VIT®

Vellore Institute of Technology

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

SCHOOL OF ELECTRICAL ENGINEERING

B. Tech

Electrical and Computer Science Engineering

(B.Tech ECS)

Curriculum

(*2023-2024 admitted students*)

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 ELECTRICAL ENGINEERING

To be a leader for academic excellence in the field of electrical, instrumentation and control engineering imparting high quality education and research leading to global competence for the societal and industrial developments.

MISSION STATEMENT OF THE SCHOOL OF ELECTRICAL ENGINEERING

M1: Impart high quality education and interdisciplinary research by providing conducive teaching learning environment and team spirit resulting in innovation and product development.

M2: Enhance the core competency of the students to cater to the needs of the industries and society by providing solutions in the field of electrical, electronics, instrumentation, and automation engineering.

M3: Develop interpersonal skills, leadership quality and societal responsibility through ethical value-added education.

CREDIT INFO		
S.no	**Catagory**	**Credits**
1	Foundation Core	49
2	Discipline-linked Engineering Sciences	16
3	Discipline Core	47
4	Discipline Elective	15
5	Projects and Internship	9
6	Open Elective	15
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	BCSE103E	Computer Programming: Java	Embedded Theory and Lab	1.0	1	0	4	0	3.0
5	BEEE102L	Basic Electrical and Electronics Engineering	Theory Only	1.0	3	0	0	0	3.0
6	BEEE102P	Basic Electrical and Electronics Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
7	BENG101L	Technical English Communication	Theory Only	1.0	2	0	0	0	2.0
8	BENG101P	Technical English Communication Lab	Lab Only	1.0	0	0	2	0	1.0
9	BENG102P	Technical Report Writing	Lab Only	1.0	0	0	2	0	1.0
10	BFLE200L	B.Tech. Foreign Language - 2021onwards	Basket	1.0	0	0	0	0	2.0
11	BHSM200L	B.Tech. HSM Elective - 2021 onwards	Basket	1.0	0	0	0	0	3.0
12	BMAT101L	Calculus	Theory Only	1.0	3	0	0	0	3.0
13	BMAT101P	Calculus Lab	Lab Only	1.0	0	0	2	0	1.0
14	BMAT102L	Differential Equations and Transforms	Theory Only	1.0	3	1	0	0	4.0
15	BMAT201L	Complex Variables and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0
16	BMAT202L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0
17	BMAT202P	Probability and Statistics Lab	Lab Only	1.0	0	0	2	0	1.0
18	BPHY101L	Engineering Physics	Theory Only	1.0	3	0	0	0	3.0
19	BPHY101P	Engineering Physics Lab	Lab Only	1.0	0	0	2	0	1.0
20	BSTS101P	Quantitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5
21	BSTS102P	Quantitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5
22	BSTS201P	Qualitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5
23	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	BECS201L	Semiconductor Devices and Circuits	Theory Only	1.0	3	0	0	0	3.0
2	BECS201P	Semiconductor Devices and Circuits Lab	Lab Only	1.0	0	0	2	0	1.0
3	BEEE203L	Circuit Theory	Theory Only	1.0	3	1	0	0	4.0
4	BEEE206L	Digital Electronics	Theory Only	1.0	3	0	0	0	3.0
5	BEEE206P	Digital Electronics Lab	Lab Only	1.0	0	0	2	0	1.0
6	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	BCSE205L	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0
4	BCSE302L	Database Systems	Theory Only	1.0	3	0	0	0	3.0
5	BCSE302P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0
6	BCSE303L	Operating Systems	Theory Only	1.0	3	0	0	0	3.0
7	BCSE303P	Operating Systems Lab	Lab Only	1.0	0	0	2	0	1.0
8	BCSE308L	Computer Networks	Theory Only	1.0	3	0	0	0	3.0
9	BCSE308P	Computer Networks Lab	Lab Only	1.0	0	0	2	0	1.0
10	BECM301L	Signal Processing	Theory Only	1.0	3	0	0	0	3.0
11	BECM301P	Signal Processing Lab	Lab Only	1.0	0	0	2	0	1.0
12	BECS301L	Electrical Machines	Theory Only	1.0	3	0	0	0	3.0
13	BECS303L	Power Electronics and Drives	Theory Only	1.0	3	0	0	0	3.0
14	BECS303P	Power Electronics and Drives Lab	Lab Only	1.0	0	0	2	0	1.0
15	BEEE303L	Control Systems	Theory Only	1.0	3	0	0	0	3.0
16	BEEE303P	Control Systems Lab	Lab Only	1.0	0	0	2	0	1.0
17	BEEE309L	Microprocessors and Microcontrollers	Theory Only	1.0	3	0	0	0	3.0
18	BEEE309P	Microprocessors and Microcontrollers Lab	Lab Only	1.0	0	0	2	0	1.0

Discipline Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BCSE204L	Design and Analysis of Algorithms	Theory Only	1.0	3	0	0	0	3.0
2	BCSE204P	Design and Analysis of Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
3	BCSE208L	Data Mining	Theory Only	1.0	2	0	0	0	2.0
4	BCSE208P	Data Mining Lab	Lab Only	1.0	0	0	2	0	1.0
5	BCSE301L	Software Engineering	Theory Only	1.0	3	0	0	0	3.0
6	BCSE301P	Software Engineering Lab	Lab Only	1.0	0	0	2	0	1.0

Discipline Elective									
7	BCSE304L	Theory of Computation	Theory Only	1.0	3	0	0	0	3.0
8	BCSE307L	Compiler Design	Theory Only	1.0	3	0	0	0	3.0
9	BCSE307P	Compiler Design Lab	Lab Only	1.0	0	0	2	0	1.0
10	BEEE213L	Embedded Systems Design	Theory Only	1.0	3	0	0	0	3.0

Open Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	BECE320E	Embedded C Programming	Embedded Theory and Lab	1.0	2	0	2	0	3.0
2	BHUM201L	Mass Communication	Theory Only	1.0	3	0	0	0	3.0
3	BHUM202L	Rural Development	Theory Only	1.0	3	0	0	0	3.0
4	BHUM203L	Introduction to Psychology	Theory Only	1.0	3	0	0	0	3.0
5	BHUM204L	Industrial Psychology	Theory Only	1.0	3	0	0	0	3.0
6	BHUM205L	Development Economics	Theory Only	1.0	3	0	0	0	3.0
7	BHUM206L	International Economics	Theory Only	1.0	3	0	0	0	3.0
8	BHUM207L	Engineering Economics	Theory Only	1.0	3	0	0	0	3.0
9	BHUM208L	Economics of Strategy	Theory Only	1.0	3	0	0	0	3.0
10	BHUM209L	Game Theory	Theory Only	1.0	3	0	0	0	3.0
11	BHUM210E	Econometrics	Embedded Theory and Lab	1.0	2	0	2	0	3.0
12	BHUM211L	Behavioral Economics	Theory Only	1.0	3	0	0	0	3.0
13	BHUM212L	Mathematics for Economic Analysis	Theory Only	1.0	3	0	0	0	3.0
14	BHUM213L	Corporate Social Responsibility	Theory Only	1.0	3	0	0	0	3.0
15	BHUM214L	Political Science	Theory Only	1.0	3	0	0	0	3.0
16	BHUM215L	International Relations	Theory Only	1.0	3	0	0	0	3.0
17	BHUM216L	Indian Culture and Heritage	Theory Only	1.0	3	0	0	0	3.0
18	BHUM217L	Contemporary India	Theory Only	1.0	3	0	0	0	3.0
19	BHUM218L	Financial Management	Theory Only	1.0	3	0	0	0	3.0
20	BHUM219L	Principles of Accounting	Theory Only	1.0	3	0	0	0	3.0
21	BHUM220L	Financial Markets and Institutions	Theory Only	1.0	3	0	0	0	3.0
22	BHUM221L	Economics of Money, Banking and Financial Markets	Theory Only	1.0	3	0	0	0	3.0
23	BHUM222L	Security Analysis and Portfolio Management	Theory Only	1.0	3	0	0	0	3.0
24	BHUM223L	Options , Futures and other Derivatives	Theory Only	1.0	3	0	0	0	3.0
25	BHUM224L	Fixed Income Securities	Theory Only	1.0	3	0	0	0	3.0
26	BHUM225L	Personal Finance	Theory Only	1.0	3	0	0	0	3.0
27	BHUM226L	Corporate Finance	Theory Only	1.0	3	0	0	0	3.0
28	BHUM227L	Financial Statement Analysis	Theory Only	1.0	3	0	0	0	3.0
29	BHUM228L	Cost and Management Accounting	Theory Only	1.0	3	0	0	0	3.0
30	BHUM229L	Mind, Embodiment and Technology	Theory Only	1.0	3	0	0	0	3.0
31	BHUM230L	Health Humanities in Biotechnological Era	Theory Only	1.0	3	0	0	0	3.0
32	BMGT108L	Entrepreneurship	Theory Only	1.0	3	0	0	0	3.0

Open Elective									
33	BSTS301P	Advanced Competitive Coding - I	Soft Skill	1.0	0	0	3	0	1.5
34	BSTS302P	Advanced Competitive Coding - II	Soft Skill	1.0	0	0	3	0	1.5

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	BEEE101N	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

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 - Infographics **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 - Abstract/Summary – 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 / Assignments / Quiz / Presentations / Oral examination

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

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

Course Code	Course Title	L	T	P	C
BPHY101L	Engineering Physics	3	0	0	3
Pre-requisite	NIL	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 (Qualitative) - Standing waves and their eigenfrequencies.		
Module:2	**Electromagnetic waves**	**7 hours**
Physics of divergence - gradient and curl - Qualitative understanding of surface and volume integral - Maxwell Equations (Qualitative) - Displacement current - Electromagnetic wave equation in free space - Plane electromagnetic waves in free space - Hertz's experiment.		
Module:3	**Elements of quantum mechanics**	**6 hours**
Need for Quantum Mechanics: Idea of Quantization (Planck and Einstein) - Compton effect (Qualitative) – de Broglie hypothesis - - Davisson-Germer experiment - Wave function and probability interpretation - Heisenberg uncertainty principle - Schrödinger wave equation (time dependent and time independent).		
Module:4	**Applications of quantum mechanics**	**5 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 CO2 lasers and their engineering applications.		
Module:6	**Propagation of EM waves in optical fibers**	**6 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**	**6 hours**
Introduction to semiconductors - direct and indirect bandgap – Sources: LED and laser diode, Photodetectors: PN and PIN.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(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, 1st Edition, 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

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

BARB101L	Arabic	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Demonstrate proficiency in communicating in Arabic language.
2. Develop the ability to narrate and describe in past, present, and future time by acquiring Arabic grammar knowledge.
3. Develop the knowledge of Arabic literature, culture, and Arabic technical terminologies.

Course Outcome

The student will be able to:

1. Remember Arabic Alphabets and Vowel signs.
2. Remember simple phrases like days, months, colors with simple conversation in professional and corporate mellow.
3. Understand the parts of speech and conjugations (Past, Present, Futures & Imperative).
4. Remember the Cardinal and Ordinal numbers and different types of members of the family as well as society.

Module:1	حروف لهجاء	**2 hours**
Arabic alphabet. The Pronunciation (Phonetic symbol of Arabic Alphabet). Shapes of Arabic letters.		
Module:2	حروف لغة	**3 hours**
The Vowel. The Vowel Signs & the Cases. The Sun letters & Moon letters.		
Module:3	قسام للكلمة	**4 hours**
The Noun. The Verb. The Particle. The Definite & the Indefinite.		
Module:4	لجنس. لموصوف ولصفة	**5 hours**
The Gender. Singular, Dual & Plural. Adjective and Noun qualified.		
Module:5	لضمائر	**5 hours**
The Personal Pronoun. The Demonstrative Pronoun. The Relative Pronoun. The Subject & the Predicate. The Demonstrative Phrase.		
Module:6	تصريف الفعال (لماضي ولمضارع والأمر)	**5 hours**
Conjugations. Daily usage vocabularies.		
Module:7	الأعداد ولمصطلحات لتقنية	**4 hours**
Numerals. Days of the week. Months of the year. Seasons. Colors. Relationship. Technical terminologies (Computer, Civil & Mechanical Engineering)		
Module:8	محاضرات	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)

1. Dr. V. Abdur Rahim, Arabic Course for English Speaking students (Vol-1, 2 & 3), 2019, First Edition, Goodword Books, New Delhi. ISBN: 978-0-9879146-2-0.

Reference Books

1. Dr. W. A. Nadwi, A Practical Approach to the Arabic Language, Islamic studies Research.
2. Academy, New Delhi. Revised edition-2016. ISBN: 9798189202148
   Dr. Aurang zeb Azmi, A New approach to the Arabic Grammar, Al-balagh Publication-New Delhi. 2018. ISBN: 978-93-83313-57-0.

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

Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BCHI101L	Chinese I	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Develop basic Chinese and do simple conversation.
2. Write Chinese writing system and basic Chinese characters.
3. Understand basic language texts relating to common daily settings and develop translation ability (Chinese to English & vice-versa).

Course Outcome

The students will be able to:

1. Greeting people in Chinese and use of personal pronouns and interrogative pronouns.
2. Express family names and understand yes – no question and correct use of phonetics.
3. Create expressions related to nationality, place of origin and special questions.
4. Learnoccupations in Chinese, Adverbials of time and place and noun and pronouns and create expressions related to age, numbers, special questions in Chinese.

Module:1	**Phonetics语音 YuYin**	**3 hours**

- Phonetics: Syllable initials:/ b/ / p/m /f ;;
- Syllable simple finals:/ a //o// e//i/u// ü;
- Phonetics: Syllable initials:/ d//t/ /n/l;
- Syllable compound finals: an// ie //uo/
- Phonetics: Syllable initials:/ g/k/ h/;
- Syllable compound finals::/ ai // ao//ei//en/
- Phonetics: Syllable initials:/j//q//x/;
- Syllable compound finals: /ang //eng//ong//iang// iong/
- Phonetics: Syllable initials:/z/c//s/;
- Phonetics: Syllable initials:/zh//ch//sh//r;
- Tones: /1// 2 // 3/ /4/

Module:2	**Writing System书写系统 shuxiexitong**	**4 hours**

- Chinese Characters
- Radicals
- Stroke order

Module:3	**Greetings问候 wenhou**	**3 hours**

- Learn the basic ways to greet people, and tell one's own name and other's name
- The personal pronouns"你，我，他/她，您，您们"
- Question with the interrogative pronoun"谁"

Module:4	**Family Names名姓 mingxing**	**4 hours**

- Learn to ask and tell Family names, given names
- Special questions with "什么"
- The Affirmative-Negative questions

Module:5	**Nationality国籍 guoji**	**4 hours**

- Learn to ask and tell one's Nationality and origin)
- Using "不" to express negation
- Special questions with "哪儿"or "什么地方"

Module:6	**Occupation职业 zhiye**	**5 hours**

• Learn to ask and tell one's occupation • Adverbials of time and place • Noun/pronoun+"的"+noun		
Module:7	**Numbers数字 shuzi**	**5 hours**
• Age (Learn to ask and tell one's age) • The numerals • The special questions with "几" • Time (Learn to tell time in native speakers' style) • Currency (Get idea about the usage of notes and coins in China) • The questions with "多少" and "怎么"		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)	
1.	Jiang Liping (2014) 《HSK Standard Course 1》Beijing, Beijing Language and Culture University Press, ISBN7-5619-3709-9.
Reference Books	
1.	Kang Yuhua & Lai Siping, (2005) 《Conversational Chinese 301》 Book-1& 2, Beijing, Beijing Language and Culture University Press, ISBN 978-7-5619-1403-8/ H 05014.
Mode of Evaluation: CAT, Digital assignment, Quiz, FAT	

Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BESP101L	Spanish I	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Demonstrate proficiency in reading, writing, and speaking in basic Spanish.
2. Learn vocabulary related to profession, education centers, day-to-day activities, food, culture, sports and hobby, family set up, workplace, market, and classroom activities.
3. Demonstrate the ability to describe things in simple forms and their details and translate from Spanish to English and vice versa.

Course Outcome

The students will be able to

1. Remember greetings, give personal details and identify genders by using correct articles.
2. Apply the correct use of SER, ESTAR, and TENER verbs to describe people, place, and things.
3. Discuss time and weather conditions by knowing months, days, and seasons in Spanish.
4. Create opinion about people and places by using regular verbs and reflexive verbs and creating small paragraphs about the daily routine, hometown, best friend, and family.

