:3	Inequality, Inequity, Poverty and Vulnerability Analysis	6 hours

Describing and measuring inequality - Decomposing inequality - Pro-poor growth and the growth incidence curve - The growth-inequality-poverty development triangle - Equity and development -inclusive growth - Characterize welfare: choice of an indicator of wellbeing - Poverty profile and aggregate indicators - Vulnerability - Other aspects of poverty - Correlates of poverty – poverty maps - behavioral poverty traps - Reducing poverty.

Module:4	International Trade and Industrialisation Strategies	5 hours

Trade openness - Gains from trade - Absolute, comparative and competitive advantage - Tradepolicy and indicators of protection - Tariffs and subsidies - Trade and the environment – Trade and food security - WTO and Multilateralism - Exchange trade Policies - regimes.

Module:5	Economic Growth and Human Capital	7 hours

Growth puzzle - Generic modelling of income growth - Harrod-Domar model - Solow model -Endogenous growth model - Education and Health - Education and Growth - Determinants of levels of Schooling - Estimating the returns to Education - Impact of Health on development.

Module:6	Agriculture, Labour, Migration and Population	5 hours

The state of world agriculture - Determinants of agricultural growth - food security in developing countries - Role of subsidies – European Union common agricultural policy - The economics of farm households - Farm household behaviour models - Responses to market signals - Labour and employment - Rural-urban migration - Demography - concepts - Some data for world Population - Cause of Population growth - Population Policy.		
Module:7	**Sustainable Development and Environment**	**7 hours**
Sustainable development goals - Links between development, Resource conservation, and environmental sustainability - negative externalities - Public goods - Economics of Common Property Rights (CPR) - Discounting: Private Vs Social and Exponential Vs Hyperbolic - the sustainability objective - Dilemmas in environment - development relation - Introducing new markets: payments for environmental services.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book (s)	
1.	Alain de Janvry and Elisabeth Sadoulet (2021), Development Economics: Theory andPractice. Second Edition, Routledge.
2.	H.L. Ahuja (2016), Development Economics - A Critical Study of Economic Growth, Development and Environment, S. Chand Publishers, New Delhi.
Reference Books	
1.	A.P. Thirlwall and Penelope Pacheco - Lopez (2017), Development Economics: Theory and Evidence. Tenth Edition, Springer Nature Limited.
2.	J. Edward Taylor and Travis J. Lybbert (2015), Essentials of Development Economics. Second Edition, University of California Press, California, USA.
3.	Gerard Roland (2014), Development Economics, Routledge, USA.
4.	Claudia Sunna and Davide Gualerzi (2016), Development Economics in the Twenty-FirstCentury, Routledge.
5.	Robert J.Barro, Xavier Sala I Martein (2003), Economic Growth, MIT Press, Cambridge, London.

Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No.69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM206L	International Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand trade related concepts and their applications in international trade
2. To understand the importance and role of foreign capital and foreign exchange for the economicdevelopment of the nations
3. To understand the nature of trade related issues and its solutions

Course Outcomes

Upon successful completion of the course students will be able to

1. Comprehend the concepts of international economics through the nature of trade issues and theimportance of international cooperation.
2. Assess the importance of international trade and its contribution to economic development andgrowth.
3. Ascertain the basics of international trade theories and the role of factor movement at the globallevel.
4. Examine the essence of foreign capital flow, foreign exchange reserve and the method ofexchange rate determination.
5. Review trade policies for trade promotion and trade restriction.
6. Analyse the importance and impact of balance of trade and balance of payment in the nationaleconomy.

Module:1	Trade and Economy	4 hours

Introduction to International Economics – Subject matter - Internal trade and International Trade – Current International Economic problems and challenges – Categories of Economies - Global Economic Integration – New Economic Policy.

Module:2	International Trade and Economic Development	5 hours

Introduction – Importance of trade and development – Terms of trade and economic development – trade problems and economic development – Foreign debt and economic development – Export instability and economic development.

Module:3	Theories of Trade	4 hours

Comparative cost theory – Hicksion theory of trade - Factor endowment theory – International factor movement - gains from trade.

Module:4	Trade Policies and Regional Co-operation	6 hours

Trade promotion: export promotion, Export subsidies, and Custom union – Export Oriented Units (EOU) – Special Economic Zones (SEZ) - Trade restriction: Tariff and Quota – Effects of Tariff and Quota - Import substitution – Dumping – World Trade Organization (WTO) - Regional economic co-operation (ASEAN, NAFTA, EU, and SAARC).

Module:5	Capital Flow	9 hours

Foreign capital – Foreign Direct Investment (FDI) - FDI policy in India - FDI Cap-reforms – initiatives - Foreign Investment Promotion Board (FIPB) and Foreign Portfolio Investment (FPI) – FDI in retailing – world investment reports, IMF reports - International Financial Institutions – (World Bank, UNCTAD, International Monetary Fund, Asian Development Bank) – Financial crisis.

Module:6	Foreign Exchange	9 hours

Foreign exchange market: Meaning, functions – risks - IMF classification of exchange rate – IMF AREAER Report - Rate of exchange: Determination – Effects – Fixed, Flexible and Floating exchange rate - exchange rate models – Foreign exchange reserve - exchange rate risk (case studies of Indian IT industries) - risk management – Currency Crises - Currency Wars.		
Module:7	**Balance of Payment**	**6 hours**
Balance of trade – meaning - favorable and unfavorable - Balance of payment – meaning – favorable and unfavorable – current account and capital account – Disequilibrium in balance of payment – measures to correct disequilibrium.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Paul R. Krugman, Maurice Obstfeld and Marc J. Melitz (2017), International Economics.11th Edition, Pearson Education.
2. Francis Cherunilam (2020), International Economics. 6th Edition, Tata MC Graw HillCompanies, New Delhi.

Reference Books

1. Dominick Salvatore (2021), International Economics. 13th Edition, John. Wiley and Sons, Inc.
2. Hendrik Van Den Berg (2016), International Economics. 3rd Edition, Taylor & Francis.
3. James Rickards (2012), Currency Wars: The Making of the Next Global Crisis, Penguin Books.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.

Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM207L	Engineering Economics	3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. To introduce the basic concepts of economics in engineering decision making, theories and tools of economics in engineering applications
2. To analyze cost and revenue data and carry out economic analysis to justify or rejectalternatives and projects based on an economic perception
3. To analyze the risk and project uncertainty and to provide guidance to use the appropriateapproach to handle the project uncertainty

Course Outcomes

Upon successful completion of the course students will be able to

1. Comprehend the basic principles of engineering economics.
2. Evaluate the methods of cost estimation and forecast the present and future values of cashflows.
3. Identify project appraisal techniques and evaluate the key factor of the project which definesthe viability of a project proposal.
4. Determine the depreciation and understand the tax impact while calculating depreciation.
5. Identifying, analyse and manage various types of risk.
6. Make decisions on investing funds in the most appropriate and efficient projects.

Module:1	Overview of Engineering Economics	4 hours

The Principles of Engineering Economics – Engineering Economics and the Design Process –Engineering Economic Analysis.

Module:2	Cost Concepts and Cost Estimation Techniques	6 hours

Cost Concepts - Cost terminology - The General Economic Environment - Cost-Driven Optimisation. Cost Estimation Techniques – An Integrated Approach - Selected EstimatingTechniques (Models) and Parametric Cost Estimating.

Module:3	The Time Value of Money	8 hours

Simple Interest - Compound Interest - The concept of Equivalence. Cash flows – Relating present and future equivalent values of single Cash Flows - Relating a uniform series (Annuity) to its present and future equivalent values – Deferred Annuities – Equivalence calculations involving multiple interest formulas – uniform (Arithmetic) Gradient of cash flow – Geometric sequences of cash flow – Interest rates that varies with time - Nominal and effective interest rate – compounding more often than once per year – continuous compounding and discrete cash flow.

Module:4	Project Estimation and Evaluation Techniques	8 hours

Determining the minimum attractive rate of interest (MARR) – The present worth method – The future worth method - The annual worth method - The internal rate of return method - The external rate of return method and payback (payout) period method. Evaluation of Alternatives – comparison and selection among alternatives - Techniques of Evaluation. Cost-Benefit Analysis – Perspective and terminology for analysing public projects and evaluating independent projects.

Module:5	Depreciation and Income Taxes	6 hours

Depreciation concepts and terminology - The classical depreciation methods – The modified accelerated cost recovery system – Income taxes – The effective corporate income rate – Gain (loss) on the disposal of an asset – General procedure for making After-tax economic analysis and Economic value added.

Module:6	**Project Risk Analysis**	**5 hours**
Breakeven analysis – Sensitivity analysis – Multiple factor sensitivity analysis. Probabilistic risk analysis – Sources of uncertainty – Distribution of random variables – Evaluation of projects – Discrete random variables and Continuous random variables - Evaluation of risk and Uncertainty by Monte Carlo Simulation.		
Module:7	**The Capital Budgeting Process and Decision Making**	**6 hours**
Debt Capital – Equity capital – The weighted average cost of capital (WACC) – Project selection – Budgeting of Capital Investments and Management Perspective – Leasing decision and Capital allocation. Multi-attributes – Choices of attributes, Selection of a measurement scale, and Dimensionality of the problem – Compensatory and Non-compensatory models.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book (s)	
1.	Sullivan G William, Elin M Wicks and C. Patrick Koelling (2018), Engineering Economy.Pearson Education, 17th Edition.
Reference Books	
1.	Blank, Leland and Anthony Tarquin (2017), Engineering Economy. Tata Mc Graw Hill, 8th Edition.
2.	Chan S.Park (2019), Fundamentals of Engineering Economics. Pearsons Education, 4th Edition.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM208L	Economics of Strategy	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To create awareness about the importance of strategic thinking among students
2. To understand the need for being competitive in all aspects of business
3. To familiarize the students with modern industrial organization with business strategyperspective

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe and apply elasticity of demand.
2. Apply the Economies of scale and scope concepts.
3. Interpret and apply the vertical integration concepts.
4. Explain and apply diversification.
5. Analyze and explain the market structures.
6. Critically evaluate entry and exit decisions.

Module:1	**Economic Concepts For Strategy**	**7 hours**

Demand, Elasticity and Revenue, Total Revenue and Marginal Revenue, Costs and Cost Functions - Fixed and Variable Costs, Theory of the firm, Game Theory - Normal and Extensive Games,Economic Costs and Profitability.

Module:2	**Production and Cost Behavior**	**6 hours**

Economies and Diseconomies of Scale and Economies of Scope – Sources, Indivisibilities, and the Spreading of Fixed Costs, The Learning Curve, Learning and Organization

Module:3	**The Economics of Transaction Costs**	**6 hours**

The Vertical Boundaries of Firm, Make Vs Buy Decisions, Contracts, Transactions Cost, Asset Specificity, Rents and Quasi-Rents, The Holdup Problem.

Module:4	**Diversification**	**6 hours**

Diversification - Reasons for Diversification, Costs of Diversification, Performance of Diversified Firms, Mergers and Acquisition- Benefits.

Module:5	**Market Structure**	**6 hours**

Market Structure and Competition, Measuring Market Structure, Monopoly, Monopolistic and Oligopoly Market Structures - Cournot and Bertrand Models, Market Structure and Performance

Module:6	**Industry Analysis**	**6 hours**

Five - Forces Analysis - Application of Five - Forces, Entry and Exit Decisions, Barriers to Entry, Entry - Deterring Strategies, Exit- Promoting Strategies.

Module:7	**Strategic Positioning**	**6 hours**

Competitive Advantage and Value Creation - Value Creation Vs Value Redistribution, Cost and Benefit Advantage, Broad Coverage versus Focus Strategy.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. David Dranove, David Besanko, Mark Shanley and Scott Schaeffer (2017), Economics of Strategy. Wiley, 7th Edition.