Module:1	**Abecedario; Saludos y Despedidas**	**4 hours**

El Abecedario, Saludos y Datos personales: Origen, Nacionalidad, Números Cardinales (1-100)

Recursos Gramaticales: Vocales y Consonantes, Sílabas. Artículos definidos e indefinidos (Número y Género).

Recursos Comunicativos: Saludar y despedirse: Aprender a Presentarnos, a preguntar cosas en clase.

Module:2	**Datos personales; recursos para preguntar sobre las palabras**	**4 hours**

Edad y posesión. Números Cardinales (101-100 000), Profesión, Los días de la semana.

Recursos Gramaticales: Pronombres personales. Adjetivos. Los verbos SER y TENER. Los verbos regulares (-AR, -ER, -IR) en el presente.

Recursos Comunicativos: Escribe sobre mismo/a y los compañeros de la clase.

Module:3	**Describir lugares; Expresar existencia y ubicación**	**4 hours**

Hacer un conocimiento del mundo Hispano. Vocabulario de Mi habitación, Países y Ciudades. Colores, Números Ordinales:

Del Primero a Décimo (1 - 10). Descripción de lugares y cosas.

Recursos Gramaticales: Adjetivos posesivos. El uso del verbo SER y ESTAR. Diferencia entre SER y ESTAR. ¿qué, cuál / cuáles, cuántos / cuántas, dónde, cómo, quién, cuándo?

Recursos Comunicativos: Mi habitación, Mi Ciudad.

Module:4	**Mi familia; Direcciones; Expresar la hora y los gustos**	**4 hours**

Mi familia. Direcciones. Expresar la hora.

Los meses del año. Expresar y preguntar sobre gustos e intereses.

Recursos Gramaticales: Frases preposicionales. Uso del HAY.

La diferencia entre MUY y MUCHO. Uso del verbo GUSTAR, JUGAR,

Recursos Comunicativos: Mi familia. Dar opiniones sobre tiempo.

Module:5	**El clima; habilidades y aptitudes; Cualidades y defectos de las personas**	**4 hours**

Expresar fechas, el tiempo y las direcciones. Presentar y Describir a una persona y lugar.

Recursos Gramaticales: Los verbos irregulares (E-IE, O-UE, E-I) en el presente.

Recursos Comunicativos: Mi mejor amigo/a. Expresar fechas. Traducción Inglés al español y español al inglés.		
Module:6	**Describir el diario; Las actividades cotidianas;**	**4 hours**
Describir el diario. Las actividades cotidianas. Identificar objetos, expresar necesidad. Recursos Gramaticales:Los Verbos y pronombres reflexivos y posesivos. Recursos Comunicativos:El horario. Traducción Inglés a español y español a inglés.		
Module:7	**La Gastronomía: Ir al Restaurante**	**4 hours**
La Gastronomía: ¡A Comer! Dar opiniones sobre alimentos y bebidas. Describir mi ciudad y Ubicar los sitios en la ciudad. Recursos Gramaticales: Los verbos irregulares. Estar + gerundio. Poder + Infinitivo. Recursos Comunicativos:En la cafetería, Conversación en un restaurante. Mi ciudad natal. Mi Universidad.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)

1.	Jaime Corpas, Eva Garcia, Agustin Garmendia, AULA INTERNACIONAL 1, Curso de Español, 1 January 2016, GoyalPublishers and DistributorsPvt. Ltd, New Delhi, India

Reference Books

1.	Shalu Chopra, VIVA LATINO 1, January 2019, Goyal Publishers and Distributors Pvt.Ltd, New Delhi, India
2.	Ramón Díez Galán, NuevoDELE A1: Versión 2020. Preparación para el examen. Modelos de examen
3.	DELE A1 (Spanish Edition), July 14, 2020, Independently Published. Spain.
	Charo Cuadrad, Pilar Melero, Enrique Sacristan, PROTAGONISTAS A1. LIBRO DEL ALUMNO,1 January 2018, GoyalPublishers and DistributorsPvt. Ltd, New Delhi, India

Mode of Evaluation: CAT, Digital Assignment, Quiz, FAT

Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BFRE101L	French I	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Develop language competencies for effective communication in French.
2. Provide insights into the French culture and make them understand the nuances through communication activities.
3. Enable the students to communicate effectively in general and in a professional context.

Course Outcome

The students will be able to:

1. Acquaint with the basics of the French Language.
2. Comprehend the various parts of speech and grammar concepts to frame basic sentences in French.
3. Translate and acquire knowledge on a broad range of printed materials for general, specific, and practical information.
4. Acquire and explain the culture of French people through the language studied in the class.

Module:1	**Saluer et se presenter:**	**6 hours**

Les Alphabets, Les Salutations, Les nombres (0-100000), L'heure, Les jours de la semaine, Les mois de l'année, Les Pronoms personnels sujets, La conjugaison des verbes réguliers (Les verbes ER) / irréguliers (avoir / être)

Savoir-faire et savoir-agir :

Saluer, Se présenter, Présenter quelqu'un, Donner des informations, Discuter de la classe / l'université.

Module:2	**L'activitéinteractive:**	**6 hours**

La Nationalité du Pays, Les articles définis / indéfinis, Les prépositions de lieu et l'article contracté, L'heure en français, La Couleur, La conjugaison des verbes - habiter / venir/Aller etc.

Savoir-faire et savoir-agir :

Localiser des lieux dans une ville, Exprimer l'heure en français et Échanger des informations sur un hébergement.

Module:3	**Les activités quotidiennes:**	**4 hours**

Les adjectifs possessifs, L'accord des adjectifs, Les pronoms toniques, La conjugaison du verbe 'faire' avec du, de la, de l', des. L'interrogation avec combien / comment / où etc. L'adjectif démonstratif, L'adjectif interrogatif,**La traduction simple** (français-anglais/anglais-français)

Savoir-faire et savoir-agir :

Parler de la famille, Décrire une personne, parler de nos goûts, parler de nos activités.

Module:4	**S'exprimer:**	**4 hours**

Les parties du corps. Avoir mal à + les parties du corps

La conjugaison des verbes pronominaux, La conjugaison des verbes réguliers (ir) et les autres verbes tels que -lire, écrire, pouvoir, vouloir, devoir, et sortir.

Savoir-faire et savoir-agir :

Parler de nos quotidiennes, proposer une sortie, inviter, accepter et refuser une invitation.

Module:5	**La culturefrançaise:**	**3 hours**

La gastronomie française. Les endroits. Le présent progressif, L'article partitif, Mettez les phrases au pluriel et faites des phrases avec les mots donnés, Trouvez les questions.

Savoir-faire et savoir-agir :

Décrire une journée extraordinaire, Répondre aux questions générales en français, Faire

des phrases.		
Module:6	**L'activitédialogique:**	**2 hours**
La traduction avancée (français-anglais/anglais-français) **Savoir-faire et savoir-agir :** Faire des achats, Demander la direction, Réserver une chambre dans un hôtel, La compréhension écrite et orale.		
Module:7	**L'activité de loisir**	**3 hours**
La rédaction / Dialogue:Décrire / parler de: ses goûts et préférences/ une personne / une place/ à la cafeteria / la profession / l'université/ les loisirs.		
Module:8	**Faciliter des échanges académiques**	**2 hours**
	Total Lecture hours:	**30hours**

Textbook(s)	
1.	Nathalie Hirschsprung, Tony Tricot, COSMOPOLITE- 1- Méthode de français, 2017, Hachette Français Langue t rang re, Paris.
Reference Books	
1.	Celine Braud, EDITO 1, Méthode de français, 2016, Didier,Paris.
2.	Marie-Noelle Cocton, GÉNÉRATION 1, Méthode de français, 2016, Didier,Paris.

Mode of Evaluation:CAT , Digital assignment , Quiz , FAT			
Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BGER101L	German I	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Demonstrate proficiency in reading, writing, and speaking in basic German.
2. Communicate in German in everyday situations.
3. Understand German culture and adapt in German speaking countries or to work with German speaking people.

Course Outcome

The students will be able to:

1. Understand basic expressions, words, signs and simple conversations.
2. Understand and translate short texts, simple descriptions, directions and illustrated narratives about daily activities.
3. Write grammatically correct sentences, short paragraphs, informal letters/e-mails, post cards etc… on matters of personal relevance and describe places and people in a simple language.
4. Use German in easy day-to-day conversations and demonstrate understanding of German culture.

Module:1	**Die ersteBegegnung**	**4 hours**

Grüßen und Verabschieden; sich und andere vorstellen; Namen, Telefonnummer und E-Mail-Adresse buchstabieren; Zahlen bis 100 und mehr nennen; über Länder, Sprachen und Nationalitäten sprechen.

Wortschatz: Begrüßungen, verabschieden, das Deutsche Alphabet, Zahlen, Länder und Sprachen
Grammatik: ,,W" Fragen, Aussagesätze, Personalpronomen im Singular und Verbkonjugation (sein/kommen/wohnen/lernen/studieren/sprechen/buchstabieren), Bestimmter Artikel
Schreiben: sich und andere vorstellen

Module:2	**Hobbys und Berufe**	**4 hours**

Über Hobbys und Freizeitaktivitäten sprechen; Wochentage und Monate nennen; die Uhrzeit nennen; über Arbeit, Berufe und Arbeitszeiten sprechen;

Wortschatz: Hobbys und Berufe, Uhrzeiten
Grammatik: Regel-und-Unregelmäßigen verbkonjugationen, haben konjugatio, Bestimmter und Unbestimmter Artikeln, Ja/Nein Fragen, die entsprechende Präpositionen (um/am/im/von...bis), Negation (nicht vs kein), Verbpositionen und Wortfolge
Schreiben: Was machst du in deiner Freizeit?

Module:3	**Familie**	**4 hours**

über Familie sprechen;

Wortschatz: Familie
Grammatik: Possessivpronomen, Nominativ und Akkusativ (Artikel und Personalpronomen)
Schreiben: ,,Meine Familie"

Module:4	**Essen und Trinken**	**4 hours**

Über Essen sprechen; Gespräche beim Essen führen; Gespräche beim Einkauf führen; über Vorlieben beim Essen sprechen;

Wortschatz: Lebensmittel, Getränke, Mahlzeiten
Grammatik: Verben - möchten/mögen, Akkusativ, Verben mit Akkusativ, Präpositionenmit dem Akkusativ (für/ohne)

Module:5	**ZusammenmitFreunden**	**4 hours**
Etwas gemeinsam planen; eine Speisekarte verstehen; im Restaurant bestellen und bezahlen; sich im Kaufhaus orientieren Wortschatz: Glückwünsche, Redemittel, Stockwerke und Waren im Kaufhaus Grammatik: Imperativ mit du und ihr, Artikel im Dativ, Personalpronomen im Dativ, Dativpräpositionen (mit, nach, ab, von), Modalverben (können, sollen, wollen) Schreiben: Inoffizielle Emails schreiben		
Module:6	**MeineWohnung**	**4 hours**
Wohnungsanzeigen verstehen, Wohnsituationen beschreiben; ein Zimmer beschreiben; Positionen beschreiben, Gefallen und Missfallen ausdrücken; Wortschatz: Wohnung, Zimmer und Räume, Möbel und Geräte, Farben Grammatik: Adjektiv mit sein, zu/sehr+Adj, Wechselpräpositionen Schreiben: ,,Wohnung“		
Module:7	**Eine Stadtrundfahrt**	**4 hours**
Nach dem Weg fragen; Verkehrsmittel und Verkehrsschilder benennen; Wortschatz: Plätze und Gebäude, Verkehrsmittel, Richtungen, Sehenswürdigkeiten Grammatik: Imperativ mit Sie, Modalverben (müssen/dürfen), Zeitadverbien: zuerst, dann, später…, Schreiben: ,,Meine Stadt“		
Module:8	**Training vom Sprechen**	**2 hours**
	Total Lecture hours:	**30hours**

Textbook(s)

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Ernst Klett Sprachen GmbH, Netzwerk A1, 2017, Stuttgart.

Reference Books

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Ernst Klett Sprachen GmbH, Netzwerk A1 Deutsch als Fremdsprache Intensivtrainer, 2019, Stuttgart
2.	Hartmut Aufderstrasse,JuttaMüller, Thomas Storz, Lagune, 2012.
3.	Dallapiazza, Rosa-Maria; Jan, Eduard von; Schönherr, Til, Hueber Verlag, 2008: Tangram aktuell.
4.	Hermann Funk, Christina Kuhn, Corneslen Verlag, Studio d A1,2010, Berlin.

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

Recommended by Board of Studies	01-11-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BGRE101L	Modern Greek	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Master the Greek terminology widely used in their subjects of specialization.
2. Communicate in Modern Greek in their day-to-day life.

Course Outcome

The students will be able to:

1. Make use of the Modern Greek language in everyday conversation.
2. Understand contents from scientific texts that use Greek letters and words, becoming familiar with fundamental linguistic aspects of the International Scientific Vocabulary, and becoming able to formulate hypotheses about unknown compound words derived from Greek.
3. Understand critical socio-economic issues in contemporary Europe, developing their aptitude for critical thinking.
4. Become more aware of linguistic theory and phonetics and correctly pronounce Greek letters and words, be more conscious and confident in using their English vocabulary derived from Greek and compare Modern Greek with a wide number of other languages through a deeper understanding of the International Phonetic Alphabet.

Module:1	**ΤοΕλληνικό αλφάβητο, ηφωνητικήκαιηπροφορά, τομονοτονικόσύστημακαιτασημείαστίξης - IntroductiontotheGreekAlphabet, Phonetics, Accentuation&Punctuation**	**10 hours**

Correct usage and pronunciation of Greek letters; Greek symbols used in mathematics, science and engineering; Greek suffixes and prefixes used in International Scientific Vocabulary; International Phonetic Alphabet and phonetics of Modern Greek; Greek monotonic system (usage of grave accent and diaeresis); word stress rules; capitalization and punctuation rules.

Module:2	**Η Δομή των Φράσεων και η Πρόταση: Γραμματική - Structureandgrammar**	**3 hours**

Gender (masculine, feminine, neuter), number (singular/plural) and case (nominative, genitive, accusative and dative); adjectives: explaining agreement (concord); definite and indefinite articles; personal, interrogative, possessive, demonstrative, indefinite pronouns.

Module:3	**Χαιρετισμοί: πληθυντικόςευγενείας -Formal and informal greetings**	**3 hours**

Communicative functions: using formal and informal greetings; introducing oneself using affirmative form.

Morphology and Syntax**:** Auxiliary verb είμαι; personal pronouns (nominative form); cardinal numerals from 1 to 20.

Module:4	**Συστήνω τον εαυτό μου- Introductions**	**3 hours**

Communicative functions: asking and providing information about basic personal details (name, age, nationality, studies, profession).

Morphology and Syntax**:**1st conjugation verbs (ending in -ω, simple present tense); masculine nouns in -ας/-ης/-ος (nominative singular); feminine nouns in -α/-η (nominative singular); neuter nouns in -ο/-ι (nominative singular).

Module:5	**Καταγωγήκαι οικογένεια - Nationality and Family**	**3 hours**
Communicative functions: asking and providing information about nationality and languages known; describing the members of a nuclear or extended family. Morphology and Syntax:2nd conjugation verbs (ending in -αω, simple present tense); accusative case (singular, parisyllabic nouns); accusative case (singular personal pronouns); adjectives of nationality.		
Module:6	**Ηκαθημερινήρουτίνα - Daily Routine and Transportation**	**3 hours**
Communicative functions: asking and providing information about habits and daily routine; telling and asking the time; asking for and giving directions. Morphology and Syntax:verbs πάω, τρώω, λέω, ακούω; simple present tense and adverbs of frequency; simple prepositions.		
Module:7	**Ο καιρός, οι εποχές του χρόνου και η ζωή στην πόλη - Weather, SeasonsandUrbanActivities**	**3 hours**
Communicative functions: talking about the weather; asking the date; asking for prices; making calculations and perform a simple commercial transaction. Morphology and Syntax:accusative case (time); cardinal numerals up to one million; ordinal numbers; indefinite articles; accusative case (plural parisyllabic nouns).		
Module:8	**Διάλεξημε προσκεκλημέν-ο/η ομιλ-ητή/ήτρια: κοινωνίακαιπραγματικότητα της σύγχρονης Ελλάδας – contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)

1.	GeorgantziEvangelia, RaftopoulouEleana, *Greek for you - Ελληνικάγιασας: Textbook A1 Beginners*,March 2018, New Bilingual Edition (ISBN: 978-9607307682), Neohel, Athens, Greece.
2.	GeorgantziEvangelia, RaftopoulouEleana, *Greek for you - Ελληνικάγιασας: Workbook A1 Beginners*, March 2018, New Bilingual Edition (ISBN: 978-9607307736), Neohel, Athens, Greece.

Reference Books

1.	Terpsi Gavala, Konstantinos Oikonomou, *Λυδία. 'Ενα καλοκαίρι στην Ελλάδα!*,2019, firstedition, Omilo, Athens, Greece.
2.	GeorgantziEvangelia, *Greek for you - Ελληνικάγιασας: Textbook A0 Early Beginners* + *CD mp3*, 2018, Bilingual Bundle Edition (ISBN: 978-9607307668), Neohel, Athens, Greece.

Mode of Evaluation: CAT, Digital Assignment, Quiz, FAT.

Recommended by Board of Studies	01-11-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BITL101L	Italian	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Communicate in Italian in their day-to-day life.
2. Describe in simple terms (both in written and oral form) aspects of their background, immediate environment and needs.
3. Learn crucial aspects of Italian culture and civilization, as well as the role of the Italian economy in the global market.

Course Outcome

The students will be able to:

1. Use Italian language in everyday conversation.
2. Analyze the evolution of Modern European languages, understanding the important connections between English and Neo-Latin languages by using Italian language in written form, thus becoming more conscious of English vocabulary which is derived from Latin and Italian.
3. Understand important cultural aspects and socio-economic issues in contemporary Europe, developing their aptitude for critical thinking and adopting an internationally oriented approach in learning.
4. Understand the concept of Made in Italy, concerning the world-renowned Italian design, fashion, food, manufacturing, craftsmanship, and engineering industries.

Module:1	**Primicontatti- Basic interaction**	**4 hours**

Communicative functions:
Salutare (greetings); chiedere il nome (asking someone's name); presentarsi (introducing yourself); chiedere e indicare la provenienza (asking and talking about one's provenance); congedarsi (leaving from a conversation); chiedere il numero di telefono e l'indirizzo e rispondere (sharing personal details such as telephone numbers and addresses); chiedere di ripetereun'informazione (asking someone to repeat a sentence or a piece of information).
Grammar and vocabulary skills:
I pronomi soggetto (subjectpronouns io, tu, Lei); il presente di essere, avere, chiamarsi al singolare (simplepresent tense of the verbs essere, avere, chiamarsi); l'alfabeto (the alphabet); gli articoli determinativi (definite articles il & la); gli aggettivi di nazionalità al singolare (adjectives of nationality - singular); gli interrogativi: come, di dove, quale (interrogatives come, dove, qual); gli aggettivi numerali cardinali da 1 a 20 (numeral cardinal adjectives from one to twenty).

Module:2	**Persone e professioni – People and professions**	**4 hours**

Communicative functions:
Chiedere e dire l'età(asking and telling someone's age); indicareoccupazione e luogo di lavoro (share information about one's profession and work place); chiedere e fornireinformazionipersonali (sharing personal details, such as email, phone number etc.); informarsidelleconoscenzelinguistichealtrui e fornire le proprie (sharing information about one's spoken languages); scusarsi e ringraziare (excusing oneself, thanking someone); chiedere e dire l'età (asking and telling about someone's age).
Grammar and vocabulary skills:
I verbi regolari in -are (regular verbs - first conjugation); i verbi essere, avere, fare e stare (auxiliaryverbs avere and essere, irreguarverbs fare and stare); i sostantivi al singolare (singularnouns); la negazione (negative clauses); articoli determinativi e indeterminativi

(definite and indefinite articles); dimostrativi questo e questa (demonstratives); le preposizioni a e in (prepositions a, in); gli interrogativi che, chi, dove, quanti (interrogatives: what, who, where, howmany); gli aggettivi numerali cardinali fino a 100 (numeral cardinal adjectives up to 100).		
Module:3	**Cibi e bevande - Gastronomic culture in Italy**	**4 hours**
Communicative functions: ordinare al bar e al ristorante (placing an order at a restaurant/café/bar); chiedere e ordinarequalcosa in modo cortese (asking something politely); chiederequalcosachemancasultavolo (making special requests to a waiter); chiedere il conto (requesting the bill); fare una prenotazionetelefonica (making a reservation over phone); compitare (spelling a name/address). Grammar and vocabulary skills: i verbi regolari in -ere (regular verbs - second conjugation); i verbi volere e preferire (irreguarverbs volere and preferire); il plurale dei sostantivi (pluralnouns); articoli determinativi plurali (plural definite articles); bene e buono | (adverb bene and adjective buono); gli interrogativi che cosa, quali, quante (interrogative forms: what, which one, howmany).		
Module:4	**Tempo libero, attivitàabituali - Free time and routine activities**	**4 hours**
Communicative functions: parlare del tempo libero (discussing about free time and leisure); parlaredellafrequenza con cui si fa qualcosa (talking about the frequency of a certain activity). Grammar and vocabulary skills: i verbi regolari in -ire (regular verbs - thirdconjugation); i verbi andare, giocare, leggere e uscire (verbs andare, giocare, leggere and uscire); gli avverbi di frequenza (adverbs of frequency).		
Module:5	**La casa e la stanza d'albergo - Describing a room and everyday objects**	**4 hours**
Communicative functions: Descrivereun'abitazione (describing a home); descrivereiservizi di un albergo (describing a hotel room and the services available); recensire un albergo (writing a simple hotel review); chiedereassistenza (asking for someone's assistance). Grammar and vocabulary skills: iverbiregolari in -ire con -isc (regular verbs - third conjugation in -isc)c' / ci sono (usage of there is / there are); iverbipotere / venire (to be able to, to come); le preposizioni di tempo da… a (prepositions da… a); le preposizioniarticolate (articulated prepositions); imesidell'anno (months of the year); aggettivinumeraliordinali (ordinal numeral adjectives); l'interrogativoquanto (usage of quanto); i numeri cardinalimaggiori di 100 (cardinal numerals above 100); la data (date and time).		
Module:6	**Spazio e tempo – Space and Time**	**4 hours**
Communicative functions: descriverela propria città(describing one's city); chiedereun'informazione e reagire (asking for directions in an interactive way); descrivere un percorso (describing a route); rammaricarsi/scusarsi (expressing regret/apologizing); indirizzarequalcunoadaltrepersone (giving directions); parlaredegliorari di apertura e chiusura (talking about opening hours); parlare del tempo atmosferico (talking about weather). Grammar and vocabulary skills: ci e il verbo andare (usage of the particle ci in combination with the verb to go); la concordanza degli aggettivi con i sostantivi (adjective-noun agreement); gli aggettivi in -co/-ca (adjectivesending in -co and -ca); il partitivo - l'articolo indeterminativo al plurale (partitives and quantitatives); molto (usage of molto); i verbi dovere e sapere (the verbs dovere and sapere); c' un…? / dov' il…? (usage of isthere a…? / whereis the…?); gli interrogativi quando e dove (interrogatives: when&where); l'orario - a che ora…? (usage of a cheora…? - at what time…?).		

Module:7	**Parliamo di me – Habits and Preferences**	**4 hours**
Communicative functions: parlare di gusti e preferenze (talking about preferences and one's tastes); esprimereaccordo e disaccordo (expressing agreement and disagreement); chiedere e dire l'ora (asking and telling the time). Grammar and vocabulary skills: preposizioni in, a, con (prepositions in, a, con); i giorni della settimana (days of the week); mi piace/mi piacciono (usage of mi piace); l'interrogativo perché (the interrogative perché).		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)	
1.	L. Ziglio, G. Rizzo, *Nuovo Espresso 1: Libro dello studente e esercizi*, 2018(under license of ALMA, Italy), ISBN: 978-9386862853,Goyal Publishing House, New Delhi.
Reference Books	
1.	C.M. Naddeo, E. Orlandino, *Dieci lezioni di italiano – Corso di lingua italiana per stranieri A1*, 2020, ALMA edizioni, Florence (Italy).
Mode of Evaluation: CAT, Digital Assignment, Quiz, FAT.	

Recommended by Board of Studies	01-11-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BJAP101L	Japanese I	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus Version**			
		1.0			

Course Objectives

The course gives students the necessary background to:

1. Develop interest in Japanese language by teaching them culture and general etiquettes.
2. Develop four basic skills that is reading, writing, listening, and speaking Japanese language.
3. Develop skills to understand and use everyday expressions as well as basic phrases.

Course Outcome

Students will be able to:

1. Greet in Japanese and remember Japanese alphabets.
2. Introduce themselves as well as can briefly exchange the personal details related to family, home, favorite foods etc., in Japanese.
3. Create simple questions and its answers in Japanese as well as can briefly describe their daily routine in Japanese.
4. Understand the Japanese culture and etiquettes.

Module:1	**Introduction, Hiragana, Katakana and Kanji**	**4 hours**

Introduction of Japanese language and alphabets; Hiragana and katakana
Reading and writing Hiragana and Katakana, 20 Nouns in Hiragana and 10 Nouns in Katakana, Numerals
Basic rule of Japanese phonetics.

Module:2	**Konnichiwa. Hajimemashite.**	**4 hours**

Daily greetings and basic phrases to introduce yourself
Express about your name, occupation, age, where you live, where you are from and what language you can speak
Body Language such as bowing, pointing to your face, etc.

Module:3	**WatashinoKazoku**	**4 hours**

Talk briefly about your family, how many members there are and who they are,
Talk about your family showing a photo. Learn some phrases to give compliments.

Module:4	**Sukinatabemono. Hitotsukudasai.**	**4 hours**

Talk briefly about your favorite foods and dishes. Talk about your breakfast and where to go for lunch.
Order food in a fast food restaurant.

Module:5	**Watashinoie. Ojamashimasu.**	**4 hours**

Say what kind of home you live in. Say what you have in your room and around your home
Invite your friend to your place / visit your friend's house.

Module:6	**Nanjiniokimasuka. Itsugaiidesuka.**	**4 hours**

Say the time and days you do something, Talk about your plans in the week
Talk about your plans and schedule.

Module:7	**KonoHitohaDareDesuka.**	**4 hours**

Demonstrative pronoun - Kore, Sore, Are and Dore, (This, That, Over there, which) Kono, sono, Ano and Dono (this, that, over there, which) Kochira, Sochira, Achira and Dochira. this way....) Koko, Soko, Asoko and Doko (Here, There…. location).Classification of Question words (Dare, Nani, Itsu, Doyatte, dooshite, Ikutsu, Ikura).

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

	Total Lecture hours:	**30 hours**

Textbook(s)			
1.	The Japan Foundation (2017), Marugoto Japanese Language and Culture Starter (A1)Course book For Communicative Language Activities, New Delhi: Goyal Publishers (9788183078054).		
Reference Books			
1.	The Japan Foundation (2017), Marugoto Japanese Language and Culture Starter A1 Course book For Communicative Language Competences, New Delhi: Goyal Publishers (9788183078047).		
2.	Banno, Eri et al (2020), Genki: An Integrated Course in Elementary Japanese I [Third Edition], Japan: The Japan Times.		
Mode of Evaluation: CAT, Digital Assignment, Quiz, FAT			
Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

Course Code	Course Title	L	T	P	C
BKOR101L	Basic Korean – Level 1	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To learn the basic Korean alphabet.
2. To enable to read and speak basic Korean necessary for daily life: salutations, self-introduction.
3. To know basic verbs and noun ending and conjugation
4. To read and write the bulletin board writings, invitations, menu card, simple memo noteand sign boards.

Course Outcomes

1. Read and write Korean.
2. Greet with Korean and introduce her/himself in Korean.
3. Grasp basic grammar and writing in Korean.
4. Understand and produce key expressions for everyday activities.

Module 1	Introduction	3 hours

Introduction to Korean Language, Culture, Cross Cultural Communication. After completing the lessons, students will be able to understand Korean Culture.

Module 2	Korean Alphabets – Hangeul – I	6 hours

Philosophy of Korean alphabets, Introducing phonics, the character system. In this module, students will learn the Korean alphabet or Korean writing system called 'Hangeul'. After completing the lessons, the students will be able to understand the principles of how each letter was invented. Also, students will be able to read and write Hangeul.

Module 3	Korean Alphabets – Hangeul – II	6 hours

Philosophy of Korean alphabets, Introducing phonics, the character system. In this module, students will learn the Korean alphabet or Korean writing system called 'Hangeul'. After completing the lessons, the students will be able to understand the principles of how each letter was invented. Also, students will be able to read and write Hangeul.

Module 4	Basic Grammar	4 hours

Noun, Pronoun Basic Verb and Greetings & Introducing, after completing the lessons, students will be able to understand basic grammar, basic greetings and introducing oneself.

Module 5	Self-Introduction & Essential expressions - I	3 hours

In this module, Students will learn how to greet and answer those questions in Korean. After completing the lessons, students will be able to introduce themselves, greet a person and talk about someone's nationalities and occupations.

Module 6	Self-Introduction & Essential expressions - II	3 hours

In this module, Students will learn how to ask someone's nationalities and answer those questions in Korean. After completing the lessons, students will be able to introduce themselves, greet a person and talk about someone's nationalities and occupations.

Module 7	Location and Positions	3 hours

Talking about location, expressing movement, place marker & writing. In this module, students will learn how to explain where a thing is, where I am and where I go to. Students will learn manyvocabularies related with various places.		
Module 8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**30 hours**
Reference Books		
Introduction to Sejong Korean		
E-Books		
1.	https://nuri.iksi.or.kr/e-book/ecatalog5.jsp?Dir=303&catimage=&callmode=admin	
2.	https://nuri.iksi.or.kr/e-book/ecatalog5.jsp?Dir=611&catimage=&callmode=admin	
Mode of Evaluation: CAT / Assignment / Quiz / Seminar/ FAT		

Recommended by Board of Studies	03-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BKOR102L	Basic Korean – Level 2	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To read and write the bulletin board writings, invitations, menu card, simple memo noteand sign boards.
2. To speak an make a note basic requirements and ordering at shop or restaurant
3. To learn the basic grammar
4. To talk about weather and Time
5. To enable to make an appointment and suggestion.

Course Outcomes

1. Shopping and ordering with numbers what they want.
2. Talk about weather, date, and time in various situations.
3. Describe their plan and explain what they did in last weekend and past
4. Make an appointment with friends and suggest what they want to

Module 1	Shopping and Restaurant	4 hours

In this module, students will learn how to order food and make requests at a restaurant in Korean. After completing the lesson, students will be able to inquire about restaurant menus, order a specific portion of food at a restaurant, and order a drink at a café. Students will learn how to make purchases at various types of stores inKorean. After completing the lesson, you will be able to express pricesper item, purchase a product from a store, and make a specific request while shopping.

Module 2	Time & Date and Daily Activities	4 hours

In this module, students will learn various Korean vocabulary regarding your daily lives. After completing the lessons, studentswill be able to utilize informal sentence endings, ask and answer about their everyday life. Students will learn about time and date in Korean.

Module 3	Number and Time	2 hours

In this module, students will learn Two ways of counting numbers and saying time in Korean numbers and Sino numbers. Always use two different names of numbers are commonly used in daily life. Students can count in mathematics and pay Korean currency, Kwon as well.

Module 4	Introduction to Tenses – I	6 hours

In this module, Students will learn how to explain what they did yesterday or last weekend. After completing the lessons, students will be able to speak about their school time story and what happened to them yesterday and last year.

Module 5	Introduction to Tenses – II and Past Tense	4 hours

In this module, Students will learn how to explain what they did yesterday or last weekend. After completing the lessons, students will be able to speak about their school time story and what happened to them yesterday and last year.

Module 6	Making appointment and Suggestions – I	4 hours

Talking about location, expressing movement, place marker and directions.