Reference Books			
1.	Paul Belleflamme and Martin Peitz (2015), Industrial Organization: Markets and Strategies.Cambridge University Press, 2nd Edition.		
2.	Don E Waldman and Elizabeth J Jensen (2019) Industrial Organization: Theory and Practice.Routledge, 5th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM209L	Game Theory	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide game theory fundamentals so as to apply the same in their professional life
2. To make the students understand the strategic interactions between players using game theory
3. To provide tools of game theory to apply in different decision making situations

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe and apply knowledge of strategic games with perfect information.
2. Identify Nash equilibrium in games.
3. Describe mixed strategy games.
4. Analyze extensive games with perfect information.
5. Describe extensive games with imperfect information.
6. Apply bargaining in Game theory setting.

Module:1	**Games with Perfect Information**	**5 hours**
Strategic Games and Examples. Nash Equilibrium, Strict and Nonstrict Nash Equilibria, Best Response Functions, Dominated Actions - Strict and Weak Domination, Symmetric Games.		
Module:2	**Nash Equilibrium**	**6 hours**
Cournot's Model of Oligopoly - Bertrand's Model of Oligopoly, Electoral Competition, Median Voter Theorem and Auctions.		
Module:3	**Mixed Strategy Equilibrium**	**5 hours**
Randomization and Expected Payoffs, Mixed Strategy Nash Equilibrium and Properties, Dominated Actions – Strict and Weak Domination.		
Module:4	**Extensive Games with Perfect Information**	**7 hours**
Strategies and Outcomes, Nash Equilibrium, Subgame Perfect Equilibrium, Backward Induction, The Ultimatum game, The Holdup game and Stackelberg's Model of duopoly, Properties of Subgame perfect equilibrium.		
Module:5	**Extensive Games with Imperfect Information**	**6 hours**
Strategies and Nash Equilibrium, Beliefs and Sequential equilibrium, Sequential Rationality, Signaling Games, Separating and Pooling Equilibrium.		
Module:6	**Repeated Games**	**7 hours**
Finitely and Infinitely Repeated Prisoner's dilemma, Grim Trigger and Tit-for-tat Strategies, Nash Equilibria of General Infinitely Repeated Games, Finitely Repeated Games.		
Module:7	**Bargaining**	**7 hours**
Bargaining as an Extensive Game, Nash's axiomatic Model, Bargaining Solution, Pareto Efficiency and Symmetry, Nash Bargaining Solution.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book (s)

1. Avinash Dixit, Susan Skeath and David McAdams (2020), Games of Strategy. W.W.Nortonand Co, Fifth Edition.

2.	Bernhard Von Stengel (2021), Game Theory Basics. Cambridge University Press, 1st Edition.		
Reference Books			
1.	Drew Fudenberg and Jean Tirole (1991), Game Theory. MIT Press, 1st Edition.		
2.	Osborne, Martin J (2012), An Introduction to Game Theory. Oxford University Press, 1stEdition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM210E	Econometrics	2	0	2	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the basic concepts of econometrics
2. To familiarize the students with econometrics methodology
3. To use appropriate econometrics tools based on data sets

Course Outcomes

Upon successful completion of the course students will be able to

1. Analyse economic data based on a broad knowledge of the linear regression model.
2. Apply the multiple regression model and test hypothesis.
3. Examine the use of dummy variables in regression model.
4. Explain the violations of OLS assumptions, such as multicollinearity, heteroscedasticity, andauto correlation.
5. Analyse and assess empirical results and econometric findings.
6. Design, develop and execute various time series models.

Module:1	Inferential Statistics	3 hours

Normal distribution, chi-square, t - and F- distributions - Estimation of parameters - Testing of hypotheses - Defining statistical hypotheses - Distributions of test statistics - Testing hypotheses related to population parameters - Type-I and Type-II errors; Power of a test - Tests for comparingparameters from two samples.

Module:2	The Nature and Scope of Econometrics	3 hours

Introduction to Econometrics – Methodology of Econometrics – Types of Data: Parametric and Non-Parametric test and Sources of Data – Population Regression Function and SampleRegression Function – Significance of error term.

Module:3	Simple Linear Regression Model: Two Variable Case	3 hours

Estimation of model by method of ordinary least squares - Properties of estimators – Gauss Markov Theorem (BLUE) - Goodness of Fit - Testing of Hypothesis - Scaling and units of measurement - Confidence Intervals - Forecasting.

Module:4	Multiple Regression Analysis	5 hours

Estimation of parameters - Properties of OLS estimators - Goodness of fit- R^2 and Adjusted R^2 – Partial regression coefficients - Testing Hypotheses: Individual and Joint - Functional Forms of RegressionModels.

Module:5	Dummy Variables in Regression Models	4 hours

Exogenous Dummy Variable - Formulating and interpreting coefficients on dummy explanatory variables, interactions involving dummy variables and the use of dummy variables in seasonal analysis, piece wise regression analysis, the dummy variable alternative to chow test.

Module:6	Violation of Classical Assumptions	4 hours

Multicollinearity – autocorrelation – heteroscedasticity – problems – causes – consequences remedial measures – model specification and diagnostic testing.

Module:7	Time Series Analysis and Forecasting Models	6 hours

Stationarity Vs. Non - Stationarity – Unit root Stochastic Process – Tests of Stationarity - The Unit Root Test - Transforming Non-stationary Time Series – Cointegration and Error Correction Mechanism (ECM) - ARIMA model – The Box Jenkins Methodology – Vector Auto regression (VAR) Estimation.				
Module:8	**Contemporary Issues**			**2 hours**
	Total Lecture Hours			**30 hours**
Text Book(s)				
1.	Damodar. N. Gujarati and Sangeetha (2021), Basic Econometrics. 6th Edition, Tata McGraw-Hill.			
2.	Christopher Dougherty (2016), Introduction to Econometrics. 5th Edition, Oxford UniversityPress.			
Reference Books				
1.	Jeffrey M.Wooldridge (2019), Introductory Econometrics: A Modern Approach, 7th Edition,Cengage Learning.			
2.	G.S. Maddala and Kajal Lahiri (2012), Introduction to Econometrics, 3rd Edition, Pearson.			
3.	Greene, W. (2018), Econometric Analysis, 8th Edition, Pearson.			
4.	Chris Brooks (2014), Introductory Econometrics for Finance. 3rd Edition, CambridgeUniversity Press.			
Indicative Experiments				**Hours**
1.	Statistical Inferences			**2 hours**
2.	The Classical Linear Regression Model			**4 hours**
3.	Multiple Regression Analysis			**4 hours**
4.	Functional Forms of Regression Models			**4 hours**
5.	Dummy (Binary) Variables			**4 hours**
6.	Testing for Violation of Classical Assumptions			**4 hours**
7.	Tests of specification errors (Ramsay Test)			**2 hours**
8.	Time Series Modelling			**6 hours**
	Total Laboratory Hours			**30 hours**
Mode of Evaluation: CAT, Quiz, Assignment and FAT.				
Recommended by Board of Studies	23-02-2023			
Approved by Academic Council	No. 69	Date	16-03-2023	

Course Code	Course Title	L	T	P	C
BHUM211L	Behavioral Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To impart knowledge on current ideas and concepts regarding decision making in Economics,Particularly from a behavioral science perspective.
2. The course will explore key departures and the consequences of behavior of firms, householdsand other economics entities
3. To provide an overview of how behavioral principles have been applied to economic problems.

Course Outcomes

Upon successful completion of the course students will be able to

1. Identify and evaluate evidence for systematic departures of economic behavior from thetraditional economic models.
2. Predictions of the neoclassical model, and psychological explanations for these anomalies.
3. Incorporate psychologically motivated assumptions into economic models, and interpret theimplications of these assumptions.
4. Explain how these models change the predictions for equilibrium behavior and welfare analysis,and assess the implications for optimal policy.
5. Compare the predictions of neoclassical and behavioral models, and evaluate the best methodfor approaching a given topic.
6. Apply Behavioral principles in economic problems.

Module:1	Introduction	6 hours

The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and inbehavioral economics; applications gains and losses, money illusion, charitable donation.

Module:2	Basics of Choice Theory	6 hours

Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis consumption and addiction, environmental protection, retail therapy; applications pricing, valuation, public goods, choice anomalies.

Module:3	Beliefs, Heuristics and Biases	6 hours

Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self-projection; inconsistent and biased beliefs; probability estimation; trading applications trade in counterfeit goods, financial trading behavior, trade in memorabilia.

Module:4	Choice under Uncertainty	6 hours

Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications ownership and trade, income and consumption, performance in sports.

Module:5	**Intertemporal Choice**	**6 hours**
Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis mobile calls, credit cards, organization of government; applications consumption and savings, clubs and membership, consumption planning.		
Module:6	**Game and Strategy Behavior**	**6 hours**
Review of game theory and Nash equilibrium strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signaling, learning; applications competitive sports, bargaining and negotiation, monopoly and market entry.		
Module:7	**Social Preference**	**7 hours**
Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion; policy analysis norms and markets, labor markets, market clearing, public goods; applications logic and knowledge, voluntary contribution, compensation design.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	N.Wilkinson and M.Klaes (2017), An Introduction to Behavioral Economics", 3rd Edition, Red Globe Press.
Reference Books	
1.	Bazerman, Max and Don Moore (2012), Judgment in Managerial Decision Making, 8th Edition, John Wiley & Sons.
2.	Kahneman, Daniel (2011), Thinking, Fast and Slow, New York: Farrar, Straus and Giroux.
Mode of Evaluation: CAT /Quiz / Assignment / FAT.	

Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM212L	Mathematics for Economic Analysis	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide basic mathematical tools and techniques to solve the problems that arise fromEconomics
2. To develop skills in Mathematical Modelling
3. To demonstrate the use of Mathematics in understanding theoretical Economics

Course Outcomes

Upon successful completion of the course students will be able to

1. Demonstrate the use of tools of differentiation in solving the economic problems.
2. Apply mathematical techniques to economic theory.
3. Describe economic problems in mathematical terms.
4. Implement methods from calculus to find the optimal location and value (maximum/minimum)of a mathematical function.
5. Explain the constrained optimization techniques in economic models and apply them toeconomic problems.
6. Apply the optimization techniques to economic problems.

Module:1	Economic Models and Functions	6 hours

Equations and Identities, The Real Number System, The Concept of Sets, Functions – Types. Graphs of Functions, Types of Functions; Linear, Quadratic, Polynomial, Power, Exponential and Logarithmic functions – Limits and continuity. Economic Applications - Demand, Cost and Revenue functions.

Module:2	Unconstrained Optimization	5 hours

Slopes of Curves, Simple Rules of Differentiation, Second and Higher order derivatives, Maxima and Minima, Convex and Concave functions. Economic Applications – Marginal Revenue, Marginal Propensity to Consume.

Module:3	Derivatives and Optimization	5 hours

The Chain Rule, Partial Elasticities, Homogeneous and Homothetic functions and Systems of Equations. Economic Applications – Macroeconomic Models.

Module:4	Multi Variable Optimization	7 hours

Functions of Several Variables, Geometric representation of functions of several variables, Partial derivatives, Higher order partial derivatives. Economic Applications - Marginal Product of Labour and Capital.

Module:5	Constrained Optimization	6 hours

The Lagrange Multiplier method, Economic Interpretations of Lagrange Multipliers, Linear Programming Problems - Kuhn-Tucker Method, Kuhn- Tucker Sufficiency Theorem, Arrow - Enthoven Sufficiency Theorem. Economic Applications – Utility Maximization with Constraints.

Module:6	Integration, Differential and Difference Equations	6 hours

Definite and Indefinite Integrals and Economic Applications, First order and Second order Difference equations, First order and second order differential equations. Economic Applications- Income Distribution.

Module:7	Matrix and Vector Algebra	8 hours

Systems of Linear Equations – Matrices and Matrix Operations – Matrix

Multiplication – The Transpose – Vectors – Determinants and Inverse of a Matrix – The Leontief Model. Linear Programming – Graphical Approach – The Duality Theorem – Matrix Formulation.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Books	
1.	Knut Sydsaeter, Peter Hammond, Arne Strom and Andres Carvajal (2021), Essential Mathematics for Economic Analysis. Pearson, Sixth Edition.
Reference Books	
1.	Chiang, Alpha C and Kevin Wainwright (2017), Fundamental Methods of Mathematical Economics. McGraw Hill Education, 4th Edition.
2.	Simon C P and Lawrence Blume (2018), Mathematics for Economists, Viva Norton Student Edition.
3.	Dowling, Edward T (2011), Shaum's Outline Series on Introduction to Mathematical Economics. McGraw Hill, 3rd Edition.