Students will learn many vocabularies related with various places.		
Module 7	**Making appointment and Suggestions – II**	**4 hours**
Talking about location, expressing movement, place marker & writing about travelling from one place to another. In this module which is an extension of **Module 6**, students will learn how to explain where a thing is, where I am and where I go to. Students will learn many vocabularies related with various places.		
Module 8	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**30 hours**
Reference Books		
Introduction to Sejong Korean		
E-Books		
1.	https://nuri.iksi.or.kr/e-book/ecatalog5.jsp?Dir=303&catimage=&callmode=admin	
2.	https://nuri.iksi.or.kr/e-book/ecatalog5.jsp?Dir=611&catimage=&callmode=admin	
Mode of Evaluation: CAT / Assignment / Quiz / Seminar/ FAT		

Recommended by Board of Studies	03-03-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

BCLE212L	NATURAL DISASTER MITIGATION AND MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide adequate knowledge about disaster mitigation, preparedness, response, and recovery to face disaster among government bodies, institutions, NGO's, etc.
2. Obtain the knowledge different disaster and its preparedness and mitigation methods.
3. Provide adequate knowledge about applications of space technology in disaster monitoring and information dissemination.

Course Outcomes

Upon completion of this course, the student will be able to :

1. Understand the safety precautions and how to handle the disasters.
2. Develop skills in different disasters and its mitigation methods.
3. Examine how quickly to response and prepared for different disasters.
4. Understand how the space and communication technology used in disaster monitoring and early warning.
5. Learn the current affairs on disaster management and resilience to disasters.

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

Natural Disasters Principles, Elements, Important Community needs-Hyogo Framework for Action (HFA)–Sendai Framework for Disaster Risk Reduction-Disaster Management System-Hazard, Vulnerability and Risk–History of Disaster Management in India-Disaster Management Act-Disaster Management Structure in India-Nodal Agencies for Disaster Management in India-Disaster Types.

Module: 2	**Water and Climate Related Disasters**	**6 hours**

Floods, Cyclones-Tornadoes and Hurricanes, Hailstorm, Cloud Burst, Heat Wave and Cold Wave, Snow Avalanches, Droughts, Famine, Sea Erosion, Thunder and Lighting – Definition, Cause, Types, Safety Precautions.

Module: 3	**Geology Related Disasters**	**5 hours**

Landslides and Mudflows, Earthquakes, Dam Failures / Dam Bursts, Mine Fires, Tsunami– Definition, Cause, Types, Safety Precautions.

Module: 4	**Chemical, Nuclear and Biological Related Disasters**	**5 hours**

Chemical and Industrial Disasters, Nuclear Disasters, Biological Disaster and Epidemics, Pest Attacks, Cattle Epidemics, Food Poisoning-Definition, Cause, Types, Safety Precautions.

Module: 5	**Accident Related Disasters**	**6 hours**

Forest Fires, Urban Fires, Mine Flooding, Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival Disasters and Fires, Electrical Disasters and Fires, Air, Road and Rail Accidents, Boat Capsizing, Village Fire-Definition, Cause, Types, Safety Precautions.

Module: 6	**Mapping and Monitoring**	**7 hours**

Modelling, risk analysis and loss estimation–Natural disaster risk Reduction Strategies-Prevention and mitigation-Applications of Space Technology (Satellite Communications, GPS, GIS and Remote Sensing and Information / Communication Technologies (ICT) in Early warning Systems-Disaster Monitoring and Support Centre–Information Dissemination–Mobile Communications-Social Media etc through case studies.

Module: 7	**Community Based Disaster Risk Reduction**	**7 hours**

Psychological effects after disasters-Socio Psycho care-Managing stress–Education and Training–Establishment of capacity building among various stake holders–Government, Educational institutions, Civil Society–Use of Multi-media knowledge products for self-education.

Module: 8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
Text Book(s)		
1	Bhandari, R.K, Disaster Education and Management, A Joyride for Students, Teachers and Disaster Managers, 2014, Springer, India.	
2	Ranke, Ulrich, Natural Disaster Risk Management-Geosciences and Social Responsibility, 2016, First Edition, Springer International Publishing.	
Reference Books		
1	Brian Tomaszewski, Geographic Information Systems (GIS) for Disaster Management, 2014, CRC Press, UK.	
2	Harsh K. Gupta, Disaster Management, 2006, Second Edition, Indian National Science Academy.	
3	Dhawan, Disaster Management and Preparedness, 2012, First Edition, CBS Publisher Pvt. Ltd.	
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

Course Code	Course Title	L	T	P	C
BCLE214L	Global Warming	3	0	0	3
Pre-requisite	NIL	Syllabus version 1.0			

Course Objectives

The objectives of this course is to :

1. Learn atmospheric dynamics and transport of heat.
2. Evaluate climate changes using models and predict global warming.
3. Acquire the concept of mitigation measures for global warming.

Course Outcomes

Upon completion of this course, the student will be able to :

1. Understand the principles of atmospheric dynamics and demonstrate the intimidations of global warming at global and regional level.
2. Understand the need for mitigation and vulnerability assessment of regional and global warming.
3. Critically evaluate the scientific insights of the IPCC, global policies on global warming and mitigation.
4. Develop climatic models to predict global warming.
5. Relate knowledge of science and engineering for mitigation of global warming.

Module:1	Introduction	5 hours

Introduction to global warming–Significance of ozone in environment–Depletion of ozone layer-Greenhouse gases-Vienna convention and Montreal protocol-Role of hydrological cycle with greenhouse gases-Carbon cycle.

Module:2	Characteristics of atmosphere and its effects	8 hours

Physical and chemical characteristics of atmosphere-Biogeochemistry-Atmospheric stability-Temperature profile of the atmosphere–Temperature inversion effects–Isobaric heating and cooling–Adiabatic lapse rates-Radiation, convection and advections-Sun & solar radiation–Energy balance–Terrestrial radiation and the atmosphere.

Module:3	Elements of global warming	7 hours

Total carbon dioxide emissions by energy sector–industrial, commercial, transportation, residential–Impacts–air quality, hydrology, green space–Causes of global and regional climate change–Changes in patterns of temperature, precipitation and sea level rise–Greenhouse effect.

Module:4	Impacts of global warming	7 hours

Roots of global warming-Temperature alteration in the atmosphere-Melting of ice Pole-sea level rise-Impacts on Ecosystem–Water Resources-Methods and Scenarios–Uncertainties in the impacts of global warming–Risk of irreversible changes –Vulnerability assessment.

Module:5	Forecasting global warming with climate change models	6 hours

Developing climate models–Climate system model–Climate simulation and drift–Evaluation of climate model simulation–Regional (RCM)–Global (GCM)–Global average response to warming–Climate change observed to date.

Module:6	Global Policies and regulations towards global warming	5 hours

National and national legislative frameworks–UNFCCC–IPCC–Kyoto protocol–Kyoto mechanisms, clean development mechanisms, IPCC details and actions–Carbon credits-International and Regional cooperation.

Module:7	Mitigation measures of global warming	5 hours

Carbon sequestration and Carbon capture and storage (CCS)-Clean development mechanism (CDM)–Carbon trading-Future clean technology–Renewable and alternative energy, Green building, eco-friendly plastic.		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1. Robin Moilveen, Fundamentals of weather and climate, 2010, Second Edition, Oxford University Press, UK.
2. Neelin David J, Climate Change and Climate Modelling, 2011, First Edition, Cambridge University Press, UK.

Reference Books

1. Thomas Stocker, Introduction to Climate Modelling, Advances in Geophysical and Environmental Mechanics and Mathematics. 2011, Springer, UK.
2. Robert T. Watson, Marufu C. Zinyowera, Impacts, Richard H. Moss, Adaptation and mitigation of climate change-Scientific Technical Analyses, 1996, Cambridge University Press, Cambridge, USA.
3. J.M. Wallace, P.V. Hobbs, Atmospheric Science, 2006, Second Edition, Elsevier / Academic Press, USA.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 66	**Date**	16-06-2022

Course Code	Course Title	L	T	P	C
BCLE215L	**Waste Management**	**3**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the different sources of the waste.
2. Analyse the socio-economic and environmental factors for waste management.
3. Imply the shift of waste management in the closed loop approach.

Course Outcomes

Upon completion of this course, the student will be able to :

1. Understand the potential impacts of waste management.
2. Develop the environmental, social and economic framework towards sustainable development.
3. Apply sustainable development tools in regulating the waste management.
4. Implement life cycle analysis in waste management.
5. Involve in the concepts of closed loop approach and circular economy.

Module:1	**Introduction to Waste Management**	**5 hours**

Perspective of waste generation–Sources, impacts, characteristics, segregation and disposal of waste-Linear economy –Urbanization and new challenges in waste management–Problems associated with the waste-Relevant Regulations.

Module:2	**Municipal Solid Waste Management**	**7 hours**

Sources; composition; generation-Rates; collection of waste; separation-Transfer and transport of waste-Treatment and disposal options-Landfill-Bio-mining-Incineration-Biomedical waste-Source, generation and classification-Waste management and reduction techniques.

Module:3	**Hazardous Waste Management**	**6 hours**

Characterization of waste-Compatibility and flammability of chemicals-Storage-Transport-Secured Landfills-Treatment techniques-Fundamental concepts on fate and transport of chemicals-Health effects.

Module:4	**Radioactive Waste Management**	**6 hours**

Sources, measures and health effects-Nuclear power plants and fuel production-Waste generation from nuclear power plants–Low level and high level waste-Management-Radiation standard by ICRP and AERB-Regulatory framework.

Module:5	**Wastewater Management**	**5 hours**

Sources and characteristics of wastewater–Primary wastewater treatment–Secondary wastewater treatment–Sludge treatment alternatives–Industrial wastewater treatment–Zero Liquid Discharge–Wastewater disposal methods.

Module:6	**Emerging waste**	**9 hours**

Sources and Characteristics of Plastic waste, marine plastic waste, microplastic, E-waste, Agriculture waste, Glass waste, Metal waste, Oil and gas exploration and production of waste, Space waste, Construction material waste-Recycling non-biodegradable waste, Tyre recycling, End of life textiles, Recovery of value added products, Reuse of waste.

Module:7	**Closed Loop Approach Towards Circular Economy**	**5 hours**

Introduction to the Circular Economy-Transition from Linear to Circular Economy-Closed loop supply chain–Integrated waste refinery-Sustainable Development Goals (SDGs)-

Circular Economy policies towards Sustainable Development.		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture Hours		**45 hours**
Text Book(s)		
1. Salah M. El-Haggar, Sustainable Industrial Design and Waste Management Cradle-to-cradle for Sustainable Development, 2007, Elsevier Academic Press, USA.		
Reference Books		
1. Trevor M. Letcher and Daniel A. Vallero, Waste- A Handbook for Management, 2019, Second Edition, Elsevier Academic Press, USA. 2. Alexandros Stefanakis and Ioannis Nikolaou, Circular Economy and Sustainability Volume 2: Environmental Engineering, 2021, First Edition, Elsevier Academic Press, USA.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 66	**Date** 16-06-2022

Course Code	Course Title	L	T	P	C
BCLE216L	Water Resource Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Acquire the basic principles of water resources and its planning and management.
2. Enhance the knowledge on recent technologies in assessing the water resources.
3. Identify the challenges facing water management in varied climate types around the world.

Course Outcomes

Upon completion of this course, the student will be able to :

1. Understand the planning of water resources and need for water resource management.
2. Understand the water resource potential in global, India scenario and explore the water resources using different technologies.
3. Acquire a knowledge international and national water law and its policy.
4. Explain the concept of water in agricultural and economic aspects.
5. Predict the future trends of water demand and its management during crisis.

Module:1	Water, A Multi-Dimensional Resource	5 hours

Water resources planning-Multi-dimensional management-Water withdrawal and consumption by sector-Stress, international policy-Climate change, oceans, challenges and need for water resource management.

Module:2	Global and Indian Scenario for Water Resources	4 hours

Surface Water and Groundwater Global and Indian Scenario-Quality of water resources-Water use and sustainable reuse methods-Usable water resources by continent and country-Water footprint.

Module:3	Water Resources Assessment	5 hours

Network design-Stream flow gauging-Weir design-Gauges-Current gauging-Salt dilution-Geophysical exploration-Test drilling-Application of remote sensing techniques.

Module:4	Water in Agricultural Systems	7 hours

Water for food production, virtual water trade for achieving global water security, irrigation efficiencies, irrigation methods and current water pricing, water for livestock and processing, water pollution from agricultural production

Module:5	Water Economics	8 hours

Economic characteristics of water good and services-Nonmarket monetary valuation methods-Water economic instruments-Policy options for water conservation and sustainable use, pricing, distinction between values and charges-Private sector involvement in water resources management.

Module:6	Water Legal and Regulatory Settings	8 hours

National and International Framework for Water Law; Basic structure of water law- An overview of water law in India -Evolution of water law, key features of water law, evolving water law and policy-Water policy for Irrigation, decentralization and participation in irrigation management, and the policy measures proposed to establish water user associations. National level initiatives for regulation of groundwater, State groundwater laws and rainwater harvesting.

Module:7	**Demand Management**	**6 hours**
Balancing supply and demand-Economic theory of supply and demand-management by use of tariffs-Timing, long-term, operational time-frame-Crisis management-Cost of water-Future trends-Economic value of water-Loss control-Water harvesting.		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1. David Stephenson, Water Resources Management, 2004, A. A. Balkema Publishers, Netherlands.

Reference Books

1. Louis Theodore, Ryan Dupont R., Water Resource Management Issues, Basic Principles and Applications, 2020, CRC Press, Taylor & Francis Group, New York.
2. Philippe Cullet and Sujith Koonan, Water Law in India- An Introduction to Legal Instruments, 2017. Second Edition, Oxford University Press, New Delhi.
3. Subramanya. K., Engineering Hydrology, 2020, Fifth Edition, McGraw Hill Education Pvt. Ltd., New Delhi.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 66	**Date**	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM102E	Indian Classical Music	2	0	2	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Bring in awareness of Music and understand the basics
2. Bring in awareness of Indian Classical Music
3. Developing skills to sing with tāḷaṁ and śruti

Course Outcome

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

1. Acquire basic knowledge on sound, music and history of Indian Music
2. Interpret the structure of hindusthāni, karṇāṭaka saṁgītaṁ and the musical forms in both styles
3. Practice different aspects in music
4. Attain skills in different genres of music
5. Explain the advanced scientific aspects of music
6. Sing songs with perfection

Module:1	The World of Music	4 hours
Sound-Music – Rhythm - Introduction to Different Genres of Music.		
Module:2	**History of Indian Classical Music**	**4 hours**
Indian Classical music History and evolution from Sanskrit tradition to modern era (hindusthāni and karṇāṭaka saṁgītaṁ), Folk Music.		
Module:3	**Carnatic Classical Music**	**4 hours**
nādaṁ-svaraṁ-śruti-rāgaṁ,tāḷaṁ-sinkarṇāṭakasaṁgītaṁ.Compositions (gītaṁsvarajati varṇaṁkīrttanaṁpadaṁtillāna) – Legends of karṇāṭaka saṁgītaṁ.		
Module:4	**Hindustani Music**	**4 hours**
Origin-Evolution-musical forms (khayāl,dhrupad,tappa andtarāna) - Tendhāt-s. Majorgharāna-sinhindusthāni Music - Legends in hindusthāni Music.		
Module:5	**Film Music**	**4 hours**
Contemporary music, Western music, Background Music- Music Composing.		
Module:6	**Music and Mind**	**4 hours**
Emotions – Conditioning -Therapeutic Effects of Music, Science and Music, science in music. Artificial intelligence used in music.		
Module:7	**Music as a Profession**	**4 hours**
Concert Platforms, Different Types of Shows, New avenues in Music industry.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lectures by Academician/ Industrial Experts		
	Total Lecture Hours:	**30 hours**

Text Book (s)

1.	Prof. P. Sambamoorthi (2021), South Indian Music, Volume I – Indian Music Publishing House
2.	Vijay Prakash Singha (2018), An Introduction to Hindustani Classical Music: A Guidebook for Beginners, Roli Books.

Reference Books

1.	Sangeetha Widwan A.S. Panchapakesa Iyer (2014), Ganamrutha Bodhini, Ganamrutha Prachuram.
2.	Dr. P T Chelladurai (2010), The Splendor of South Indian Music, Vaigarai Publishers, Dindigul.