Mode of Evaluation : CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM213L	Corporate Social Responsibility	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the need and importance of Corporate Social Responsibility and Ethics
2. To familiarise with CSR Legislations and Responsibilities
3. To identify the role of NGOs in CSR

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe the concepts of Corporate Social Responsibility.
2. Explain and Clarify the Legal provisions of Corporate Social Responsibility.
3. Identify the role of different stakeholders of CSR and effective implementation.
4. Analyse CSR Strategy and its implementation.
5. Carry out CSR need and impact study.
6. Design, develop and implement CSR strategy and policies.

Module:1	Corporate Social Responsibility	6 hours

Definition, evolution, essentials of CSR, and arguments for CSR. The driving forces of CSR: inequality within countries and inequality among countries, sustainability, globalization, and communication- mobile and social media. Brands with attitude.

Module:2	Stakeholder Theory	5 hours

Definition. Stakeholder categorization: organizational and economic and societal stakeholders. Evolving issues. Model of stakeholder management, stakeholder engagement. Case Study – Capitalism; The rise of Socialism.

Module:3	CSR Behavioural Perspective	5 hours

Markets: Shareholders as market makers. Profit: economic value and social value. Profit optimization, production value and consumption value, social progress, the next billion, case study – Unilever.

Module:4	CSR Strategy & Implementation	7 hours

Vision, mission, strategy and tactics. Strategic analysis - Resource perspective and industry perspective. Integrating CSR, strategy formulation and CSR implementation. Strategic CSR is not an option – Not philanthropy, not caring capitalism and not sharing value. Strategic CSR is business. Case study - Starbucks.

Module:5	CSR Legal Provisions	6 hours

Clause 135 of Companies Act 2013. Schedule VII in Section 135 of Companies Act (2013), Companies (Corporate Social Responsibility) Rules 2014. CSR Policy Amendment Rules 2021 and 2022. CSR Committee, CSR Policy, Roles and Responsibilities of Board of Directors.

Module:6	Compliance and Accountability	7 hours

Voluntary Vs mandatory, Self-interest; behavioural economics; nudges. Accountability – defining CSR- measuring CSR. CSR reporting - standardizing CSR, certifying CSR and labelling CSR. Pricing CSR, Life cycle pricing. Case study – Socially responsible investing. Impact investing.

Module:7	Sustainable Development and Business	7 hours

UN Sustainable Development Goals, Sustainability in practice – climate change, resilience and natural capital. Waste: E-waste and plastic. Beyond sustainability. Sustainable value creation – values, morals and business ethics. Conscious capitalism and Value based business.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Chandler. D. (2022), Strategic Corporate Responsibility: Sustainable Value Creation, 6th Edition, North America: Sage Publication Inc.
2.	Kadakia, R.S. (2022), Corporate Social Responsibility: Law and Practice. Delhi: Taxman.
Reference Books	
1.	Mitra. N. and Schmidpeter, R. (2017), Corporate Social Responsibility in India: Cases and Development After the Legal Mandate. Springer Link.
2.	Confederation of Indian Industry (2013), Handbook on Corporate Social Responsibility in India. Delhi: PricewaterhouseCoopers Private Limited (PwCPL).
3.	Kotler.P. & Lee, N. R. (2005), Corporate Social Responsibility: Doing the Most Good for Your Company and Cause. New Jersey: John Wiley & Sons.
4.	Hohnen. P (2007), Corporate Social Responsibility: An implementation guide for business, Potts. J (Ed). Winnipeg, Manitoba, Canada: International Institute for Sustainable Development(IISD's).

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM214L	Political Science	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To describe the salient features of Indian politics
2. To understand political phenomena, and to explore their ethical and normative dimensions
3. To identify and reflect on the major issues confronting politics

Course Outcomes

Upon successful completion of the course students will be able to

1. Develop basic understanding of the Constitution.
2. Examine the working of the political system and institutions in India.
3. Understand different political theories and ideologies.
4. Critically analyze the issues and concerns of political life surrounding them.
5. Analyse the challenges for contemporary India.
6. Provide policy level solutions for the issue in world politics.

Module:1	**Indian Constitution at Work**	**5 hours**
Nation and State - Salient Features of the Constitution of India - Regimes - Fundamental Rights.		
Module:2	**The Bases of Politics**	**6 hours**
Politics - Political Science - Political Theory - Political ideologies - Liberalism - Conservatism - Marxism - Nationalism - Totalitarianism.		
Module:3	**Political Attitudes**	**5 hours**
Political culture - Subculture - Political Socialization - Public Opinion - Opinion Polls.		
Module:4	**Political Interactions**	**6 hours**
Political Communication - the Mass Media and Politics - Social Media - Media and Government - Interest Groups.		
Module:5	**Parties – Elections**	**7 hours**
Parties - Parties in Democracies - Classification – Party systems - Elections – People Vote - Electoral System - Electoral Realignment - Democracy - Changing Positions.		
Module:6	**Political Institutions**	**8 hours**
Legislature - the origin of Parliament system - modern day politics. Executive and Bureaucracies - Presidents and Prime ministers - Executive Leadership - Cabinets - issues and challenges. Judiciaries - Types of Law - the Court - the Bench and the Bar - Common Law vs Code Law – role of Courts - Indian Judicial System.		
Module:7	**Political System Rule**	**6 hours**
Political Economy - Welfare of the state - the costs of Welfare - Poverty - the role of big governments - Violence and Revolution - International Relations - Power and National Interest - War and Peace - Foreign Policy.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1.	Michael G. Roskin, Robert L. Cord, James A. Medeiros and Walter S. Jones (2019), Political Science: An Introduction, 14th Edition, Pearson Education.
Reference Books	
1.	Basu, Durga Das (2022), Introduction to the Constitution of India, 26th Edition, Nagpur: Lexis Nexis Butterworths Wadhwa.
2.	M Laxmikanth (2021), Indian Polity, 6th Edition, McGraw Hill Education (India) Private Limited, Noida.
3.	O.P. Gauba (2019), An Introduction to Political Theory, 7th Edition, Mayur Paperbacks.
4.	Robert Garner, Peter Ferdinand and Stephanie Lawson (2023), Introduction to Politics, 5th Edition, OUP Oxford.
5.	Peter Ferdinand, Robert Garner and Stephanie Lawson (2018), Politics, Oxford University Press.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM215L	International Relations	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand India's bilateral relationships and its role in global economic, security andpolitical regimes
2. To analyse the issues and developments pertaining to India's foreign policy
3. To update the knowledge on contemporary issues and challenges at the global level

Course Outcomes

Upon successful completion of the course students will be able to

1. Trace the historical development of India's foreign policy.
2. Describe social, economic and political institutions (regional and global).
3. Critically evaluate the role of India as emerging super power.
4. Examine Sustainable Developmental goals of contemporary Indian society and the world.
5. Identify the opportunities and challenges between India and rest of the world.
6. Provide policy level solutions for the major challenges faced by India in the 21st century.

Module:1	**India's International Relations: A Historical Perspective**	**7 hours**

A Historical Perspective of diplomatic relations - Genesis of India's Foreign Policy – Objectives and Principles - Determinants - Internal and External Dimension - Non-Alignment: Concepts, Policy and Relevance - Evolution of India's Foreign Policy - Neo-Colonialism.

Module:2	**India and the Global Economic and Political Scenario**	**5 hours**

India and the United Nations: Security Council Reforms - India and World Trade Organization (WTO) -World Bank - IMF - G7 - G20.

Module:3	**Emerging India**	**5 hours**

Globalization- SWOT-Asian Century- India's Role in the World Today-Strategic Challenges.

Module:4	**India's Foreign Policy towards Neighboring Countries**	**5 hours**

Pakistan - Afghanistan - Sri Lanka - Bangladesh - Nepal - Bhutan - Maldives.

Module:5	**India's Policy towards Major Powers**	**6 hours**

USA - Russia - China - Japan - UK.

Module:6	**India's Multilateral Engagement**	**9 hours**

Association of South East Asian Nations (ASEAN) - South Asian Association for Regional Cooperation (SAARC) - East Asia Summit (EAS) - European Union (EU) - The African Union (AU) - BRICS - Shanghai Cooperation Organization - The Indian Ocean Rim Association (IORA) - The Asia-Pacific Economic Cooperation (APEC) - The North Atlantic
Treaty Organization (NATO).

Module:7	**India's Domestic and External Challenges**	**6 hours**

Poverty – Education – Health - Terrorism - Climate Change - Energy and Food Security.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1.	Peu Ghosh (2020), International Relations, PHI Learning; 5th Edition.			
Reference Books				
1.	Deepanshu Singh (2021), International Relations -Interests & Challenges, Disha Publication.			
2.	Aparna Pande (2020), From Chanakya to Modi: The Evolution of India's Foreign Policy New Delhi: Harper.			
3.	Alyssa Ayres (2018), Our Time Has Come: How India is Making Its Place in the World, Oxford University Press.			
4.	Arvind Gupta and Anil Wadhwa (2020), India's Foreign Policy: Surviving in a Turbulent World, SAGE Publications Pvt Ltd.			
5.	Adluri Subramanyam Raju and R. Srinivasan (ed.) (2023), The Routledge Handbook of South Asia: Region, Security and Connectivity, Routledge India.			
Mode of Evaluation: CAT, Quiz, Assignment and FAT				
Recommended by Board of Studies		22-02-2023		
Approved by Academic Council		No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM216L	Indian Culture and Heritage	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To enthuse the students to know more about India's rich traditions and culture
2. To inspire the students to appreciate and respect the History and Society through the Ages
3. To familiarize students on heritage sites and its history and importance

Course Outcomes

Upon successful completion of the course students will be able to

1. Illustrate the meaning of culture and heritage and the factors which contributed to themaking of our culture.
2. Examine the glory of Indian history.
3. Trace the evolution of Indian society over centuries.
4. Identify the development of our heritage and its features.
5. Explain the significance, conditions and development of ancient Indian science andtechnology.
6. Critically analyse the modernization of Indian culture from the past to the present and thefuture.

Module:1	Indian Culture	5 hours

Concept and meaning of Culture - Culture and Civilization - Culture and Heritage - Importance of Culture in Human life - Indian Culture - Characteristics of Indian Culture - Unity and Diversity - Aspects of Indian Culture - Cultural Identities - Significance of Geography on Indian Culture - Cultural influences.

Module:2	History, Society and Culture through the Ages	9 hours

Indus Valley Civilisation - Invasions and its impact on Indian culture - Ashoka the great - Legacy of Mauryans - Socio cultural development of Deccan and South India - Classical age of Gupta - Life of people under Delhi sultanate - Cultural development during Mughals - India in the 18th Century: Economy, Society and Culture - Origin and Evolution of Nationalist Movement.

Module:3	Indian Languages and Literature	4 hours

Evolution of script and languages in India: Harappan Script and Brahmi Script - Role of Sanskrit: Vedas, Upanishads, Epics and Puranas - Buddhist and Jain literature in Pali and Prakrit – Evolution of regional Languages and literature: Sangam literature, Urdu and Hindi - Role of Christian missionaries in the Indian languages and literature.

Module:4	Religion and Philosophy	6 hours

Vedic religion - Hinduism and branches - Jainism – Buddhism - Islam and Sufism - Sikhism - Bhakti movement - religious and social reform movements.

Module:5	Arts and Architecture	9 hours

Origin and Evolution of Paintings in India - Concept of Performing Arts - Indian classical music: Ancient and Modern Indian Music and Folk Music - Dances of India: Various Dance forms - Indian Sculpture - Art schools in ancient India - Architecture: Meaning, Form and Context, The Temple, Medieval Architecture of India and Colonial Architecture – World Heritage Sites.

Module:6	Science and Technology	6 hours

Development of Science in ancient India - Science and Technological developments inmedieval India - Science and Technology in Modern India - Scientists of Ancient India - Medical Science in Ancient India.		
Module:7	**Education in India**	**4 hours**
Education in Ancient Period - Education in Modern Period - Recent development in Education - New Education Policy.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Books	
1.	S.B. Singh (2019), Culture and Heritage in India, Sivani Book.
2.	Nitin Singhania (2021), Indian Art and Culture, McGraw Hill, 4th Edition.
3.	Poonam Dalal Dahiya (2017), Ancient and Medieval India, McGraw Hill Education.
Reference Books	
1.	Dr. S. Srikanta Sastri, Translated by S. Naganath (2021), Indian Culture, Notion Press.
2.	Binod Bihari Satpathy (2018) Indian culture and heritage, Catholic University of Santa Maria.
3.	Romila Thapar (2019), Cultural Pasts: Essays in Early Indian History, Oxford University Press.
4.	Indra Deva and Shrirama (2018), Society and Culture in India: Their Dynamics through the Ages, Rawat Publications.
5.	Devdutt Pattanaik (2021), Indian Culture, Art and Heritage, Pearson India.

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM217L	Contemporary India	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the process of making the Constitution and the Integration and Reorganizationof Indian States
2. To acquaint the students with the political developments in India after Independence
3. To comprehend the socio-economic changes and progress in India

Course Outcomes

Upon successful completion of the course students will be able to

1. Understand the reconstructive events of post-independence India.
2. Examine the socio-economic transformation and political realignments in India.
3. Describe the Political developments since 1991.
4. Analyse the factors responsible for Socio – Economic issues.
5. Critically asses the opportunities and challenges in the globalized environment.
6. Review the progress of recent developments in India towards policy development.

Module:1	Making of the Republic - The Constituent Assembly	6 hours

The Legacy of Colonialism and National Movement - Framing of Indian Constitution - Constituent Assembly - Draft Committee Report - declaration of Indian Constitution - Features of Indian Constitution.

Module:2	Challenges of Nation Building (1947 – 1964)	6 hours

India on the eve of Independence - Partition of India - Integration of Princely States - Internal and External policies of Nehru - Integration and Reorganization of Indian States - Socio- Economic Reforms - Planning Commission – Five year planning.

Module:3	Political, Social and Economic Developments (1964 – 1991)	5 hours

Political Developments after Nehru Era - Green Revolution - White Revolution – Blue Revolution - Abolition of Privy Purses and Titles - Nationalization of Banks - The Emergency - JanataGovernment; Return of Congress to power.

Module:4	Political, Social and Economic Reforms since 1991	8 hours

Political Developments - relations with neighboring countries - Liberalization, Privatization and Globalization - important economic achievements of Vajpayee - Economic growth under Manmohan Singh - Mahatma Gandhi National Rural Employment Guarantee Act - Economic Reforms and Policy Implementation under Modi - Make in India - Digital India - Atmanirbhar Bharat – Citizenship Amendment Act (CAA) - Confidence-building Measures in Kashmir – Post COVID-19 reality.

Module:5	Emerging Trends	6 hours

An Emerging Global Power - ISRO and Its Achievements - India and Its Digitalization - Indian Smart Cities - Science, Technology and Education - Healthcare - IT - Service Industry – Governance -Concept of Society 5.0.

Module:6	Socio-Cultural and Economic Issues	6 hours

Communalism and Separatist Movements - Unemployment and Income inequalities – Inflation - Child Labour - Poverty - Gender issues - Women safety.

Module:7	**Empowerment Programs**	**6 hours**
Entrepreneurship Programs - A brief mention of ongoing welfare schemes of the Central and State Governments for women, aged, youth - Women Empowerment and Policy of Reservation.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Bipan Chandra (2017), India Since Independence, Imprint: India Penguin.
2.	Deepak Singh (2022), India at 75 - History of Post-Independence India, Disha Publication.
Reference Books	
1.	Chinmaya Saxena, Smiti Saxena (2021), India Post Independence, Notion Press.
2.	Basu, Durga Das (2021), Introduction to the Constitution of India, 5th Edition, Nagpur: Lexis Nexis Butterworths Wadhwa.
3.	Ramachandra Guha (2017), India After Gandhi: The History of the World's Largest Democracy. New York: Ecco (Harper Collins).
4.	Neera Chandhoke and Praveen Priyadarshi (2009), Contemporary India: Economy, Society, Politics, Pearson Education India; First edition
5.	Sanjaya Baru (2022), Journey of a Nation: 75 years of Indian Economy, Rupa Publications India.
6.	L,O-Paul Dana and Naman Sharma and Satya Ranjan Acharya (eds.) (2021),Organising Entrepreneurship and MSMEs across India, World Scientific India.
7.	https://www.ibef.org/

Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies	22-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM218L	Financial Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To develop through understanding of the role of the financial manager
2. To learn financial decision making relates to Working Capital, Investment, Capital structure and Dividend.
3. To attain application level knowledge in financial decision making.

Course Outcomes

Upon successful completion of the Course the students will be able to

1. Understand role and functions of a Financial Manager
2. Assess the linkages between the economic environment and corporate.
3. Apply Working Capital Management techniques
4. Use various capital budgeting tools and techniques
5. Critically evaluate and implement different financial decisions.
6. Demonstrate professional level financial managerial skills.

Module:1	Financial Management – An Overview	4 hours

Finance and Related Disciplines; Scope of Financial Management; Objectives of Financial Management; Primary Objective of Corporate Management; Agency Problem; Organization of Finance Function; and Emerging Role of Finance Managers in India - Economic Environment and Businesses.

Module:2	Risk and Return of Portfolio	5 hours

Time Value of Money, Conceptual Framework of Risk and Return: Type of Risks; Risk and Return of a Single Asset; Risk and Return of Portfolio; Portfolio Selection; and Capital Asset Pricing Model (CAPM)

Module:3	Capital Budgeting Decision	7 hours

Capital budgeting process - Estimation of relevant cash flows – Payback Period method - Accounting Rate of Return - Net Present Value - Net Terminal Value - Internal Rate of Return - Profitability Index - Capital Budgeting Under Risk –Certainty Equivalent Approach and Risk Adjusted Discount Rate.

Module:4	Financing Decision	7 hours

Cost of Capital and Financing Decision - Estimation of Components of Cost of Capital: Equity Capital - Retained Earnings - Debt and Preference Capital –Weighted Average Cost of Capital and Marginal Cost of Capital - Sources of Long-Term Financing – Capital Structure - Operating and Financial Leverage - Determinants of Capital Structure.

Module:5	Working Capital Management	7 hours

Meaning and Nature of Working Capital - Determination of Working Capital Requirement - A Brief Overview of Cash Management, Inventory Management and Receivables Management.

Module:6	Dividend Decision	4 hours

Meaning – Types – Dividend Decision Policy – Factors Affecting Dividend Decisions - Dividend Decisions Theories.

Module:7	Business Valuations	9 hours

Nature and Purpose of the Valuation of Business and Financial Assets - Models for

the Valuation of Shares - Valuation of Debt and Other Financial Assets - Efficient Market Hypothesis (EMH) and Practical Considerations in the Valuation of Shares.		
Module:8	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	I.M. Pandey, (2021) Financial Management. Pearson New Delhi.
2.	Eugene. Brigham, Joel. Houston (2021),Fundamentals of Financial management, South & Western Cengage Learning India (PVT) Ltd.
Reference Books	
1.	Prasanna Chandra, (2022), Financial Management, Theory and Practice, Tata McGraw Hill Publishing Company, New Delhi.
2.	M Y Khan and P K Jain, (2018), Financial Management: Text, Problems and Cases | 8th Edition Tata McGraw Hill Publishing Company, New Delhi.
3.	James.C. Van Horne, (2015), Fundamentals of Financial Management, Pearson ,UK

Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies	06-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM219L	Principles of Accounting	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the Accounting fundamental concepts and principles.
2. To know the accounting Process and preparation of Financial Statements.
3. To analyse the financial statements for business decision making.

Course Outcomes

Upon successful completion of the Course the students will be able to

1. Acquire knowledge on double entry system of book keeping.
2. Prepare the Financial Statements
3. Develop understanding on Global and Indian Accounting Standards.
4. Apply different depreciation methods for capital assets.
5. Analyse, interpret and use accounting data in managerial decision making.
6. Acquire knowledge on Accounting Information System

Module:1	Fundamentals of Accounting	6 Hours

Fundamentals of Accounting – Meaning – Scope, Objects and limitations; Financial Accounting – Role of Financial Accounting – Differences – Financial Accounting - Management Accounting – Accounting concepts & convention - Bank Reconciliation Statement

Module:2	Accounting Framework	5 Hours

Capital and Revenue items - Double Entry System - Introduction to Journal - Ledger and Procedure for Recording and Posting - Introduction to Trial Balance

Module:3	Accounting Standards	5 Hours

IFRS - GAAP – Ind AS - Specific Standards - AS 1 : Disclosure of Accounting Policies - AS 2 : Valuation of Inventories - AS 3 : Cash Flow Statements - AS 10 : Property, Plant and Equipment - AS 11 : The Effects of Changes in Foreign Exchange Rates - AS 12 : Accounting for Government Grants - AS 13 : Accounting for Investments - AS 16 : Borrowing Costs

Module:4	Financial Statements and Analysis	9 Hours

Financial Statements - Meaning and Components of Financial Statements - Preparation of Final Accounts - Profit and Loss Account - Balance Sheet – Problems with Simple Adjustments. Comparative Financial Statement – Common Size Financial Statements and Trend Analysis – Key Ratios

Module:5	Depreciation	6 Hours

Depreciation – Concepts – Causes – Methods of Deprecation – Problems on Straight Line Method and Written Down Value Method.

Module:6	Accounts from Incomplete Records	6 Hours

Single Entry System – Features - Advantages – Disadvantages - Single Entry Versus Double Entry- Statement of Affairs – Meaning – Profit Calculation.

Module:7	Accounting Information System	6Hours

Application of Computers in Accounting- Data analytics in Accounting – Frauds and Errors – Controls. Revenue Cycle – Expenditure Cycle – Production Cycle- Payroll Accounting- Introduction to ERP, Accounting Softwares and Core Banking

Module: 8	Contemporary Issues	2 Hours

Total Lecture hours:	45 hours

Text Book(s)	
1.	R.L. Gupta and V. K Gupta, (2019) Principles and Practice of Accountancy, Sultan Chand and Sons
2.	S.P. Jain, K.L. Narang, Simmi Agrawal and Monika Sehgal (2018), Financial Accounting, Volume 1, 21st Edition, Kalyani Publishers, New Delhi
Reference Books	
1.	M.C. Shukla, T.S. Grewal and S.C. Gupta, (2022), Advanced Accounts Volume 1, 19th Edition, S. Chand Publishing, New Delhi
2.	S.N. Maheshwari, CA S.K. Maheshwari and S.K. Maheshwari, (2018), Advanced Accountancy, Volume 1, 11th Edition, Vikas Publishing House Ltd., New Delhi
3.	T. Horngren Charles, L. Sundern Gary, A. Elliott John, R. Philbrick Danna, (2017), Introduction to Financial Accounting, Pearson Education, India
Mode of Evaluation: CAT / Assignment / Quiz/ Final Assessment Test	

Recommended by Board of Studies	06-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM220L	Financial Markets and Institutions	3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. To understand the structure, operations and different instruments of capital markets
2. To explain the role and challenges of financial intermediation
3. To acquire knowledge on the regulatory framework of the financial system

Course Outcomes

Upon successful completion of the course students will be able to

1. Explain the regulator's role in a country's Financial System.
2. Articulate the structure of Indian capital market operations.
3. Appreciate the operation of the capital market.
4. Comprehend the Money market operations.
5. Assimilate the role of depositories and stock broking services.
6. Explain various financial services offered by financial institutions.

Module:1	An Overview of Financial Environment	7 hours

The nature and role of financial system- Financial structure – Different financial functions - Role offinancial Markets and Institutions - Recent developments. Indian financial system – History and developments. Globalization and financial sector changes. Reforms in the financial system.

Module:2	Financial Institutions	6 hours

Overview of Financial Institutions - Regulatory and non - regulatory institutions - Banking and nonbanking institutions – Role and functions.