3.	Lakshminarayana Subramaniam (2018), Classical Music of India: A Practical Guide, Tranquebar Publisher.			
4.	B.Subbarao (1979), Raganidhi, Music Academy, Madras.			
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test				
List of Challenging Experiments (Indicative)				
1.	Swara exercises (sarali variśai, janta variśai, madhyasthāyi variśai, dhātu variśai) listening to music.			6 hours
2.	Tālaexercises(alaṁkāraṁ-sRūpakatālaṁ.ēkatālaṁ, triputatālaṁ)			4 hours
3.	Compositions: (gītaṁ-s.)			2 hours
4.	Compositions: kīrttanaṁ in Telugu			2 hours
5.	Compositions: kīrttanaṁinTamil			2 hours
6.	Compositions: kīrttanaṁ in Kannaḍa			2 hours
7.	Compositions: kīrttanaṁ in Malayālaṁ			2 hours
8.	Compositions: kabeer ke dohe and abhang			2hours
9.	Music composing techniques			4 hours
10.	Basics of audio recording			4 hours
		Total Laboratory Hours		**30 hours**
Mode of Evaluation: Lab Experiments and Lab Final Assessment Test				
Recommended by Board of Studies	23-05-2022			
Approved by Academic Council	No. 66	Date	16-06-2022	

Course Code	Course Title	L	T	P	C
BHUM102E	Indian Classical Music	2	0	2	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Bring in awareness of Music and understand the basics
2. Bring in awareness of Indian Classical Music
3. Developing skills to sing with tāḷaṁ and śruti

Course Outcome

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

1. Acquire basic knowledge on sound, music and history of Indian Music
2. Interpret the structure of hindusthāni, karṇāṭaka saṁgītaṁ and the musical forms in both styles
3. Practice different aspects in music
4. Attain skills in different genres of music
5. Explain the advanced scientific aspects of music
6. Sing songs with perfection

Module:1	The World of Music	4 hours
Sound-Music – Rhythm - Introduction to Different Genres of Music.		
Module:2	**History of Indian Classical Music**	**4 hours**
Indian Classical music History and evolution from Sanskrit tradition to modern era (hindusthāni and karṇāṭaka saṁgītaṁ), Folk Music.		
Module:3	**Carnatic Classical Music**	**4 hours**
nādaṁ-svaraṁ-śruti-rāgaṁ,tāḷaṁ-sinkarṇāṭakasaṁgītaṁ.Compositions (gītaṁsvarajati varṇaṁkīrttanaṁpadaṁtillāna) – Legends of karṇāṭaka saṁgītaṁ.		
Module:4	**Hindustani Music**	**4 hours**
Origin-Evolution-musical forms (khayāl,dhrupad,tappa andtarāna) - Tendhāt-s. Majorgharāna-sinhindusthāni Music - Legends in hindusthāni Music.		
Module:5	**Film Music**	**4 hours**
Contemporary music, Western music, Background Music- Music Composing.		
Module:6	**Music and Mind**	**4 hours**
Emotions – Conditioning -Therapeutic Effects of Music, Science and Music, science in music. Artificial intelligence used in music.		
Module:7	**Music as a Profession**	**4 hours**
Concert Platforms, Different Types of Shows, New avenues in Music industry.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lectures by Academician/ Industrial Experts		
	Total Lecture Hours:	**30 hours**

Text Book (s)

1.	Prof. P. Sambamoorthi (2021), South Indian Music, Volume I – Indian Music Publishing House
2.	Vijay Prakash Singha (2018), An Introduction to Hindustani Classical Music: A Guidebook for Beginners, Roli Books.

Reference Books

1.	Sangeetha Widwan A.S. Panchapakesa Iyer (2014), Ganamrutha Bodhini, Ganamrutha Prachuram.
2.	Dr. P T Chelladurai (2010), The Splendor of South Indian Music, Vaigarai Publishers, Dindigul.

3.	Lakshminarayana Subramaniam (2018), Classical Music of India: A Practical Guide, Tranquebar Publisher.			
4.	B.Subbarao (1979), Raganidhi, Music Academy, Madras.			
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test				
List of Challenging Experiments (Indicative)				
1.	Swara exercises (sarali variśai, janta variśai, madhyasthāyi variśai, dhātu variśai) listening to music.			6 hours
2.	Tālaexercises(alaṁkāraṁ-sRūpakatālaṁ.ēkatālaṁ, triputatālaṁ)			4 hours
3.	Compositions: (gītaṁ-s.)			2 hours
4.	Compositions: kīrttanaṁ in Telugu			2 hours
5.	Compositions: kīrttanaṁinTamil			2 hours
6.	Compositions: kīrttanaṁ in Kannaḍa			2 hours
7.	Compositions: kīrttanaṁ in Malayālaṁ			2 hours
8.	Compositions: kabeer ke dohe and abhang			2hours
9.	Music composing techniques			4 hours
10.	Basics of audio recording			4 hours
		Total Laboratory Hours		**30 hours**
Mode of Evaluation: Lab Experiments and Lab Final Assessment Test				
Recommended by Board of Studies	23-05-2022			
Approved by Academic Council	No. 66	Date	16-06-2022	

Course Code	Course Title	L	T	P	C
BHUM103L	Micro Economics	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To enable students to understand economic concepts from a managerial perspective.
2. To integrate theoretical knowledge with quantitative and qualitative evidence for effective decision making.
3. To evaluate the consequences of market structure, pricing and competition at the domestic and global levels.

Course Outcome

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

1. Describe traditional and modern definitions of economics.
2. Analyse supply and demand forces that determine equilibrium in a market economy.
3. Evaluate the factors affecting firm behaviour, such as production and costs.
4. Develop the skills to apply theories, models, and graphs to analyze the national and internationalcases.
5. Discuss the behaviour of market, industry and the performance of firms under different market structures.
6. Examine the market failures and the role of government in dealing with those failures.

Module:1	Microeconomic Principles	5 hours

Introduction to Economics – Definition (Wealth, Welfare, Scarcity and Growth); Economics as Arts versus Science; Positive versus Normative Approaches.

Module:2	Consumer Behavior Theories	8 hours

Ordinal versus Cardinal approach- Law of Diminishing Marginal Utility - Indifference curveanalysis - Consumer equilibrium - Demand Analysis – movement and shift in Demand; exception to law of demand; Demandforecasting; Law of supply – Market equilibrium – Resource Allocation.

Module:3	Elasticity of Demand and Supply	5 hours

Elasticity of Demand: Price, Income and Cross – Price elasticity's; measurement of elasticity –Elasticity of supply.

Module:4	Production Function	5 hours

Production Function; Features of Production - The Production Function with One Variable Input and The Production Function with Two Variable Inputs – Law of Returns to Scale – Iso - quant and Iso - cost line - Producer Equilibrium.

Module:5	Cost and Revenue Functions	5 hours

Cost Functions – Nature of cost – Short Run cost function and Long Run cost curves - Revenue Functions – Types. Break-even analysis.

Module:6	Market Structure – Partial Equilibrium	8 hours

Products Markets – Perfect and Imperfect Competition- Monopoly, Monopolistic competition, Duopoly and Oligopoly, Efficiency and Regulation Factor market – Factor pricing.

Module:7	General Equilibrium and Economic Welfare	7 hours

General Equilibrium of Production and Exchange; Externalities - Asymmetric information, Adverse selection - Moral hazard; Pareto Optimality; Social Welfare Function.

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

Text Book(s)

1.	N. Gregory Mankiw (2015), “Principles of Microeconomics”, South-western Cengage Learning, USA, 7th Edition.		
Reference Books			
1.	Jeffrey M Perloff (2019), “Microeconomics”, Pearson Education, 17th Edition.		
2.	Dominick Salvatore ((2020), “Managerial Economics Principles and World Wide Applications”, Oxford University Press, 9th Edition.		
3.	Varian H.R. (2015), “Intermediate Microeconomics: A Modern Approach”, East West Press Pvt., Ltd, New Delhi, 9th Edition.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM104L	Macro Economics	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To enable students to identify the determinants of macroeconomic aggregates and the major challenges associated with the measurement of these aggregates.
2. Enable students to critically evaluate the consequences of macroeconomic aggregates under differing economic conditions.
3. To discuss the linkages between financial markets and the real economy.

Course Outcome

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

1. Describe the macroeconomics aggregates.
2. Compute different measures of macroeconomic activity such as the national income.
3. Explain the general principles of consumption function and Investment function.
4. Develop the skills to use theories of multiplier and accelerator models to analyze everydayproblems in real world situations and evaluate economic policies.
5. Analyse macroeconomics concepts such as growth and inflation.
6. Evaluate how the government and central bank can influence the economy andthe markets through fiscal and monetary policies.

Module:1	Macroeconomic Principles	5 hours

Introduction to Macroeconomics – Macroeconomic issues – Importance of Macroeconomics – Macroeconomic Aggregates.

Module:2	National Income	5 hours

Circular flow of income, National income: Meaning, - Concepts – Nominal and real income -Methods of measurement – Importance – Problems in measurement.

Module:3	Theory of Income and Employment Determination	5 hours

Classical dichotomy – Keynesian income determination model – Money illusion, wage price rigidity – stability of equilibrium– stabilization of fiscal policy, Labour market and unemployment
– Aggregate demand, aggregate supply and price level.

Module:4	Consumption and Investment Function	7 hours

Consumption: Meaning - Components – Determinants - Consumption function: Meaning – Kinds
- Investment: Meaning - Components – Determinants - Investment function: Meaning – Kinds –Application.

Module:5	Multiplier and Accelerator	7 hours

Multiplier: Meaning – Working of multiplier – Accelerator: meaning – Working of accelerator –
Super multiplier.

Module:6	Inflation and Deflation	7 hours

Inflation: Meaning - Types - Causes – Philips curve - The long-run Phillips curve. Inflation
Expectations. The rational expectations - Deflation: Meaning – Causes – Consequences.

Module:7	Money, Banking and Financial Market and Institution	7 hours

Demand and Supply of money – The IS curve. Money Market and the LM curve. Liquidity trap. The IS-LM model – Central Bank - Monetary policy: meaning – Objectives – Variables – The instruments of Monetary control. Financial Markets - Savings, Investment and Financial System – Financial Markets and Financial Intermediaries. Financial Institution. Global Economic Indicators.

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

Text Book (s)	
1.	Mankiw, G. (2019), Macroeconomics, Worth Publishers, 10th Edition.
Reference Books	
1.	Frederic S. Mishkin (2017), "The Economics of Money Banking and Financial Markets", Pearson, 12th Edition.
2.	Blanchard, O. (2016), "Macroeconomics", Pearson Education Inc. 17th Edition.
3.	Paul A Samuelson Williamson (2017), "Macroeconomics", Gaurav-APM2NBMGSCY9L,19th Edition.

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM105L	Public Policy and Administration	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To introduce the students to the various aspects of Public Administration and Public Policy
2. To impart knowledge on administrative machinery in India and its contribution to public policy.
3. To study the various State and Central level programmes related to social and economic issues in India.

Course Outcome

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

1. Familiarize with the conceptual aspects and theoretical frameworks of public administration.
2. Describe the principles of public organisation and management.
3. Analyse the public finance management and budgeting system in India.
4. Acquire knowledge on the personal administration system in India, including the recruitment and service condition of central and state civil service cadres.
5. Demonstrate public policy making, implementation and evaluation.
6. Evaluate and interpret various legal and welfare policies framed by the different governments.

Module:1	**Background of Public Administration**	**6 hours**
Meaning, nature and scope of public administration, Private and public administration, Evolution of public administration, New public administration.		
Module:2	**Theories of Public Administration**	**6 hours**
Scientific theory, Classical theory, Bureaucratic theory, Human relation theory.		
Module:3	**Basic Concepts and Principles**	**6 hours**
Hierarchy, Unity of command, Span of control, Delegation, Line, staff and auxiliary agencies.		
Module:4	**Financial Administration**	**6 hours**
Organs of financial administration, Concepts and types of Budgeting, Preparation of budget, Enactment of budget, Execution of budget, Auditing of budget, Control over public finance.		
Module:5	**Personnel Administration in India**	**6 hours**
Role of Civil Service in Administration, All India and central services, Recruitment, Training, Promotion, Pay and service conditions.		
Module:6	**Introduction to Public Policy**	**6 hours**
Meaning, nature and significance of Public Policy, Evolution of Public Policy and Policy Sciences, Public Policy and Public Administration		
Module:7	**Public Policy Process in India**	**6 hours**
Formulation, implementation and evaluation.		
Module:8	**Contemporary Issues**	**3 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Bidyut Chakrabarty, Prakash Chand Kandpal (2020), Public Administration in a Globalizing World: Theories and Practices, Sage Publications, New Delhi.

2.	Rumki Basu (2012), Public Administration: Concepts and Theories, Sterling Publication, New Delhi.
Reference Books	
1.	Raymond W Cox III, Susan Buck, Betty Morgan (2015), Public Administration in Theory and Practice, Routledge, New York.
2.	Christoph Knill, JaleTosun (2020), Public Policy: A New Introduction, Bloomsbury Publishing, London.
3.	Bidyut Chakrabarty, Prakash Chand (2019), Public Policy: Concept, Theory and Practice, Sage Publications, New Delhi.
4.	B.L. Fadia and Kuldeep Fadia (2015), Public Administration: Administrative Theories and Concepts, Sahitya Bhawan Publication, Agra.
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test	

Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No.66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM106L	Principles of Sociology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. To develop awareness on sociological perspectives and sociological concepts.
2. To introduce students to the basic social processes of society, social institutions and patterns of social behavior.
3. To explore and understand sociology not merely as a social science discipline but as a distinctive branch of knowledge.

Course Outcomes:

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

1. Define sociology as a discipline and differentiate from other disciplines.
2. Discuss the field of sociology, major concepts and vocabulary.
3. Explain the relevance of socialization, groups, and institution's influence and constrain on individual agency.
4. Interpret the structural distinctions of caste and class within social dynamics.
5. Analyze various social phenomena through the lens of sociological perspectives.
6. Develop and prescribe models and solutions to address societal issues.

Module:1	**Sociology**	**6 hours**
Definition – Nature -Scope - Field - Importance - Relationship with other Social Sciences.		
Module:2	**Sociological Concepts**	**7 hours**
Society - Community-Association -Institution - Social Process - Social Structure- Role and Status.		
Module:3	**Culture**	**5 hours**
Meaning**–** Characteristics – Functions - Elements - Cultural Lag - Culture and Civilization.		
Module:4	**Socialization**	**6 hours**
Meaning - Socialization as a Process - Factors - Importance – Agents – Types –Adult Socialization.		
Module:5	**Social Groups**	**6 hours**
Meaning – Characteristics - Importance- Types: Primary group and Secondary group-In-group and Out-group-Reference group.		
Module:6	**Social Institutions**	**6 hours**
Marriage – Family – Education – Economics – Polity and Religion.		
Module:7	**Social Stratification**	**7 hours**
Meaning – Characteristics – Functions – Types. Caste system: Meaning – Factors - Characteristics – Origin – Functions and Changes. Social Class: Meaning – Nature – Differences between Caste and Class.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Richard T. Schaefer (2021), Sociology – A Brief Introduction, McGraw Hill; 13th Edition.
2. Antony Giddens and Philip W. Sutton (2017), Sociology, Atlantic Publishers & Distributors Pvt. Ltd; 8th Edition.

Reference Books

1. C.N. Shankar Rao (2019), Sociology: Principles of Sociology: With an Introduction to Social Thoughts, S Chand & Company Ltd.

2.	Haralmbos, M. & Holborn (2022), Sociology: Themes and Perspectives, Collins Publishers, 8th Edition.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	24-05-2022		
Approved by Academic Council	No.66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM107L	Sustainability and Society	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. To understand holistic and critical perspective on sustainability.
2. To provide with clear understanding of social development and sustainability.
3. To educate the students to think practically and strategically about sustainability.

Course Outcome:

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

1. Familiarize the conceptual aspects of protection and reconcile economic growth, environmental balance and social progress.
2. Develop understanding of the labour welfare and human rights.
3. Discuss social mobility and integration.
4. Analyze and resolve conflict in equal manner.
5. Demonstrate understanding of the importance of education and equality.
6. Evaluate the factors that influence the sustainable society, design, develop the policies to achieve SDGs.

Module:1	Understanding Social Sustainability	6 hours

Concept and Context of Sustainability: Definition – Brief History – Sustainable Development in India – 17 SDGs - Importance and Challenges.

Module:2	Education	5 hours

Role and Importance of Education in Sustainable Development – Education and Media for Sustainable Societies – Education for Climate Action.

Module:3	Labor Force and Reforms	6 hours

Green Tribunals – Green Economy – Problem of Industries and Sustainability - Role of Government Initiatives for Labor Welfare in India.