Module:3	Regulatory Framework	6 hours

Financial system regulators: Reserve Bank of India (RBI) – Securities and Exchange Board of India (SEBI) – Pension Fund Regulatory and Development Authority (PFRDA) - Insurance Regulatory and Development Authority (IRDA). Role and functions – Acts and regulations.

Module:4	Primary Market	5 hours

New issues - Primary market operation - Intermediaries – lead managers - underwriting- bankers to Issue - listing mechanism – listing regulations. Registrar and share transfer agents.

Module:5	Secondary Market	7 hours

Stock exchanges - intermediaries and stock broking services – custodial services – depository System - clearing and settlement systems. Role of technology in financial markets operations.

Module:6	Money Market	5 hours

Instruments - Intermediaries – importance and applications.

Module:7	Financial Services	7 hours

Fee based Financial services: Merchant banking - Mergers and Acquisitions – Credit Syndication - Credit Rating. Fund based Financial services**:** Leasing – Hire Purchasing- Mutual Funds - Bills Discounting – Factoring and Forfaiting –Housing finance – Venture Capital – Insurance.

Module:8	Contemporary Issues	2 hours

	Total Lecture Hours	**45 hours**
Text Book (s)		
1.	Bharti V. Pathak (2018), Indian Financial System, Pearson India, 5th Edition.	
2.	Anthony Saunders, Marcia Millon Cornett and Anshul Jain (2021), Financial Markets and Institutions, McGraw Hill, 7th Edition.	
Reference Books		
1.	L.M.Bhole and Jitendra Mahakud (2017), Financial Institutions and Markets. Structure, Growth and Innovations, McGraw Hill Education, 6th Edition.	
2.	Mishkin, Frederic S, Stanley G Eakins, Tulsi Jayakumar and R.K.Pattnaik (2017), Financial Markets and Institutions, Pearson Education, 8th Edition.	
Mode of Evaluation: CAT, Quiz, Assignment and FAT.		
Recommended by Board of Studies	23-02-2023	
Approved by Academic Council	No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM221L	Economics of Money, Banking and Financial Markets	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To create awareness about Financial Markets
2. To make students understand the nuances of Financial Economics
3. To create awareness about the working of Banks and Financial Institutions

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe financial markets and institutions.
2. Explain the functions of money
3. Define and apply interest rate dynamics
4. Critically evaluate monetary policy and its tools
5. Interpret exchange rate changes and its impact
6. Articulate the interconnected dynamics of the financial system.

Module:1	Financial System and Economic Indicators	7 hours

Financial System – Financial Markets - Banking and Financial Institutions - Regulatory Framework. Global and National Macroeconomic Indicators – Economic Growth, Money Supply, Inflation and Interest Rates. Business Cycles. Role of Commodity Markets. Monetary Policy and its uses.

Module:2	Money Supply, Liquidity and Credit	6 hours

Money – Meaning and Functions - Money Supply - Types – Liquidity Theory – RBI's Monetaryand Liquidity Aggregates - Factors influencing Supply and Demand for Money. Credit Multiplier – Determinants of Credit.

Module:3	Interest Rates	6 hours

Understanding Interest Rates and Return. Real and Nominal Interest Rates. Changes in interest rates. Term Structure of Interest Rates. Behavior of Interest Rates - Asset Demand – Demand in Bond and Money Markets – Equilibrium Interest Rates – Shifts in Equilibrium Rates.

Module:4	Central Banking and Monetary Policy	5 hours

Central Bank – Role and Functions. Central Bank's Balance Sheet and the Control of Monetary Base. Monetary Policy – Goals and Tools. Monetary Transmission Mechanism – Channels. Reserve Bank of India – Objectives, Organization, Functions and Role. Financial Stability - Regulation and Enforcement – Debt Management - Currency Management.

Module:5	The Foreign Exchange Market	7 hours

Foreign Exchange Market – Foreign Exchange Rates – Determination – Changes in the Exchange Rates. Law of One Price – Purchasing Power Parity Theory. Exchange Rates in the Short run and Long run. Big Mac Index. Currency War.

Module:6	The Keynesian IS-LM Model	5 hours

Aggregate Demand – Keynesian View, Shifts in Aggregate Demand and Aggregate Supply - Determination of Aggregate Output, Investment and the Role of the Government. The ISLM Model – Equilibrium in the Goods Market and Money Market. Monetary and Fiscal Policy inISLM Model.

Module:7	Financial Crises and Learning	7 hours

Great Depression in the US 1929 - South Asian Financial Crises - 1997-98. Financial Crisis in Mexico 1994-95 and Argentina - 2001-02. Subprime Financial Crisis - 2007-08. Banking Crises. Factors causing financial Crises – Agency Problem – Housing Price Bubbles – Financial Innovations.				
Module:8	**Contemporary Issues**			**2 hours**
			Total Lecture Hours	**45 hours**
Text Book(s)				
1.	Frederic S Mishkin (2021), The Economics of Money, Banking and Financial Markets, Pearson Education Limited, 13th Edition.			
Reference Books				
1.	N. Gregory Mankiw (2022), Principles of Macroeconomics, Cengage India, 9th Edition.			
2.	O. Blanchard (2020), Macroeconomics, Pearson Education, 7th Edition.			
Mode of Evaluation: CAT, Quiz, Assignment and FAT				
Recommended by Board of Studies		23-02-2023		
Approved by Academic Council		No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM222L	Security Analysis and Portfolio Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To create awareness about functions and structure of financial markets and institutions
2. To make students understand the nuances of investment decision making
3. To achieve investment advisory skills

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe the linkages between Macroeconomic environment and financial markets.
2. Explain theoretical foundations of financial markets.
3. Demonstrate skills in financial statement analysis.
4. Apply financial security analysis.
5. Execute portfolio construction and evaluation techniques.
6. Demonstrate professional investment advisory skills.

Module:1	Macroeconomics and Financial Market	6 hours

Financial Markets and the Economy- Economic Growth, Business Cycles, Inflation, Interest Rates, Commodity Prices. Monetary and Fiscal Policy. Global Economic Indicators. Financial Market - Instruments – Institutions - Regulatory Framework. Trading: Trading mechanics – Types of Orders – Margins.

Module:2	Investment Theories	7 hours

Risk and Return – Mean, Variance, Covariance and Standard Deviation. Efficient Market Hypotheses- Random Walk – Modern Portfolio Theory – Dow Theory. Mean – Variance Portfolio Theory - Beta – Capital Asset Pricing Model (CAPM). Security Market Line (SML) Efficient Frontier. Portfolio Models. Index Models – Single and Multi -Index Models. Fama- French Model.

Module:3	Financial Statement Analysis	6 hours

Financial Statements – Standalone Vs Consolidated – Analysis of Balance Sheet, Profit and Loss and Cash flow Statement. Ratio Analysis – Investment Related Ratios (Return, Operating and Profitability Ratios). Common size and Comparative size Statement Analysis.

Module:4	Fundamental and Technical Analysis	5 hours

Economy – Industry - Company Analysis - Top down approach-Value investing principles - Short term vs Long term investing - Qualitative and Quantitative factors. Valuation models. Technical Analysis - Chart Types – Candle Chart, Bar Chart, Line Chart – Chart Patterns – Candle Patterns. Technical Indicators – Oscillators – Rule Based Trading Strategies.

Module:5	Equity Valuation	7 hours

Cost of capital – Weighted Average Cost of Capital (WACC) - Growth estimation - cash flow estimation – Discounted Cash Flow (DCF) models. Stock Valuation: Stock Valuation models - Dividend Discount Models, Price-Earnings Ratio, Free Cash flow - Valuation Approaches.

Module:6	Fixed Income Securities	5 hours

Bonds - Corporate and Government securities - Treasury Securities - Types. Bond - Yield,

Maturity and Bond valuation - duration and modified duration - Bond Portfolio Strategies.		
Module:7	**Portfolio Management**	**7 hours**
Diversification and Portfolio Risk, Combination of risky assets – Portfolio possibilities curve. Portfolio Management Process - tools and techniques, Sharpe Ratio, Jensen Alpha and Treynor Index. Coffee Can Investing. Mutual Funds and Alternate Investments - Mutual Funds – Classification – Mutual Fund Investments – Systematic Investment Plan (SIP) - Hedge Funds - Real Estate Investment Trusts (REITs).		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Zvi Bodie, Alex Kane, Alan J. Marcus and Pitabas Mohanty (2019), Investments, McGrawHill, 11th Edition.
2.	Prasanna Chandra (2021), Investment Analysis and Portfolio Management, McGraw Hill, 6thEdition.
Reference Books	
1.	Frank Reilly and Keith C Brown (2019), Investment Analysis and Portfolio Management, Cengage, 11th Edition.
2.	Charles P Jones (2016), Investments: Principles and Concepts. Wiley Finance, 12th Edition. Edwin J Elton, Martin J Gruber, Stephen J Brown and
3.	William N.Goetzmann (2015), Modern Portfolio Theory and Investment Analysis. John Wiley, 9th Edition.

Mode of Evaluation: CAT, Quiz, Assignment and FAT

Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM223L	Options, Futures and other Derivatives	3	0	0	3
Pre-requisite	NIL	Syllabus version			
Course Objectives		1.0			

1. To identify the basic principles of Derivatives Market
2. To define the nature of risk and identify hedging strategies
3. To describe the principles of risk management and the role of the risk manager

Course Outcomes

Upon successful completion of the course students will be able to

1. Examine the role of Risk Manager in the Financial Planning Process.
2. Analyze and evaluate various risk exposures.
3. Compare and contrast the different types of derivatives.
4. Identify the different types of options.
5. Critically evaluate Option Pricing Mechanism.
6. Explain the concept of commodity derivatives.

Module:1	Financial Risks – An Overview	7 hours

Financial Risk - Types - Market Risk - Credit Risk - Liquidity Risks - Operational Risk - Commodity Price Risk - Trading Risk - Portfolio Risk. Global Financial Crises and RiskManagement – Hedging - Tools and Techniques.

Module:2	Derivatives	6 hours

Derivatives – definition - classification. Risk - risk management. Futures Vs. forwards, Over the Counter (OTC) Vs. exchange traded contracts. Futures and options on stocks, indices, commodities, exchange rates etc., understanding quotes.

Module:3	Futures and Forwards	6 hours

Futures: Specification-spot, forward and future relationship convergence – delivery and settlement. Margi-margin call. Hedging strategies using futures. Determination of forward and future prices.

Module:4	Options	7 hours

Options: Mechanics of option market - option properties – Put, Call, American and European options. Put - Call parity - underlying asset. Option pricing model: Black-Scholes option pricing model assumptions - theoretical Vs market price – volatility - historical and implied volatility- volatility estimation - volatility smile. Option Greeks: Delta - delta hedging – theta – Gamma - Vega-Rho - relationship between them.

Module:5	Option Trading Strategies	5 hours

Single option strategies - Multiple option strategies – Neutral and Volatility based strategies.

Module:6	Credit Derivatives	5 hours

Credit derivatives: Credit risk - credit default swap – Asset backed Securities – collateralized securities. Swaps: LIBOR – interest rate swaps - currency swaps-total return swaps – other types.

Module:7	Commodity Derivatives	7 hours

Commodity derivatives: Commodity market – commodity price risk – futures and options on commodities – hedging using commodity derivatives.

Module:8	Contemporary Issues	2 hours
	Total Lecture Hours	45 hours
Text Book(s)		

1. Hull, John.C and Shankarshan Basu (2022), Options, Futures and other Derivatives, Pearson, 11th Edition			
2. Don M Chance, Robert Brooks and Sanjay Dhamija (2019), An Introduction to Derivatives and Risk Management, Cengage India, 10th Edition.			
Reference Books			
1. John Hull (2012), Risk Management and Financial Institutions, Wiley.			
2. Robert A. Strong (2016), Derivatives An Introduction Second Edition, South-Western.			
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM224L	Fixed Income Securities	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To make the students comprehend the specific features of the Indian and Global Fixed Incomesecurities markets
2. To make the students learn and use the term structure theories to form fixed income portfolio techniques and to use the appropriate immunization strategies to manage the fixed income portfolio
3. To make the students understand Government securities market

Course Outcomes

Upon successful completion of the course students will be able to

1. Comprehend the bond market and players in the bond market.
2. Value the bonds under changing interest rate market scenario.
3. Apply the term structure theory in forecasting the future interest rates.
4. Grasp the price sensitivity of bonds to changing interest rate and apply quantitativeimmunization strategy to mitigate the risk.
5. Construct the bond portfolio to accommodate the changing interest rates.
6. Explain corporate debt markets.

Module:1	Instruments and Characteristics	7 hours

Fixed Income Securities - Bond and Money Markets – Instruments- Bond Features and Types – Risk Associated with Bonds. Pricing of Bonds - Review of Time value of Money – Fixed and Floating Rate Securities. Nominal Vs Real Interest Rates Coupon Rate and Current Yield, Zero Coupon Rate – Supply and Demand of Bonds – Changes in Equilibrium Interest Rates.

Module:2	Volatility and Term Structure of Interest Rates	6 hours

Term Structure of Interest Rates – Classical Theory of Term Structure. Yield Curve, Zero Coupon Bond Yield Curve. Bond Price Volatility – Price Sensitivity – Immunization – Measurement of Duration, Modified Duration- Convexity Measurement, Factors influencing yield. Term Structure of Interest Rate, Spread, Corporate Debt Instruments.

Module:3	Fixed Income Portfolio Management	6 hours

Active and Passive Bond Portfolio Construction – Management Strategies. Indexing – Bond Indices. Setting Portfolio Objectives, Interpreting Portfolio Parameters and PerformanceMeasurement.

Module:4	Risk and Risk Management	5 hours

Interest Rate Risk- Impact on Bonds – Risk Management – Tools and Techniques. Swaps and Futures, Credit Derivatives – Credit Default Swaps, Plain Vanilla Options and Exotic derivatives.

Module:5	Securitization	7 hours

Mortgage backed securities – Collateral Mortgage Obligations – Asset backed securities – Collateral Debt Obligation.

Module:6	Indian Government - Securities Market	5 hours

Government Security (G-Sec) – Participants - How they are issued – Auction-Auction Type -Open Market Operation – Repo and Reverse Repo - Liquidity Adjustment Facility. Treasury Bills. Yield Calculation.

Module:7	Corporate Debt Markets	7 hours

Primary and Secondary Markets- Corporate Debt Instruments – Types – Bond with embeddedOptions- Sinking Funds – Convertible Bonds- Warrants. Commercial Papers – Preference Shares – High Yield Bonds. Credit Analysis - Credit Rating - Methodology.				
Module:8	**Contemporary Issues**			**2 hours**
	Total Lecture Hours			**45 hours**
Text Book(s)				
1.	Frank J. Fabozzi (2012), Bond Markets, Analysis and Strategies, Pearson India, 9th Edition.			
2.	Moorad Choudhry, Masekoldrisch (2012), Fixed Income Market: Instruments, Application, Mathematics. Wiley Finance Series, 2nd Edition.			
Reference Books				
1.	Fabozzi, F.J (2017), The Handbook of Fixed Income Securities, McGraw Hill Education, 8th Edition.			
2.	Choudhry (2010), Fixed Income Securities and Derivatives Handbook, Wiley, 2nd Edition.			
3.	Suresh Sundaresan (2009), Fixed Income Markets and their Derivatives, Academic Press Inc, 3rd Edition.			
Mode of Evaluation: CAT, Quiz, Assignment and FAT.				
Recommended by Board of Studies		23-02-2023		
Approved by Academic Council		No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM225L	Personal Finance	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To explain the aspects of financial planning like savings, investment, taxation, insurance & retirement planning and to develop necessary skills to become a successful financial planner
2. To impart knowledge on various investment instruments
3. To make the students understand the personal finance planning process with its elements

Course Outcomes

Upon successful completion of the course students will be able to

1. Describe outline the meaning and relevance of financial planning.
2. Identify the need for career planning and financial services.
3. Examine the concept of personal tax planning
4. Explain the concept of investment planning and its methods.
5. Analyze insurance planning and its relevance.
6. Demonstrate personal financial advisory skills.

Module:1	Personal Finance Foundations	7 hours

The financial planning process – setting goals-achieving goals. Time value of money and opportunity cost concepts. Economic Way of Thinking. Career Planning and Financial Planning **-** Career choice – opportunities – long term career development. Money management – personal financial records – asset and liability – budgeting.

Module:2	Macroeconomic Environment	6 hours

Economic growth – Household Savings – Circular Flow of Income - Business Cycles - Inflation – Interest rates - Banking and financial markets.

Module:3	Tax Planning	6 hours

Tax Planning - Income tax – Tax Slabs - Gross Income and Taxable Income – Eligible Deductions – HRA Calculations – HRA Exemptions - Tax Deducted at Source (TDS). Tax on property, wealth and earnings. Tax filing – PAN and TAN – Tax planning strategies. Capital Gains – Short Term and Long Term Capital Gains and Taxes.

Module:4	Credit Planning	5 hours

Credit Planning - Types of Credit – Home, Auto and Personal loans. Mortgage Loans – Reverse Mortgage Loans - Consumer Credit - Credit Cards - Purchasing decisions - Credit Score (CIBIL).

Module:5	Insurance Planning	7 hours

Need for Protection Planning - Risks of Mortality - Life Insurance - Term Insurance - Whole Life Insurance – Endowment Policy - Money Back Policy - Children Policies - Annuity Plans – Unit Linked Insurance Policies (ULIP). Health insurance - Cashless Facility - Exclusions-Add – ons. Motor Insurance – Liability Only Policy – Package Policy - Coverage and Exclusions. Travel Insurance - Property and General insurance - Insurance and Tax planning.

Module:6	Investment Management	5 hours

Investment plan - Process and Objectives - Risk and Return - Portfolio Risk and Return - Diversification. Factors influencing investment – asset allocation - source of information. Investing in stocks – short term vs long term – stock evaluation and analysis. Mutual funds and Systematic Investment Plans (SIP). Fixed income securities - real estate investments - Precious metals – alternate investments - Commodities - Various Savings Schemes.		
Module:7	**Retirement Planning**	**7 hours**
Controlling Financial Future: Retirement planning – Financial analysis - Planning for retirement income. Pension Schemes - Estate planning – Will – Trust - Estates.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Kapoor, J.R, Les R Dlabay, Robert J Hughes and M.M.Hart (2020), Personal Finance, McGraw Hill, Twelfth Edition.
2.	Gitman, Joehnk, and Billingsley (2015), Personal Financial Planning, Cengage Learning, Thirteenth Edition.
Reference Books	
1.	Thomas Garman and Raymond Forgue (2014), Personal Finance, South Western College, Publishing, 12th Edition.
2.	Arthur J. Keown (2019), Personal Finance, Pearson, 8th Edition.
3.	Jeff Madura (2020), Personal Finance, Pearson, 7th Edition.
Mode of Evaluation: CAT, Quiz, Assignment and FAT.	

Recommended by Board of Studies	23-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM226L	Corporate Finance	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide foundational knowledge of corporate finance.
2. To analyse and interpret major corporate issues and challenges.
3. To advance strategic financial decision-making skills

Course Outcomes

Upon successful completion of the Course the students will be able to

1. Understand the foundational theories and concepts of corporate finance
2. Analyze capital budgeting process and techniques
3. Estimate cost of capital with due consideration of risk and returns.
4. Evaluate long term financing decisions
5. Develop strategic understanding of Mergers, Acquisition and Corporate Restructuring
6. Demonstrate application orientation skills in valuation

Module:1	Corporate Finance: Introduction	6 hours

Scope and Objectives of Corporate Finance - Overview of Financial Management Process - Financial Goals and Constraints - Role of Financial Manager - Tools of Corporate Finance -Understanding of Financial Statements and Cash Flows - Corporate Financing Decision – Corporate Taxes

Module:2	Net Present Value and Investment rules	6 hours

Time Value of Money - Present and Future Value of Single Payments - Capital Budgeting Tools and Techniques and Decisions

Module:3	Cost of Capital, Risk and Return	7 hours

Concepts of Risk and Return – Diversifiable and Non - Diversifiable Risk – Risk Return Trade off- Cost of Capital - Cost of Debt Capital - Cost of Equity Capital - Cost of Preference Capital- Weightage Average Cost of Capital- Capital Asset Pricing Model (CAPM) - Security Market Line (SML).

Module:4	Long Term Financing	5 hours

Early Stage Financing – Venture Capital - IPO – FPO - Rights Issue. Equity – Common and Preferred Stock; Debt – Bank Loans- Bonds – International Bonds - Capital Dilution – Leasing - Types of Leasing.

Module:5	Mergers, Acquisition and Corporate Restructuring	6 hours

Merger and Acquisition in India, Forms of Merger, Concept of Acquisition, Difference between Merger and Acquisition, Strategic Rationales for M&A, Steps in M&A Process, Due Diligence, Regulatory Framework for M&A - Corporate Restructuring.

Module:6	Valuation: Principles and Practice	8 hours

Concept of Valuation - Equity Valuation – Valuation Models - Dividend Discount Model - Discounted Cash Flow Model - Residual Income Model – Asset - based Model.

Module:7	International Corporate Finance	5 hours

Foreign Exchange Markets - Exchange Rates – Exchange Rate Risk – Interest Rate – Interest Rate Risk – International Capital Budgeting – Political Risk – Risk Management Tools.

Module:8	**Contemporary Issues**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)	
1.	Aswath Damodaran (2020) Corporate Finance: Theory and Practice John Wiley & Sons.
2.	Ross, S. A., Westerfield, R., Jordan, B. D., & Biktimirov, E. N. (2021) Fundamentals of Corporate finance. McGraw-Hill
Reference Books	
1.	Brealey Myer (2013) Principles of Corporate Finance McGraw-Hill Education.
2	Vernimmen, P., Quiry, P., & Le Fur, Y. (2022). Corporate finance: theory and practice. John Wiley & Sons.
3	Jonathan Berk, Peter DeMarzo, Jarrad Harford, Fundamentals of Corporate Finance (2019, 3rd Edition), Pearson, India.

Mode of Evaluation: CAT / Assignments / Quiz/ Final Assessment Test			
Recommended by Board of Studies	06-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM227L	Financial Statement Analysis	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To Provide framework for Financial Statement Analysis
2. To develop a thorough understanding of tools and techniques of Financial Statements
3. To understand the application of tools and techniques in the Financial Statement Analysis.

Course Outcomes

Upon successful completion of the Course the students will be able to

1. Understand role and purpose of Financial Statement Analysis
2. Apply various tool and techniques to analyze Financial statements
3. Carry out effective Cash Flow Analysis
4. Estimation of Enterprise value
5. Forecast Company's Financial Statements
6. Evaluate Company's Performance using Credit Analysis

Module:1	**Framework for Financial Statement**	**5 hours**
Nature and Objectives of Financial Statements - Uses and Limitations of Financial Statements -Types of Financial Statements - Balance Sheet, Income Statement, Cash Flow Statement - Stakeholders of Financial Statements - Financial Reporting - Role of Auditor		
Module:2	**Tools and Techniques of Financial Statement Analysis**	**5 hours**
Ratio Analysis - Profitability ratio, Liquidity ratio, Short - Term and Long - Term Solvency Ratios - Operating and Financial Leverages- EPS and other Ratios used in Valuation – P/E and PB ratio- Dividend Payout Ratio- Application of Ratios to Prepare the Balance Sheet		
Module:3	**Cash Flow Analysis and Estimation**	**6 hours**
Cash Flow Statement - Financing, Investing, and Operating Activities As per AS 3 - Preparation of the Cash Flow Statement - Earnings before Interest and Taxes (EBIT), - EBITDA and Total Enterprise Value		
Module:4	**Inter Corporate Transactions**	**6 hours**
Corporate Investment Category- Minority Passive and Minority Active Investments. Joint Ventures – Controlling Interest Investments – Pooling of Interest – Impact of Pooling – Consolidated Financial Statements – Goodwill- Goodwill Impairment- Specil Purpose of Entity -Securitization of Assets.		
Module:5	**Forecasting Financial Statements**	**7 hours**
A Typical One -Year Projection - Sensitivity Analysis with Projected Financial Statements - Projecting Financial Flexibility - Pro Forma Financial Statements - Multiyear Projections		
Module:6	**Credit Analysis**	**7 hours**
Meaning of Credit Risk – Importance and Limitations-7 C' of Credit Worthiness		

Analysis- Credit Rating Process - Combination Ratios - Ratios Relating to Credit Risk		
Module:7	**Equity Analysis**	**7 hours**
The Dividend Discount Model - The Price-Earnings Ratio - The Du Pont Formula - Valuation Through Restructuring Potential		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**

Text Book(s)	
1.	Martin S. Fridson (Author), Fernando Alvarez (2022), Financial Statement Analysis: A Practitioner's Guide, Wiley Finance
2.	Gerald I. White, Ashwinpaul C. Sondhi, and Haim D. Fried.3e The Analysis and Use of Financial Statements, Wiley Publication
3.	P. C. Tulsian, CA Bharat Tulsian, Tushar Tulsian (2022), Analysis of Financial Statements, Tcom Prints
Reference Books	
1.	K. R. Subramanyam, (2020), Financial statement anaylsis, Published by McGraw-Hill Education, New York.
2.	Sandeep Goel (2014), Financial statement anaylsis, Publisher: Routledge Taylor & Francis Group.
3.	Robinson, Greuning, Henry, and Broihahn (2009) International Financial Statement Analysis. Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies	06-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM228L	Cost and Management Accounting	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To familiarize the students with the basic management and cost accounting concepts
2. To develop an understanding of the decision choices in business.
3. To gain the application of budgeting techniques in management decision making.