Module:4	Human Rights	6 hours

Human Rights: Migrants and Refugees – Human Trafficking – Children's Rights: Prevention and Protection Measures.

Module:5	Gender Equality	7 hours

Understanding Gender Equality and Inequality – Forms of Discrimination and Suppression - Education and Employment - Health and Well-being - LGBTQ and Sustainable Development.

Module:6	Social Hazards	7 hours

Challenges: Poverty - Water Scarcity – Worldwide and in Indian Scenario - Impact of Globalization - Rapid Urbanization and Slums –Preventive Measure to Control CO2 Emission - Programmes and Schemes.

Module:7	Integration of Indigenous Groups	6 hours

Demography and Definition of Indigenous Groups – Understanding Indigenous Knowledge and Health Practices - Challenges and Opportunities for Sustainability.

Module:8	Contemporary Issues	2 hours

Total Lecture Hours	45 hours

Text Book(s) :

1. Lintsen, H., Veraart, F., Smits, J. P., & Grin, J. (2018). Well-being, Sustainability and Social Development: The Netherlands 1850–2050. Springer Nature.
2. Kaltenborn, M., Krajewski, M., & Kuhn, H. (2020). Sustainable Development Goals and Human Rights. Springer Nature.

Reference Books :

1. Pandey, U. C., & Kumar, C. (2020), SDG5 - Gender Equality and Empowerment of Women and Girls.
2. García - Tejerolván Francisco, & Hugo DuránZuazo Victor. (2018), Water Scarcity and

	Sustainable Agriculture in Semiarid Environment: Tools, Strategies and Challenges for Woody Crops. Academic Press, an imprint of Elsevier.
3	Beeson, G. (2020), A Water Story Learning from the Past, Planning for the Future, CSIRO Publishing.
4	Anders B., Roy, K. (2020), Indigenous Knowledges and the Sustainable Development Agenda. United Kingdom: Taylor & Francis.
Reading Material:	
1.	Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. Congent Social Sciences, 5 (1), 1653531. https://doi.org/10.1080/23311886.2019.1653531
2.	https://www.oecd.org/employment/emp/50318559.pdf
3.	Aliber, Michael. (2002). Poverty-eradication and Sustainable Development.
4.	https://www.unicef.org/sdgs#sdg1
5.	https://sdgs.un.org/goals

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	24-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BHUM108L	Urban Community Development	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1.Provides the basic understanding on urban society and its way of living
2.Orient the students about urban community issues
3. Sensitize the students to know about various supporting agencies and its initiatives for urban development.

Course Outcome:

On completion of this course the students will be able to;
1. Explain the concepts and approaches of urban community development.
2. Analyze the key issues of urban community.
3. Familiarize the administrative and local bodies structure, power and function of urban community.
4. Describe the core agencies in addressing various problems of urban community
5. Evaluate the policies and programmes of urban governance and development.
6. Develop professional awareness and learning on various developmental initiatives Implemented in community.

Module:1	Urban Society	5 hours

Urban Society: Concept – Characteristics. City:Meaning – Classification -Rural Urban linkages and contrast:Urban Community Development:Concept -Objectives and Historical background.

Module:2	Urbanization and Urban Living	5 hours

Urbanisation: Concept – Definition- Theories of Urbanization. Urbanism: Characteristics - Urbanization trends in urbanization and Urban Development -Modernization and Urbanization.

Module:3	Urban Community Issues	7 hours

Urban Poverty and Inequality – Unemployment-Housing - Water – Sanitation-Waste Management – Health - Education-Drug Addiction - Juvenile Delinquency.

Module:4	Urban Administration and Local Bodies	4 hours

Town Panchayat – Municipalities – Corporations: Structures, Powers and Functions.

Module:5	Urban Development Agencies	7 hours

Non-Governmental Organisations (NGOs) - Voluntary Organisations - State Industrial Development Corporations (SIDCs) - Public Works Department (PWD)- Housing and Urban Development Corporation (HUDCO) -Metropolitan Development Authorities - Slum Clearance Board.

Module:6	Urban Development Policies and Programs	8 hours

Urban Development Policies: Urban Basic Services-Urban Development Policy in India-Urban Development Planning: Town and Country Planning Act, 1971. Urban Development Programmes: Five Year Plans and Urban Development-Urban Basic Services Programmes (UBSP), Jawaharlal Nehru National Urban Renewal Mission (JNNURM) - Nehru Rozgar Yojana (NRY) -Urban Renewal Programme - Problems in Implementation of Urban Community Development Programmes.

Module:7	Urban Growth and Challenges	7 hours

Smart Cities and Development - Urban Environment and Pollutions – Globalization-Urban Reforms -Disaster Management –Displacement –Migration -Population Growth and its Impact (social and physical) -Suitable Approaches and Strategies.

Module:8	Contemporary Issues	2 Hours
	Total Lecture Hours	45 Hours

Text Book(s)	
1.	Vanita Pandey (2021), Urban Sociology, Rawat Publication
2	Sidhartha.K (2019), Cities Urbanisation and Urban Systems New edition Kitab Mahal Daryaganj Delhi
Reference Books	
1.	Dr.Mohd Akhter Ali, M.Kamraju, Dr.Muzafar Ahmad Wani (2020), Urbanisation and Urban Systems, Rajesh Publication
2	Talja Blokland (2017), Community As Urban Practice, Edited by Talja Blokland, Polity Press
3.	Zacchaeus Ogunnika (2017), Critical Issues in Community Development: An Introduction to Rural and Urban Sociology, Trafford Publishing
4.	Pablo Shiladitya Bose (2015), Urban Development in India Global Indians in the Remaking of Kolkata, Routledge

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test.			
Recommended by Board of Studies	24-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BHUM109L	Social Work and Sustainability	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the working concept of sustainability at the micro, mezzo, and macro levels of Social Work practice.
2. To study the relationships among the concepts of environmental, economic, use of technology, and social sustainability.
3. To study the interconnectedness of sustainability with social work methods, values, and ethics.

Course Outcome

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

1. Describe various concepts of Social Work, sustainability and SDGs.
2. Attain a sense of responsibility in addressing sustainable goals in developing a better society.
3. Discuss the policies and programs from global perspectives.
4. Develop skills to work in the community with people of diversity.
5. Evaluate policies of social development and human welfare services.
6. Design, develop and implement programs and policies for the better world.

Module:1	Social Work Education and Practice	5 hours

Sustainability in the Social Work profession - Principles – Methods - Ethics – Values – Strategies for sustainable community development – Social theory –Social-Ecological practice Model.

Module:2	Social Work, Ecology, and Social Justice	5 hours

Social Work and Ecological Approaches - Human rights Violations – Rights-based approach - Restorative Approaches in Social Work - Case Studies - Role of the Social Worker in achieving sustainability.

Module:3	Sustainability and Vulnerability	6 hours

Introduction -Principles - Limitations - Challenges - Transdisciplinary approach to sustainability and vulnerability –Interlink of Sustainability and vulnerability.

Module:4	Theories in Sustainability	8 hours

Theories: Social Capital theory and Mobilization - Bottom of the pyramid approach - Humanistic sustainability theory – Social Economy theory.

Module:5	Pillars of Sustainability	8 hours

Pillars: Social – Economic – Environmental – Cultural - Political - Security aspects.

Module:6	Sustainable Developmental Goals – I	6 hours

Goal 1: No Poverty - Goal 2: Zero Hunger - Goal 3: Good Health and Well-Being - Goal 4: Quality Education - Goal 5: Gender Equality - Goal 6: Clean Water And Sanitation - Goal 7: Affordable And Clean Energy - Goal 8: Decent Work and Economic Growth.

Module:7	Sustainable Developmental Goals – II	5 hours

Goal 9: Industry, Innovation, And Infrastructure - Goal 10: Reduced Inequality - Goal 11: Sustainable Cities And Communities - Goal 12: Responsible Consumption And Production - Goal 13: Climate Action - Goal 14: Life Below Water - Goal 15: Life on Land - Goal 16: Peace and Justice Strong Institutions - Goal 17: Partnerships to achieve the goa.l

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

Text Book(s)

1. Dominelli, Lena, 2018, Green Social Work: From Environmental Crises to Environmental Justice: Rawat Publications, India

2.	Walter Leal Filho, UbiratãTortato, Fernanda Frankenberger (2021), Integrating Social Responsibility and Sustainable Development - Addressing Challenges and Creating Opportunities, springer publication.		
Reference Books			
1.	Parker, Jonathan (2021), Social Work Practice Assessment, Planning, Intervention and Review, 6th Edition, Sage Publication.		
2.	Heslop, Philip &Meredith, Cathryn (2020), Social Work Theory in Practice, SAGE Publications Ltd.		
3.	Rao, Bhaskara N (2019), Sustainable Good Governance, Development and Democracy, Sage Publication.		
4.	IFSW (2018), Social Work Statement of ethical principles. International Federation of Social Workers, Rheinfelden, Switzerland.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM110E	Cognitive Psychology	2	0	2	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the higher order process in cognition.
2. To enable the students to identify and apply the different aspects of cognitive process.
3. To enable the students to administer various assessments for mental process.

Course Outcomes

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

1. Explain how information processing works.
2. Comprehend the various cognitive processes such as attention, perception, memory, imagery and meta cognition.
3. Adopt various strategies to enhance problem solving process.
4. Describe cognitive development and disorders.
5. Apply tools and techniques to understand the cognitive processes through psychometric assessment.
6. Conduct practical experiments to assess the cognitive skills.

Module:1	Cognitive Psychology	5 hours

Contemporary Cognitive Psychology, Approaches- Experimental Cognitive Psychology - Computational Cognitive Science- Cognitive Neuropsychology- Cognitive Neuroscience, Application of Cognitive Psychology.

Module:2	Perception and Attention	4 hours

Understanding perception, Visual and auditory- Gestalt laws of organization, Perceptual constancy - depth perception, size perception, perception of movement; Various sensory modalities; Extrasensory perception.

The nature and roles of attention- types of Attention: selective attention models of selective attention divided attention and multitasking, Endogenous and Exogenous Effects in Space.

Module:3	Thinking and Reasoning	4hours

Meaning and Definition- Nature- Types: Perceptual or concrete- Conceptual or abstract- Creative – Logical or reasoning - Convergent and Divergent Thinking. Thinking and intelligence: Alterations. Reasoning: Meaning- Inductive reasoning- Deductive reasoning- Abdicative reasoning.

Module:4	Creativity	3hours

Meaning and Aspects of Creativity - Stages of Creativity- Creativity and Intelligence- Measurement of Creativity.

Module:5	Memory	4hours

Introduction- Types- Sensory memory- Short-term memory- Working memory- Long-term memory- forgetting and false memory- Everyday memory: Autobiographical- Eyewitness testimony. Memory distortions: Reconstructive Retrieval- Encoding Distortions - Source Monitoring - Eyewitness Testimony. Meta cognition. Memory Enhancement Techniques.

Module:6	Problem Solving and Decision Making	4hours

Introduction- Steps, Barriers to Problem Solving: Mental Set and Functional Fixedness- Unnecessary Constraints- Irrelevant Information. Problem-Solving Strategies: Heuristic- Algorithm- Abstraction- Hypothesis testing- Means-ends analysis- Root-cause analysis- Trial and error. Decision making, hypothetical thinking and rationality. Decision-making styles.

Module:7	Cognitive Development and Disorders	4hours

Cognitive Development Theories- Piaget's cognitive development- Background and key concepts- Skills & Important Milestones. Cognitive disorders -Symptoms, Causes and Effects- Types- Developmental disorders, Motor skill disorders, Dementia - Confusion- poor motor co-ordination- Loss of memory- identity confusion- impaired judgement.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**30 hours**

Text Book(s)

1.	Galotti,K.M.(2017),Cognitive Psychology In and Out of the Laboratory, 6th Edition,Sage.
2.	Kellogg, R.T. (2015), Fundamentals of Cognitive Psychology, 3rdEdition, Sage Publications.

Reference Books

1.	Goswami, U. C. (2020), Cognitive Development and Cognitive Neuroscience: The Learning Brain. London; New York: Routledge, Taylor & Francis Group.
2.	Whiteley, C. (2020), Cognitive Psychology, CGD Publishing, 2nd edition.
3.	Eysenck, M. W., & Brysbaert, M. (2018), Fundamentals of Cognition. Milton: Taylor and Francis.
4.	Stemberg, R.J., Stenberg, K. (2016), Cognitive Psychology, 7th Edition. Wadsworth.
5.	Groome, D., & Eysenck, M. W. (2016), An introduction to Applied Cognitive Psychology, London; New York: Routledge, Taylor & Francis.

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test

Indicative Experiments

1.	Assessment of Attention	3hours
2.	Assessment of Memory	3hours
3.	Assessment of Creativity	3hours
4.	Assessment of Perception (Auditory/Spatial/Visual)	3hours
5.	Assessment of Intelligence	3hours
6.	Assessment of Critical Thinking	3hours
7.	Assessment of Problem Solving/Decision Making	3hours
8.	Assessment of Logical Reasoning/Inductive Reasoning/Diagrammatic Reasoning	3hours
9.	Assessment of Error checking	3hours
10.	Assessment of Psycholinguistic Abilities	3hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Tests, Final Assessment Test

Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No.66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BHUM110E	Cognitive Psychology	2	0	2	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the higher order process in cognition.
2. To enable the students to identify and apply the different aspects of cognitive process.
3. To enable the students to administer various assessments for mental process.

Course Outcomes

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

1. Explain how information processing works.
2. Comprehend the various cognitive processes such as attention, perception, memory, imagery and meta cognition.
3. Adopt various strategies to enhance problem solving process.
4. Describe cognitive development and disorders.
5. Apply tools and techniques to understand the cognitive processes through psychometric assessment.
6. Conduct practical experiments to assess the cognitive skills.

Module:1	Cognitive Psychology	5 hours

Contemporary Cognitive Psychology, Approaches- Experimental Cognitive Psychology - Computational Cognitive Science- Cognitive Neuropsychology- Cognitive Neuroscience, Application of Cognitive Psychology.

Module:2	Perception and Attention	4 hours

Understanding perception, Visual and auditory- Gestalt laws of organization, Perceptual constancy - depth perception, size perception, perception of movement; Various sensory modalities; Extrasensory perception.

The nature and roles of attention- types of Attention: selective attention models of selective attention divided attention and multitasking, Endogenous and Exogenous Effects in Space.

Module:3	Thinking and Reasoning	4hours

Meaning and Definition- Nature- Types: Perceptual or concrete- Conceptual or abstract- Creative – Logical or reasoning - Convergent and Divergent Thinking. Thinking and intelligence: Alterations. Reasoning: Meaning- Inductive reasoning- Deductive reasoning- Abdicative reasoning.

Module:4	Creativity	3hours

Meaning and Aspects of Creativity - Stages of Creativity- Creativity and Intelligence- Measurement of Creativity.

Module:5	Memory	4hours

Introduction- Types- Sensory memory- Short-term memory- Working memory- Long-term memory- forgetting and false memory- Everyday memory: Autobiographical- Eyewitness testimony. Memory distortions: Reconstructive Retrieval- Encoding Distortions - Source Monitoring - Eyewitness Testimony. Meta cognition. Memory Enhancement Techniques.

Module:6	Problem Solving and Decision Making	4hours

Introduction- Steps, Barriers to Problem Solving: Mental Set and Functional Fixedness- Unnecessary Constraints- Irrelevant Information. Problem-Solving Strategies: Heuristic- Algorithm- Abstraction- Hypothesis testing- Means-ends analysis- Root-cause analysis- Trial and error. Decision making, hypothetical thinking and rationality. Decision-making styles.

Module:7	Cognitive Development and Disorders	4hours

Cognitive Development Theories- Piaget's cognitive development- Background and key concepts- Skills & Important Milestones. Cognitive disorders -Symptoms, Causes and Effects- Types- Developmental disorders, Motor skill disorders, Dementia - Confusion- poor motor co-ordination- Loss of memory- identity confusion- impaired judgement.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**30 hours**

Text Book(s)

1.	Galotti,K.M.(2017),Cognitive Psychology In and Out of the Laboratory, 6th Edition,Sage.
2.	Kellogg, R.T. (2015), Fundamentals of Cognitive Psychology, 3rdEdition, Sage Publications.