Course Outcomes

Upon successful completion of the Course the students will be able to

1. Gain a working knowledge of the principles of cost and Management accounting
2. Express the place and role of cost sheet in Organization
3. Prepare Material, Labour, Overheads cost and activity based costing to control them effectively
4. Apply the skills of Marginal costing techniques in managerial decision making
5. Assess the performance and control cost by analyzing the variance
6. Prepare Cash flow and different functional budgets

Module:1	**Overview of Cost and Management Accounting**	**4 hours**

Meaning - Cost & Management Accounting – Accounting Information on Managerial Decisions - Differences between Management Accounting and Cost Accounting

Module:2	**Cost - Sheet**	**4 hours**

Meaning, Elements of Cost- Preparation of Cost sheet, Basics of Tender and Quotations

Module:3	**Materials, Labour, and Overhead Cost**	**8 hours**

Materials, Labour, Overhead: Purchase Procedure- MRP (Materials Requirement Planning), EOQ (Economic Ordering Quantity); Methods of Labor Remuneration; Overhead Absorption- Activity Based Costing

Module:4	**Marginal Costing**	**8 hours**

Introduction- Significance of P/V ratio, BEP (Break-even Point), MOS (Margin of safety) - Make or Buy Decisions, Accepting Order, Product Mix Decision, Shutdown

Module:5	**Standard Costing**	**7 hours**

Meaning, Characteristics, Objectives, Differences between Estimated Costing and Standard Costing, Budgeting, and Standard Costing Differences - Variance Analysis - Material Cost Variance only

Module:6	**Cash Flow**	**5 hours**

Preparation of Cash Flow – Investment Activities – Operating Activities – Financing Activities

Module:7	**Budgeting**	**7 hours**

Meaning, Nature, Functions of Budgeting, Process of Budget Control- Zero Based Budgeting, Preparation of Budget- Flexible Budget, Production Budget, Purchase Budget

Module:8	**Contemporary Issues**	**2 hours**

Total Lecture hours				**45 hours**
Text Book(s)				
1.	Colin Drury, 11th Edition (2020) Management and Cost Accounting, Cengage Learning Publication.			
2.	Jain, S.P. and K.L. Narang, (2019) Cost and Management Accounting, Kalyani Publishers.			
Reference Books				
1.	C.A. Chhawchharia, C.A. Yash 4th Edition, (2022), Cost & Management Accounting, Taxmann Books Publications.			
2.	CA. P C Tulsian (2022) Cost & Management Accounting, S.Chand Publications			
3.	M. N. Arora 11th Edition (2021), A Textbook of Cost and Management Accounting, S. Chand Publications.			
4.	Khan, M.Y. and P.K. Jain,(2013), Management Accounting, Tata McGraw Hill, Publishing, New Delhi			
5.	S.N. Maheshwari, (2013), Management Accounting, S. Chand Publications, New Delhi.			
Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT				
Recommended by Board of Studies		06-03-2023		
Approved by Academic Council		No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM229L	Mind, Embodiment and Technology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. The course will help the science and technology students to speculate on the notion of humanness that has been configured and reconfigured by the technological developments initiated in the domain of artificial intelligence, and robotics.
2. The course will help learners to speculate on the philosophical issues related to concepts such as human, transhuman, and posthuman.
3. This course aims to establish a dialogue between scientists, engineers, and society with an aim to help the students understand the possible positive consequences and paranoia generated by technological interventions.

Course Outcomes:

1. Students will be aware of the ethical and bioethical issues related to technological developments.
2. Students will be able to gauge the positive possibilities and paranoia related to technological developments and interventions.

Module:1	Mind-Body Dualism	4 hours
The Organic Body- The Prosthetic and Entangled Bodies-The Dualist Theories of Mind and Body		
Module:2	**Mind, Body, and Technology**	**4 hours**
Humanism- Transhumanism- Posthumanism- Synthetic Beings- Antihumanism- Digital Resurrection-Digital Legacies		
Module:3	**Medical Enhancement and Posthumanism**	**4 hours**
Therapy, Enhancement, and Improvement- Bioelectronic and Implantation Devices- Queer Body and Technological Interventions		
Module:4	**Emotive Technologies**	**4 hours**
Caring through Technology- Emotions, My Mobile, and My Identity- Creativity, Motivation, and Technology		
Module:5	**Posthumanism and Morality**	**4 hours**
Posthuman Ethics- Artificial Life- Evolving Species		
Module:6	**Technology and Popular Culture**	**4 hours**
American Dystopian Science Fiction- Westworld (TV Series)- Altered Carbon (Netflix)- Love, Death+Robots (Animated Series, Netflix)- Biohackers (Netflix Webseries		
Module:7	**Novels and Short Stories**	**4 hours**
Excerpts from Mary Shelley's Frankenstein (1818)- Excerpts from Nancy Kress's Beggars in Spain (1993)- Hanif Kureishi's "The Body" (2002)- Greg Egan "The Extra" (2015)		
Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Cary, Woolfe. (2010). *What is Posthumanism*? Minneapolis and London: University of Minnesota Press.
Reference Books	
1.	Damasio, A. (2023). *Feeling and Knowing Making Minds Conscious*. Little, Brown Book Group.
2.	Clark, A. (2019). *Surfing Uncertainty: Prediction, Action, and the Embodied Mind*. Oxford University Press.
3.	Jonathan, Westphal. (2016). *The Mind-Body Problem*. Cambridge and Massachusetts: The MIT Press.
4.	Peter, Mahon. (2017). Posthumanism: A Guide for the Perplexed. London: Bloomsbury Academic.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	10-03-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
BHUM230L	Health Humanities in Biotechnological Era	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To sensitize the students about the complex entanglement between biomedicine, technology, and disability narratives.
2. To inform the students about the politics of health management, and the shame and stigma associated with the discourse of illness
3. To sensitize students about the possible consequences of biotechnological intervention in human lives.

Course Outcomes:

The students will be able to:

1. Understand the intricate relationships between the body, illness, health management, and biopolitics.
2. Understand how socially constructed phenomena such as shame, stigma, and prejudices inform our understanding of body, health, and wellbeing.

Module:1	Body, Biomedicine, and Biopolitics	4 hours
Medical Gaze- Gender Medicine- Biomedicalization- Biopolitics- Citizenship- Illness, Disease, and Sickness- Dualism		
Module:2	**Disability Studies**	**4 hours**
Madness and Civilization- Assistive Technology and the Prosthetic Self- Neurocognitive Disorders- Neurodiversity Movement- Chronic Pain- Ageing- Decadent Bodies		
Module:3	**Mental Health and Illness**	**4 hours**
Depression and Life Narratives- Narrative of a Psychopath- Living with Individual Diagnosed with Bipolar Disorder- Stories of Alzheimer Disease- Stories of Post-Traumatic Stress Disorder- Addiction and Substance Abuse		
Module:4	**Doctor's Narrative**	**4 hours**
The Uncertain World of Medicine- Gender, Space, and Medical Profession- Occupational Hazard in Medical Profession- Stress, Trauma, and the Evolution of Machinic Self		
Module:5	**Living with Dying**	**4 hours**
Family Illness Narratives of Chronic Illness and Trauma		
Module:6	**Global Health**	**4 hours**
Infection and Inequalities: The Pandemic Era- Occupational Hazards- Chronic Diseases and the Pharmaceutical Industry- Insomnia		
Module:7	**Bioethical Imperatives**	**4 hours**
Euthanasia: Death and Dying- Artificial Reproductive Technology (ART) and Surrogacy- Organ Transplantation- Brain Death		
Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**30 hours**
Text Book(s)		
1.	Bleakley, Alan. (2015). Medical Humanities and Medical Education. London and New York: Routledge.	
Reference Books		
1.	Calo, Thomas R, Nathan S. Carlin, and Ronald A. Carson. (2015). Medical Humanities: An Introduction. Cambridge: Cambridge University Press.	
2.	Chadwick, R. F., & Schüklenk Udo. (2021). This is Bioethics: An introduction. Wiley Blackwell.	
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar		
Recommended by Board of Studies	10-03-2023	
Approved by Academic Council	No. 70	Date 24-06-2023

BENG101N	Effective English Communication	L	T	P	C
		0	0	4	2
Pre-requisite	**Nil**	**Syllabus Version**			
		1.0			

Course Objectives:

1. To hone LSRW skills for effective communication
2. To enhance communication skills for future career aspirations
3. To gain critical communication skills in writing and public speaking

Course Outcomes:

1. Write effective sentences using appropriate grammar and vocabulary
2. Express clearly in everyday conversations with lucid pronunciation
3. Analyse the given listening inputs for effective comprehension
4. Apply different reading strategies to various texts and use them appropriately

Indicative Experiments	
1.	**Fundamentals of Grammar**: Parts of Speech, Articles, Tenses, Sentence Structure, Types of Sentences, Subject-Verb Agreement **Activity:** Exercises and worksheets
2.	**Speaking for Self-Expression**: Formal Self-Introduction, Expressing Oneself **Activity:** Self-Introduction, Just a Minute (JAM)
3.	**Basic Listening:** Listening to Simple Conversations, Short Speeches/Stories **Activity:** Gap fill exercises
4.	**Reading Skills:** Reading Strategies, Skimming and Scanning **Activity:** Cloze reading, Reading comprehension, Reading newspaper articles
5.	**Drafting Paragraphs:** Keywords Development, Writing Paragraphs using Connectives **Activity:** Picture and poster interpretation
6.	**Vocabulary Enrichment:** Synonyms and Antonyms, Prefixes and Suffixes, Word Formation, One Word Substitution, Frequently used Idioms and Phrases, Homophones and Homonyms **Activity:** Crossword puzzles and worksheets
7.	**Listening for Pronunciation:** Introduction to Phonemes, Listening to Native Speakers, Listening to Various Accents **Activity:** Listening and imitating, Spell Bee
8.	**Interactive Speaking:** Everyday Conversations, Team Interactions, Simulations **Activity:** Situational role plays
9.	**Email and Letter Writing:** Types and Format of Emails and Letters **Activity:** Official e-mails and letters, personal letters
10.	**Reading for Comprehension:** Short Stories by Indian Writers **Activity:** Summarising, loud reading
	Total Laboratory Hours **60 hours**

Mode of Evaluation: Continuous assessment / FAT / Written assignments / Quiz/ Oral examination / Group activity

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

Non-graded Core Requirement

BCHY102N	Environmental Sciences	L	T	P	C
		0	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

The course is aimed at students to

1. Understand and appreciate the unity of life in all its forms and their implications of life style on the environment.
2. Identify the different causes for environmental degradation.
3. Analyze individual's contribution to environmental pollution.
4. Evaluate the impact of pollution at the global/local level and find solutions for remediation.