Reference Books

1.	Goswami, U. C. (2020), Cognitive Development and Cognitive Neuroscience: The Learning Brain. London; New York: Routledge, Taylor & Francis Group.
2.	Whiteley, C. (2020), Cognitive Psychology, CGD Publishing, 2nd edition.
3.	Eysenck, M. W., & Brysbaert, M. (2018), Fundamentals of Cognition. Milton: Taylor and Francis.
4.	Stemberg, R.J., Stenberg, K. (2016), Cognitive Psychology, 7th Edition. Wadsworth.
5.	Groome, D., & Eysenck, M. W. (2016), An introduction to Applied Cognitive Psychology, London; New York: Routledge, Taylor & Francis.

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test

Indicative Experiments

1.	Assessment of Attention	3hours
2.	Assessment of Memory	3hours
3.	Assessment of Creativity	3hours
4.	Assessment of Perception (Auditory/Spatial/Visual)	3hours
5.	Assessment of Intelligence	3hours
6.	Assessment of Critical Thinking	3hours
7.	Assessment of Problem Solving/Decision Making	3hours
8.	Assessment of Logical Reasoning/Inductive Reasoning/Diagrammatic Reasoning	3hours
9.	Assessment of Error checking	3hours
10.	Assessment of Psycholinguistic Abilities	3hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Tests, Final Assessment Test

Recommended by Board of Studies	23-05-2022		
Approved by Academic Council	No.66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BMGT101L	Principles of Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide knowledge on management key concepts, evaluation of management thoughts and theories.
2. To understand the various functions of management and framework.
3. To gain a holistic understanding of multidisciplinary nature of management for effective functioning.

Course Outcomes

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

1. Understand the basic concepts of management.
2. Analyse the environmental factors that affect the organization and its growth.
3. Identify and apply appropriate techniques to manage an organisation.
4. Critically analyse the problem in each functions of the management.
5. Ascertain the role of technologies in management.

Module:1	Management Basics	6 hours

Management - nature and purpose, evolution of management concept, approaches to management process, functions and roles of management, influence of external and internal environment on decision making, factors affecting social responsibility and sustainability, and ethical business management.

Module:2	Planning	6 hours

Types of plans, steps in planning, strategic planning process, SWOT matrix, portfolio matrix, Porter's industry analysis and generic competitive strategies, decision making - importance of decision making, development of alternatives and evaluation of alternatives, and decision making under certainty, uncertainty and risk.

Module:3	Organizing	7 hours

Formal and informal organization, organizational levels and span of management, organization reengineering, structure and process of organizing, departmentation, matrix organization, strategic business units, virtual organization, line and staff authority, decentralization and delegation of authority, and organization culture.

Module:4	Staffing	6 hours

Overview to staffing functions, factors affecting staffing, position requirements, job design, job description, selection process and techniques, orientating new employees, performance appraisal and career strategy - appraisal criteria, team evaluation, rewards, and formulating career strategy, managerial training and development, conflict management, managing change, and learning organization.

Module:5	Leading	6 hours

Understanding motivation, motivation theories, leadership traits, styles, and types, committees, groups, and team decision making, communication purpose, communication process, and barriers to effective communication.

Module:6	Controlling	6 hours

Basic control process, critical control points, standards and bench marking, real-time information and control, feedforward or preventive control, control of overall performance, profit and loss control, control through ROI, management audits - balanced scorecard, bureaucratic and clan control, and control techniques and information technology.

Module:7	Managing Operations and Technology	6 hours

Operations management and corporate strategy, value chain management, role of technology in modern management practices, virtual organization and its structure, online business management, applications of digital technology, e-commerce, m-commerce, social media, and artificial intelligence in business management, and challenges to modern management practices.		
Module:8	**Contemporary Topics**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Harold Koontz and Heinz Weihrich, Essentials of Management: An International and Leadership Perspective, 2020, 11th edition, McGraw-Hill, India.
Reference Books	
1.	Stephen P. Robbins, Mary Coulter and Agna Fernandez, Fundamentals of Management, 2019, 14th Edition, Pearson Education, India.
2.	Robert N. Lussier, Management Fundamentals: Concepts, Applications, & Skill Development, 9th Edition, 2020, Sage Publications, USA
3.	Pravin Durai, Principles of Management – Texts and Cases, 2019, 2nd Edition, Pearson Education, India.
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT	

Recommended by Board of Studies	27-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BMGT102L	Human Resource Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the contributions of human resources to organizational effectiveness.
2. To apply various concepts of HR to manage the organization effectively.
3. To create various HRM concepts to enhance personal and organizational effectiveness.

Course Outcomes

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

1. Appraise and evaluate the basic principles of HRM.
2. Develop appropriate HR planning process for effective recruitment and selection.
3. Design various skills, procedures, and techniques to retain human resources.
4. Evaluate the basic and mandatory labor laws governing human resources.
5. Create a safety environment for managing human resources.

Module:1	HRM – Overview	6 Hours

Nature and scope of HRM, evolution and development of HRM, HR philosophy, policies, procedures and practices, dynamics of HRM environment, business ethics and CSR, equal employment opportunity, work force diversity, HR audit and evaluation, e-HRM, and strategic HRM.

Module:2	Human Resource Planning Process	6 Hours

Human resource planning and process - forecasting requirements, succession planning, job analysis, job analysis methods, job descriptions, job design, and global talent management.

Module:3	Recruitment and Selection	6 Hours

Recruitment process, methods, databases, job posting and bidding, recruitment sources, technology for recruiting, selection tests, interview planning, screening, selection decision, metrics for evaluating the effectiveness of recruitment, and factors affecting the selection process.

Module:4	Training and Development (T&D)	6 Hours

Training and development process, training needs, training methods, training and development delivery systems, implementing T&D programs, metrics for evaluating T&D effectiveness, and factors influencing T&D process.

Module:5	Performance Management and Appraisal	7 Hours

Performance appraisal process, establishing criteria for performance appraisal, performance appraisal methods and interview, appraisal problems, performance management, career planning and development, employee engagement, executive development, knowledge management, and importance of knowledge sharing culture for organizational effectiveness.

Module:6	Compensation and Benefits	6 Hours

Compensation overview, components of direct financial compensation, contextual influences on direct financial compensation, job evaluation, competitive pay structure, indirect compensation benefits - legal benefits, health care plans, retirement plans, workplace flexibility, and employment law.

Module:7	Employee Relations, Safety, and Health	6 Hours

Need for a safe and healthy environment, employee union and union structure, welfare activities, nature of industrial relations and labor laws, internal employee relations, resolving disputes, concept of collective bargaining, workplace bullying and violence,

social networking and employee wellness, physical fitness programs, employee assistance programs, and HR ethical practices.		
Module:8	**Contemporary Topics**	**2 Hours**
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Gary Dessler & Biju Varrkey, *Human Resource Management*, 2020, 16th Edition, Pearson Education, India
2.	Neeru Kapoor, *Concept Building Approach to Human Resource Management*, 2021, 2nd Edition, Cengage Learning, India
Reference Books	
1.	Sharon Armstrong & Barbara Mitchell, *The Essential HR Handbook*, 2019, 10th Edition, Red Wheel/Weiser, USA
2.	K Aswathappa and Sadhna Dash, *Human Resource Management - Text and Cases*, 2021, 9th Edition, McGraw-Hill, India
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT	

Recommended by Board of Studies	27-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BMGT103L	Organizational Behavior	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To familiarize the basic concepts of organizational behavior.
2. To understand, evaluate, and manage individual and group behavior effectively in an organization.
3. To formulate appropriate strategies based on individual and group behaviour.

Course Outcomes

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

1. Appraise the basic organizational and individual behaviour.
2. Describe the various dimensions of motivations.
3. Measure and monitor different aspects of stress and emotions.
4. Explain the various elements of groups and teams.
5. Analyze the different dimensions of organizational structure, culture, and change.
6. Formulate leadership traits for effective work culture.

Module:1	Organisational Behaviour - Essentials	5 hours

Understanding organizational behaviour, learning style, OB model, demographic and cultural diversity in organizations, ethical behaviour, tools of OB research, and challenges and opportunites for OB.

Module:2	Attitudes, Personality, and Values	7 hours

Individual attitudes, attitudes and behaivour, job attitudes, job satisfaction, job dissatisfaction, job satisfaction and job performance, personality frameworks, personality traits in OB, personality and situations, understanding values, values and workplace, and international values.

Module:3	Motivation	7 hours

Theories of motivation - need-based and process-based theories, designing a motivating environment, motivating employees through job design, employee involvement, benefits, and rewards to employees, and goal setting.

Module:4	Managing Stress and Emotions	4 hours

Meaning of stress, sources of stress, consequences of stress at work, avoiding and managing stress, understanding emotions, sources of emotions, and emotional intelligence.

Module:5	Group Behaviour, Work Teams, and Communications	8 hours

Group development, group size and dynamics, difference between groups and teams, types of teams, team design characteristics, management of teams, and barriers to effective teams, communication - functions, directions, and modes of communication, barriers to effective communication, power and politics, and conflict and negotiation.

Module:6	Organizational Structure, Culture, and Change	6 hours

Different types of organizational structures - common and alternate designs, organizational designs and employee behaviour, organizational culture - role of culture in organizaitons, creating and sustaining organizational culture, organizational change - forces, resistance,

and approcaches to organizational change.		
Module:7	**Leadership**	**6 hours**
Theories of leadership - tradional and contemporary styles, positive and responsible leadership, attributes of a leader, developing leaders across the organization, leadership grid, and challenges to understanding leadership.		
Module:8	**Contemporary Topics:**	**2 hours**
Guest lectures from Industry and, Research and Development Organisations		
	Total Lecture Hours	**45 hours**

Text Book(s)	
1.	Stephen P. Robbins and Timothy A. Judge, *Organizational Behaviour*, 2019, 14th Edition, Pearson Education, India
2.	Knud Sinding, Robert Kreitner, and Angeloi Kinecki, *Organisational Behaviour,* 2018, 6th Edition, McGraw-Hill Education, UK
Reference Books	
1.	*Organizational Behavior,* Open Textbook, University of Minnesota Libraries Publishing, 2017, ISBN 13: 9781946135155
2.	J.Stewart Black et.al., *Organizational Behavior*, OpenStax Textbook, Rice University, USA, Web Version Last updated: Feb 23, 2021
3.	Christopher P. Neck, Jeffrey D. Houghton and Emma L. Murray, *Organizational Behavior: A Skill-Building Approach*, 2019, 2nd Edition. Sage Publications, USA
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT	

Recommended by Board of Studies	27-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BMGT104L	Marketing Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To comprehend the basics of marketing and its related concepts.
2. To develop marketing plan for the given situation.
3. To carry out market research survey.

Course Outcomes

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

1. Create marketing strategy for the given business scenario.
2. Analyze the factors that affect the marketing program of an organization.
3. Identify market gaps and develop product ideas with appropriate STP strategies.
4. Formulate marketing mix strategies for a given business situation.
5. Develop promotional mix for a given business case.
6. Ascertain the latest trends in marketing.

Module:1	Marketing Basics	6 hours

Understanding marketing, scope of marketing, company orientation towards the marketplace, core concepts of marketing, types of market, marketing mix, value chain, core competencies, marketing strategy, and marketing plan.

Module:2	Environment Scanning and Market Research	6 hours

SWOT analysis, environment analysis - micro and macro factors, Porter's five forces framework, marketing research process, and demand measurement.

Module:3	Connecting with Customers and Building Strong Brands	9 hours

Building customer value, satisfaction, and loyalty, maximizing customer life time value (CLV), consumer buying decision process, segmentation, targeting, and positioning (STP) strategy - levels and bases of segmentation, market targeting, positioning, repositioning, understanding brand equity, building and managing brand equity.

Module:4	Setting Product and Pricing Strategies	8 hours

Product classifications, product levels, product line and mix, product life cycle (PLC), product-market growth strategies - Ansoff matrix and BCG matrix, new product development (NPD), understanding pricing, pricing strategies and methods, and responding to price change.

Module:5	Channel Management	5 hours

Channel functions and flows, channel levels, channel design, channel integration and systems, distribution strategies, channel intermediaries - wholesalers and retailers, understanding private labels, and channel conflict and resolution strategies.

Module:6	Integrated Marketing Communications (IMC)	6 hours

Advertising - ad types, advertising medium, and evaluation of ads, Sales Promotion - salesforce promotion, trade promotion, and consumer promotion, Direct Marketing - kiosk, catalogues, e-mail, SMS, vending machines, and telemarketing, Public Relations - publicity, newsletter, CSR, sponsorships, and advertorials, Digital Advertising - Types of digital media, display ads, search engine ads, social media marketing, and artificial intelligence based marketing techniques, and Personal Selling.

Module:7	Marketing for long-term Success	3 hours

Holistic marketing organization, socially responsible business models, cause-related

marketing, social marketing, marketing implementation and control, and future of marketing.		
Module:8	**Contemporary Topics**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Philip Kotler and Keller Kevin, *Marketing Management*, 2021, Global Edition (16th), Pearson Education, UK	
2.	Ramaswamy, V. S., and S. Namakumari, *Marketing Management: Indian Context, Global Perspective*, 2018, 6th Edition, SAGE Publications India Pvt Limited, India	
Reference Books		
1.	Hermawan Kartajaya, Iwan Setiawan and Philip Kotler, *Marketing 5.0: Technology for Humanity*, 2021, 1st Edition, Wiley, USA	
2.	Lilien, Gary L., Arvind Rangaswamy, and Arnaud De Bruyn, *Principles of Marketing Engineering and Analytics*, 2017, 3rd Edition, DecisionPro Inc.	
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT		
Recommended by Board of Studies	27-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BMGT105L	Consumer Behavior	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To learn the dynamics of consumer behavior and market.
2. To critically evaluate various factors influencing the buying behavior of individuals.
3. To execute consumer research survey based on the given problem.

Course Outcomes

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

1. Appraise the basics of consumer behavior and consumer decision making process.
2. Analyze psychological and personal factors that influence consumer behavior.
3. Evaluate social, cultural, and digital influence on consumer behavior.
4. Associate various theories of consumer behavior in consumer decision making process.
5. Comprehend the significance of marketing and consumer ethics.
6. Apply consumer research process for a given problem.

Module:1	Consumer Behavior - Basics	5 hours

Evolution of consumer behavior, dynamism in consumer behavior, consumer behavior and technology, market segmentation, targeting, and positioning, customer value, satisfaction, and retention, effects of marketing mix on consumer behavior, consumer decision making and integration of various disciplines, and consumer decision making process.

Module:2	Psychological Influence - Perception and Learning	6 hours

Meaning of perception, components of perception, perception process, theories of perception, perception level, challenges in formulating consumer perception, perception and semiotics, perception and positioning, perceived quality and perceived risk, meaning of learning, elements of learning, categories of learned behavior, dimensions of learning, theories of learning, and learning and memory.

Module:3	Psychological Influence - Motivation, Beliefs, and Attitude	6 hours

Types of motives, drivers of motivation, categories and theories of motivation, consumers' emotions, motivation and decision making, types of beliefs and consumer behavior, elements and characteristics of attitude, attitude formation, tri-component model of attitude, multi-attribute models, cognitive dissonance, and conflict resolution.

Module:4	Personal, Social, and Cultural Influence	9 hours

Understanding personality, elements of personality, personality theory, self-concept, personality traits, anthromorphism, elements and categories of lifestyle, values and lifestyle, approaches to marketing strategies based on personality and lifestyle, types of reference groups, role of reference groups, impact of reference groups on marketing strategies, family and consumer behavior, family structure, family life cycle, cultural influence on consumer behavior, cultural theories, Indian culture and socialization, and effect of cross-cultures on consumer behavior.

Module:5	Digital and Social Media Influence	6 hours

Media integration and consumer behavior, theoretical frameworks - TRA and UG, consumer behavior on digital platforms, blogs and consumer behavior, virtual and brand communities influence on consumer behavior, usage of mobile and its influence on consumer behavior, virtual shopping and its influence on consumer behavior, luxury and consumer behavior, and changing tri-component model of attitude.