Course Outcomes

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

1. Recognize the environmental issues in a problem-oriented, interdisciplinary perspective.
2. Classify the key environmental issues, the science behind those problems and potential solutions.
3. Demonstrate the significance of biodiversity and its preservation.
4. Identify various environmental hazards.
5. Design various methods for the conservation of resources.
6. Formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects.

Module: 1	**Environment and Ecosystem**	**5 hours**

Environment: definition; Earth–life support system. Ecosystem definition, components and types. Key environmental problems, their basic causes and sustainable solutions. Food chain, food web and their significance, Energy flow in ecosystem; Ecological succession- stages involved, primary and secondary succession - hydrarch, mesarch, xerarch.

Module: 2	**Biodiversity**	**4 hours**

Biodiversity-definition, levels and importance. Species: roles: types: extinct, endemic, endangered and rare species. Hot-spots –Significance, Mega-biodiversity. Threats to biodiversity due to natural and anthropogenic activities, Conservation methods. GM crops-advantages and disadvantages.

Module: 3	**Sustaining Environmental Quality**	**4 hours**

Environmental hazards: definition, types, causes and solutions: Biological (Malaria, COVID-19), Chemical (BPA, heavy metals), and Nuclear (Chernobyl); Air, water and soil quality management and conservation; Solid waste management methods.

Module: 4	**Clean and Green Energy**	**5 hours**

Renewable energy resources: Solar energy-thermal and photovoltaic; Hydroelectric energy. Wind energy, Ocean thermal energy; Geothermal energy; Energy from biomass; Hydrogen energy; Solar-hydrogen revolution. Electric and CNG vehicles.

Module: 5	**Environmental Protection Policies**	**4 hours**

Environmental Protection (EPA) objectives; Air Act, water Act, Forest conservation Act and Wild life protection Act. Environmental Impact Analysis: guidelines, core values. Impact assessment methodologies.

Module: 6	**Sustainable development**	**4 hours**

Effect of population-urban environmental problems; Population age structure; Sustainable human societies: tools in economics, sustainable development goals SDGs and promoting awareness. Women and child welfare, Women empowerment.

Module: 7	**Global Climate Change**	**4 hours**
Global climate change and green-house effect. Kyoto Protocol-carbon credits, The Paris Agreement, carbon sequestration: definition, types and methodologies. Ozone layer depletion: causes and impacts. Mitigation of ozone layer depletion- Montreal Protocol. Role of Information Technology in environment.		
Total Lecture hours:		**30 hours**
Assessment: Seminars, Quiz, Case Studies, Final Assessment Test.		
Text Books		
1. G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengagelearning. 2. Benny Joseph, (2012), Environmental Science and Engineering, 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, India.		
Reference Book(s)		
1. David M. Hassenzahl, Mary Catherine Hager, Linda. R. Berg (2011), Visualizing Environmental Science, 4th Edition, John Wiley & Sons, USA. 2. Raj Kumar Singh, (2012), Environmental Studies, Tata McGraw Hill Education Private Limited, New Delhi, India. 3. George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.		

Recommended by Board of Studies	14-02-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE101N	Introduction to Engineering	L	T	P	C
		0	0	0	1
Pre-requisite	Nil	**Syllabus version**			
		1.0			

Course Objective:

- To make the student comfortable and get familiarized with the facilities available on campus
- To make the student aware of the exciting opportunities and usefulness of engineering to society
- To make the student understand the philosophy of engineering

Course Outcome:

- To know the infrastructure facilities available on campus
- To rationally utilize the facilities during their term for their professional growth
- To appreciate the engineering principles, involve in life-long learning and take up engineering practice as a service to society

General Guidelines

1. Student should observe and involve in the activities during the induction programme. Both general activities and those which are discipline-specific should be included here.
2. Student should get familiarized with the infrastructure facilities available on campus during the general induction, school induction programme and also from the institutional website.
3. Student should attend the lecture by industries, including those on career opportunities, organized by the School and probably involve in 'Do-it-yourself' projects or projects involving reverse-engineering.
4. Activities under 'Do-it-Yourself' will be detailed by the School.
5. Student should prepare a report on the activities and observations, as per the specified format, and submit the same in institutional LMS, VTOP for further evaluation

   General instruction on formatting: Document to be prepared with the titles given in the template; Arial type with font size of 12 to be used; photographs can be included in the document as per the requirement; 1.5 line spacing to be used.

Mode of Evaluation: Evaluation of the submitted report and interaction with the students

Recommended by Board of Studies	02.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BHUM101N	Ethics and Values	L	T	P	C
		0	0	0	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity.
2. To understand the negative health impacts of certain unhealthy behavior.
3. To appreciate the need and importance of physical, emotional health and social health.

Expected Course Outcomes:

1. Students will be able to:
2. Follow sound morals and ethical values scrupulously to prove as good citizens.
3. Understand various social problems and learn to act ethically.
4. Understand the concept of addiction and how it will affect the physical and mental health.
5. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects.
6. Identify the main typologies, characteristics, activities, actors and forms of cybercrime.

Module:1	**Being Good and Responsible**	
Gandhian values such as truth and non-violence — Comparative analysis on leaders of past and present — Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society.		
Module:2	**Social Issues 1**	
Harassment – Types - Prevention of harassment, Violence and Terrorism.		
Module:3	**Social Issues 2**	
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices.		
Module:4	**Addiction and Health**	
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention — Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases.		
Module:5	**Drug Abuse**	
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.		
Module:6	**Personal and Professional Ethics**	
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism.		
Module:7	**Abuse of Technologies**	
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites.		
Total Lecture Hours:		**60 hours**

Text Books :

1.	R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2019, 2nd Revised Edition, Excel Books, New Delhi.
2.	Hartmann, N., "Moral Values" , 2017, United Kingdom: Taylor & Francis.

Reference Books :

1.	Rachels, James & Stuart Rachels, "The Elements of Moral Philosophy", 9th edition, 2019, New York: McGraw-Hill Education.

2.	Blackburn, S. "Ethics: A Very Short Introduction", 2001, Oxford University Press.
3.	Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts", 2016, Writers Choice, New Delhi, India.
4	Ministry of Social Justice and Empowerment, "Magnitude of Substance Use in India", 2019, Government of India.
5.	Ministry of Home Affairs, "Accidental Deaths and Suicides in India", 2019, Government of India.
6.	Ministry of Home Affairs, "A Handbook for Adolescents/ Students on Cyber Safety", 2018, Government of India.

Mode of Evaluation: Poster making, Quiz and Term End - Quiz			
Recommended by Board of Studies	27-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BSSC101N	Essence of Traditional Knowledge	L	T	P	C
		0	0	0	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. To impart the knowledge on Indian tradition and Culture.
2. To enable the students to acquire the traditional knowledge in different sectors.
3. To analyze and understand the Science, Management and Indian Knowledge System.

Course Outcomes:

1. Familiarize the concept of Traditional Indian Culture and Knowledge.
2. Explore the Indian religion, philosophy and practices.
3. Analyze and understand the Indian Languages, Culture, Literature and Arts.
4. Gives a clear understanding on the Indian perspective of modern scientific world and basic principles of Yoga and holistic health care system of India.
5. Enable knowledge on Legal framework and traditional knowledge.

Module:1	**Introduction to Traditional Knowledge**	

Traditional knowledge: Definition, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge, characteristics, Traditional knowledge vis-a-vis Indigenous knowledge, Traditional knowledge Vs Western Knowledge.

Module:2	**Culture and Civilization**	

Introduction to Culture and Civilization, Culture and Heritage, Characteristics features of Indian Culture, Importance of Culture, Cultural practices in Ancient India, Medieval India and Modern India.

Module:3	**Languages and Literature**	

Indian Languages and Literature: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature and literatures of South India.

Module:4	**Religion and Philosophy**	

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only).

Module:5	**Fine Arts in India**	

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama. Science and Technology in India, Development of science in ancient, medieval and modern India. Traditional Medicine — Herbal Healing - Yoga and Pranayama practices.

Module:6	**Traditional Knowledge in different sectors**	

Traditional knowledge and engineering, Traditional medicine system, Traditional knowledge in agriculture, Dependence of Traditional Societies on food and healthcare needs; Importance of conservation and sustainable development of environment, Management of biodiversity and Protection of Traditional knowledge.

Module:7	**Legal framework and Traditional Knowledge**	

Introduction on Legal framework and Traditional Knowledge: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, The protection of traditional knowledge bill, 2016.

Total Lecture Hours:	**60 hours**

Text Books :

1.	Shikha Jain, Parul G Munjal And Somya Joshi,(2020) Traditional Knowledge Systems And Cultural Heritage, Aryan Books International, India.
2.	Anindya Bhukta(2020), Legal Protection for Traditional Knowledge: Towards A New

	Law for Indigenous Intellectual Property, Emerald Publishing Limited, United Kingdom.		
Reference Books :			
1.	Traditional Knowledge System in India, by Amit Jha, 2009.		
2.	Basant Kumar Mohanta & Vipin Kumar Singh (2012), "Traditional Knowledge System & Technology in India", Pratibha Prakashan, India.		
3.	S. Baliyan, Indian Art and Culture, Oxford University Press, India.		
4	http://indiafacts.org/author/michel-danino/		
5.	GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi,2016.		
Mode of Evaluation: Quiz and Term End – Quiz			
Recommended by Board of Studies	16-11-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

Course Code	Course Title	L	T	P	C
BSSC102N	Indian Constitution	0	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

This Course is an introduction of Indian Constitution and basic concepts highlighted in this course for understanding the Constitution of India.

Course Outcome

At the end of the course, the student will acquire:

1. A basic understanding of Constitution of India.
2. The ability to understand the contemporary challenges and apply the knowledge gained from the course to current social contemporary legal issues.
3. The understanding of constitutional remedies.

Module:1	Introduction to Indian Constitution	5 hours

Introduction to the constitution of India and the Preamble - Sources of Indian Constitution - Features of Indian Constitution - Citizenship - Fundamental Rights and Duties - Directive Principles of state policy

Module:2	Union Government and its Administration Structure of the Indian Union	8 hours

Federalism, Centre- State relationship - President: Role, Power and Position - Prime Minister and Council of ministers - Cabinet and Central Secretariat - Lok Sabha - Rajya Sabha- The Supreme Court and High Court: Powers and Functions

Module:3	State Government and its Administration	4 hours

Governor- Role and Position - Chief Minister and Council of Ministers - State Legislative Assembly - State secretariat: Organization, Structure and Functions

Module:4	Local Administration	7 hours

District's Administration Head- Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative - Panchayati Raj: Composition and Functions Evolution and 73rd and 74th Amendments - Zila Parishad and district administration: Composition and Functions Elected officials and their roles, CEO Zila Panchayat: Position and role- Panchayat Samiti: Composition and Functions - Gram Panchayat: Composition and Functions Importance of grass root democracy

Module:5	Election Commission	6 hours

Role of Chief Election Commissioner - State Election Commission - Functions of Commissions for the welfare of SC/ST/OBC and women.

	Total Lecture hours:	30 hours

Reference Books				
1.	Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)			
2.	M.V.Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)			
3.	J.C Johari, Indian Government and Politics, Shoban Lal & Co., 2012			
4.	Noorani, A.G , Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.			
5.	R. Bhargava, (2008) 'Introduction: Outline of a Political Theory of the Indian Constitution', in R. Bhargava (ed.) Politics and Ethics of the Indian Constitution, New Delhi: Oxford University Press.			
6.	Bidyut Chakrabarty & Rajendra Kumar Pandey, Indian Government and Politics, SAGE, New Delhi, 2008			
7.	G. Austin, The Indian Constitution: CornerStone of a Nation, Oxford, Oxford University Press, 1966			
Mode of Evaluation**:** CAT, Written assignment, Quiz and FAT				
Recommended by Board of Studies		27-10-2021		
Approved by Academic Council		No. 68	Date	19-08-2022