Module:6	Information Processing and Decision Making	6 hours

Understanding information processing, information processing theories, information processing and persuasive communication, information processing and memory, methods of

information processing, information retrieval, levels of decision making, decision making methods, and consumer decision making models.		
Module:7	**Marketing Ethics and Consumer Behavior Research**	**5 hours**
Socially responsible marketing, consumers' privacy, misleading labels, camouflaged advertising, consumer ethics, and consumer research and process.		
Module:8	**Contemporary Topics**	**2 hours**
	Total Lecture Hours:	**45 hours**
Text Book(s)		
1.	Schiffman Leon G., Wisenblit Joe, Kumar S. Ramesh, *Consumer Behavior*, 2018, 12th Edition, Pearson Education, India	
2.	Jain, Varsha, and Jagdish Sheth. *Consumer Behavior: A digital Native,* 2019, 1st Edition, Pearson Education, India	
Reference Books		
1.	David L Mothersbaugh, Del I. Hawkins, Amit Mookerjee, *Consumer Behavior: Building Marketing Strategy*, 2019, 13th Edition, McGraw-Hill, India	
2.	Hoyer, Wayne D., Deborah J. MacInnis, and Rik Pieters, *Consumer Behavior*, 2016, 7th Edition, Cengage Learning, USA	
3.	Marieke de Mooij, *Consumer Behaviour and Culture: Consequences for Global Marketing and Advertising*, 2019, 3rd Edition, SAGE, USA	
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT		
Recommended by Board of Studies	27-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Code	L	T	P	C
BMGT106L	Digital Marketing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To evaluate digital marketing and digital media.
2. To get exposed to various digital marketing channels.
3. To develop online ads and assess the performance of ads.

Course Outcomes

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

1. Create digital marketing strategies for a given business scenario.
2. Develop search engine marketing strategy with the use of SEO and AdWords.
3. Formulate strategies for various digital marketing channels.
4. Develop ad campaigns on any one of the social media platforms and analyze its outcomes.
5. Know the tabs on google analytics dashboard and measure campaign performance.
6. Ascertain contemporary technologies of DM and its effects on DM.

Module:1	Digital Marketing (DM) Fundamentals	6 hours

Marketing basics, introduction to DM, origin and development of DM, traditional Vs digital marketing, digital marketing channels, digital customer journey and mapping, digital marketing funnel, creating buyer persona, types of digital media (paid, shared, owned, and earned), IMC in DM, developing DM strategy and objectives, and challenges to DM.

Module:2	Search Engine Optimization (SEO)	6 hours

Building websites and web pages, web hosting, subdomains and subfolders, website navigation, social media icons, advanced website features, setting up google analytics, search engine work mechanism, pillars of SEO, on-page and off-page optimization, SEO - visual and voice search, SEO tactics - white-hat and black-hat SEO, SEO - UX and UI, content marketing for SEO success, and external link building.

Module:3	Display Advertising & Search Engine Advertising	7 hours

Display advertising media, digital/ad metrics, types of display ads, targeting categories, geographic and language tagging, programmatic display advertising, ad server, ad exchange, challenges to display advertising. Search engine payments, google AdWords, Ad placements, Ad ranks, enhancing ad campaign, performance reports, and e-commerce ads Vs google ads.

Module:4	Social Media Marketing – Facebook, LinkedIn, & Instagram	8 hours

Developing social media ad strategy - listening, goal setting, strategy, implementation, measurement, social entertainment, and gamification. Facebook marketing - organic marketing, paid marketing, marketing with 3D posts, FB ads manager, FB pixel, FB business manager, and useful design tools. Importance of LinkedIn presence, LinkedIn strategy, LinkedIn website demographics, content strategy, LinkedIn native videos, LinkedIn analytics, and ad campaign. Instagram: objectives, content strategy, style guidelines, hashtags, sponsored ads, and apps.

Module:5	Twitter, Mobile, and Video Marketing	6 hours

Twitter building blocks, content strategy, Twitter usage, Twitter ads, Twitter analytics, Twitter tools and tips for marketers. Mobile advertising model, mobile marketing (MM) media (paid and owned), MM features, mobile apps, website and mobile responsive ads, MM strategy, and MM analytics. Needs of video marketing (VM), VM channels, VM strategy, and types of marketing videos, video production process, video optimization, and video analytics.

Module:6	Digital Analytics and Online Reputation Management (ORM)	6 hours

Data collection, key metrics, affiliate marketing, multi-channel attribution, types of tracking codes, and competitive intelligence. ORM Vs SEO, social commerce: reviews and ratings, user generated content, blogs, marketing partners, native advertising, landing page, and influencer marketing.		
Module:7	**Technological Advancements in DM**	**4 hours**
Voice search, beacon strategy, micro-moment marketing, cross device marketing, anthropomorphic AI, virtual reality (VR), augmented reality (AR), mixed reality (MR), extended reality (XR), chat bots, block chain technology, and role of virtual agents in customer relationship management.		
Module:8	**Contemporary Topics**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Seema Gupta, *Digital Marketing*, 2020, 2nd Edition, McGraw-Hill Education, India	
2.	Alan Charlesworth, *Digital Marketing: A practical Approach*, 2018, 3rd Edition, Routledge, UK	
Reference Books		
1.	Jeremy Kagan and Siddharth Shekhar Singh, *Digital Marketing: Strategy and Tactics*, 2020, 1st Edition, Wiley, USA	
2.	David Meerman Scott, *The new rules of marketing and PR: How to use Content Marketing, Podcasting, Social Media, AI, Live Video, And NewsJacking to reach buyers directly*, 2020, 7th Edition, Wiley, USA	
3.	Dave Chaffey and Paul Russell Smith, *Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing*, 2017, 5th Edition, Routledge, UK	
Mode of Evaluation: CAT, Written Assignment, Quiz, and FAT.		
Recommended by Board of Studies	27-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BMGT107L	Business Analytics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To summarize, analyze, and report the data for effective business decision-making.
2. To comprehend the advanced analytical tools available for various business problems.
3. To evaluate various analytical tools and choose the appropriate tool(s) for the given problem and data.

Course Outcomes

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

1. Compare various BA tools and evaluate various data types and scales.
2. Examine the characteristics of data to summarize it effectively.
3. Apply various supervised and unsupervised learning algorithms to business problems.
4. Use different techniques of BA to any one of the management domains.
5. Create and interpret the data analysis report to make business decisions.

Module:1	Overview to Business Analytics (BA)	5 hours
Need for business analytics, BA Vs data science, BA Vs big data, terminologies - business intelligence, machine learning algorithms - supervised and unsupervised learning, and data mining, pillars of BA, roadmap for analytics, data types and scales, data cleansing and data preparation.		
Module:2	**Descriptive Analytics**	**9 hours**
Descriptive analytics - measures of central tendency and dispersion, data visualization and exploration - histogram, bar chart, scatter plot, pie chart, box plot, and tree plot, probability, probability distributions, hypotheses testing, significance value (*p*-value) and relationship among variables.		
Module:3	**Regression Techniques**	**6 hours**
Simple linear regression and multiple linear regression (MLR), - theory, assumptions, goodness of fit, and model comparison. Applications of simple linear regression, MLR, using business problem and data.		
Module:4	**Classification Techniques**	**8 hours**
Binary logistic regression, decision tree, KNN, Naïve Bayes, LDA - theory and evaluations of classifiers (ROC and confusion matrix). Applications of binary logistic regression decision tree, KNN, Naïve Bayes, and LDA using business problem and data.		
Module:5	**Clustering and Dimensionality Reduction**	**6 hours**
Basics and uses of cluster analysis (K-means and Hierarchical clustering), and dimensionality reduction (FA and PCA). Interpretations to the outputs of K-means clustering, Hierarchical clustering, FA, and PCA.		
Module:6	**Applications of BA**	**6 hours**
Domain Applications of BA: HR analytics / marketing and retail analytics / web and social media analytics / financial analytics.		
Module:7	**Report Writing**	**3 hours**
Report writing - summary, problem identification, objectives, data visualization and exploration, methodology, interpretations, findings, and conclusions.		
Module:8	**Contemporary Topics**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1.	Dinesh Kumar U, *Business Analytics: The Science of Data-Driven Decision Making*, 2017, 1st Edition, Wiley, India.			
2.	Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, and David R. Anderson, *Essentials of Business Analytics*, 2017, 2nd Edition, Cengage Learning Inc., USA.			
Reference Books				
1.	Evans, J. R., *Business Analytics: Methods, Models and Decisions*, 2021, 3rd Edition, Pearson Education, USA.			
2.	Albright, S. C., and Winston, W. L.., Business Analytics: *Data Analysis and Decision Making*, 2020, 7th Edition, Cengage Learning India Pvt. Ltd, India.			
3.	Shmueli, G., Bruce, P. C., Yahav, I., Patel, N. R., and Lichtendahl, K. C., *Data Mining for Business Analytics: Concepts, Techniques, and Applications in R*, 2017, 1st Edition, Wiley, USA.			
Mode of Evaluation: CAT, Written Assignment, Quiz, Project, Seminar, Group Discussion, Case Study, and FAT				
Recommended by Board of Studies	27-05-2022			
Approved by Academic Council	No. 66	Date	16-06-2022	

Course Code	Course Title	L	T	P	C
BECS201L	Semiconductor Devices and Circuits	3	0	0	3
Pre-requisite	BEEE102L, BEEE102P	Syllabus version			
		1.0			

Course Objectives:

1. To apply the knowledge of solid state devices principles to analyze electronic circuits.
2. To demonstrate amplifiers under different configurations and analyse their responses.
3. To impart the knowledge of analog circuit design for various applications.

Course Outcomes:

1. Comprehend the basics of semiconductor materials.
2. Understand the behavior of semiconductor devices and their applications.
3. Comprehend design aspects of amplifier circuits.
4. Analyze the performance characteristics and applications of Op-Amp.
5. Design engineering applications using analog ICs.

Module:1	Semiconductor Materials	6 hours

Introduction to Solids, Crystals and Electronic Materials; Formation of Energy Bands; Energy Band Model; Intrinsic and Extrinsic Semiconductors; Temperature Dependence; Organic Semiconductor; Carrier Concentration, Carrier Generation and Recombination; Metal-Semiconductor Junction; Fermi Level.

Module:2	Diode Circuits	4 hours

PN Junction Diode: Characteristics; Diode Circuits: Clipper, Clamper and Rectifiers; Special Purpose Diodes: LEDs.

Module:3	Transistors	7 hours

BJT and FET Characteristics; BJT vs FET; Types of BJT and FET; Load line and Operating Point Analysis of BJT and FET.

Module:4	Amplifiers	7 hours

Basic BJT and MOSFET Amplifier Configurations; Calculation of Amplifier Parameters; Differential Amplifier; CMRR; Power Amplifiers: Applications.

Module:5	Feedback Amplifiers	5 hours

Basic Concepts of Feedback; Negative Feedback: Advantages, Types: Voltage/Current, Series/Shunt; Positive Feedback; Stability; Conditions for Oscillations: RC and LC Oscillators.

Module:6	Operational Amplifiers	8 hours

DC Characteristics, AC Characteristics; Linear applications: Adder, Subtractor, Integrator and Differentiator; Non-Linear Applications: Comparator, Multivibrator; Waveform Generator.

Module:7	Special ICs	6 hours

IC555 timer: Astable and Monostable Modes of Operation; Regulator ICs: Fixed and Variable Voltage Regulators; ADC and DAC ICs.

Module:8	Contemporary Issues	2 hours

Guest lecture from Industry and R & D Organizations

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Boylestad, Robert L., and Louis Nashelsky. Electronic Devices and Circuit Theory. Prentice Hall, 2012.
2.	Sedra, Adel S., and Kenneth Carless Smith. Microelectronic Circuits: Theory and Applications. Oxford University Press, 2013.
3.	Fiore, James M. Operational Amplifiers & Linear Integrated Circuits: Theory and Application. Dissidents, 2018.
Reference Books	
1.	Neamen, Donald A. Electronic Circuit Analysis and Design. McGraw-Hill, 2001.
2.	David A. Bell. Electronic Devices and Circuits. Oxford University Press, 2008.
3.	Albert Malvino and David Bates. Electronic Principles, McGraw Hill Education, 2021.
4.	Huijsing, Johan. Operational amplifiers. Dordrecht: Springer Netherlands, 2011.

Mode of Evaluation: CAT, Digital assignments, Quiz, and FAT			
Recommended by Board of Studies	04-04-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
BECS201P	Semiconductor Devices and Circuits Lab	0	0	2	1
Pre-requisite	BEEE102L, BEEE102P	Syllabus version			
		1.0			

Course Objectives:

1. To apply the knowledge of solid state devices principles to analyze electronic circuits.
2. To demonstrate amplifiers under different configurations and analyse their responses.
3. To impart the knowledge of analog circuit design for various applications.
4. To have hands on learning experience and software knowledge by doing practical exercises and projects.

Course Outcomes:

On the completion of this course the student will be able to:

1. Understand the behavior of semiconductor devices and their applications.
2. Comprehend design aspects of amplifier circuits.
3. Analyze the performance characteristics and applications of Op-Amp.
4. Design engineering applications using analog ICs.
5. Having an ability to design amplifiers and conduct experiments, as well as to analyze and interpret data.
6. Having an ability to design circuits and use modern engineering tools necessary for engineering practice.

	Indicative Experiments	Hours
1.	Design and implementation of a voltage multiplier circuit using diodes.	2 hours
2.	Design and implementation of diode clippers and clampers used in power circuits.	2 hours
3.	Design and implementation of a circuit to perform DC analysis of a BJT.	2 hours
4.	Design and implementation of an alarm system using BJT as a switch.	2 hours
5.	Design and implementation of MOSFET amplifier for radio frequency application.	2 hours
6.	Design and implementation of a differential amplifier using BJT and to find CMRR.	2 hours
7.	Design and implementation of RC phase shift oscillator used in GPS.	2 hours
8	Design and implementation of feedback amplifier using BJT.	2 hours
9.	Design and implementation of inverting and non-inverting amplifier.	2 hours
10.	Design of implementation of integrator and differentiator using op-amp.	2 hours
11.	Design and implementation of triangular wave and saw tooth waveform generator using op-amp.	2 hours
12.	Design and implementation of summing and difference amplifier.	2 hours
13.	Design and implementation of comparator using op-amp.	2 hours

14.	Design and implementation of astable multivibrator and monostable multvibrator using IC555 timer.	2 hours
15.	Design and implementation of ADC and DAC.	2 hours
	Total Laboratory hours:	**30 hours**

Mode of assessment: Continuous assessment / FAT / Oral examination			
Recommended by Board of Studies	04-04-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

BEEE203L	Circuit Theory	L	T	P	C
		3	1	0	4
Pre-requisite	**BEEE101L, BEEE101P**	**Syllabus version**			
		1.0			

Course Objectives

1. Familiarize the network topology, theorems and the analysis of three-phase unbalanced systems.
2. Understand the time domain system behaviour using pole zero plot, resonant circuits and to implement different types of passive filters.
3. Evaluate the transient and steady state response of electrical circuits and two port network parameters.

Course Outcomes

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

1. Understand the network topology and to apply the network theorems to estimate the steady state response for a given excitation.
2. Analyse three-phase unbalanced systems in star and delta configurations.
3. Infer and evaluate transient response, steady state response of RL, RC and RLC circuits and network functions.
4. Acquire knowledge about the application of Laplace transform, Fourier series and Fourier transform in the electrical network.
5. Evaluate two port network parameters to simplify the network computations.

Module:1	**Network Topology**	**6 hours**

Concept of tree, branch, tree link, incidence matrix, tie-set matrix and loop currents, cut-set matrix and node pair potentials; Duality

Module:2	**Network Theorems**	**10 hours**

Network theorems for AC circuits: Superposition, reciprocity, thevenin's, norton's, maximum power transfer and millman's theorem

Module:3	**Three-phase Systems**	**8 hours**

Review of balanced system; Unbalanced systems: Delta-connected, three-wire star connected, four-wire star-connected loads; Analysis of unbalanced 3-wire star load: Kirchhoff's law, loop current method, star/delta conversion method using millman's theorem

Module:4	**Analysis of Transient Response of Circuits**	**10 hours**

Review of Laplace transformation; Laplace transform of network and time domain solution for RL, RC and RLC networks for AC and DC excitations; Transient behaviour of circuit elements under switching conditions and their representations, evaluation of initial and final conditions in RL, RC and RLC circuits with AC and DC excitations

Module:5	**Network Function and Frequency Response**	**10 hours**

Transfer Function; Poles and zeros diagram, time-domain response from pole-zero plot, poles and zeros of network functions and their significance; Stability; Series and parallel resonance: Q factor and bandwidth

Filters: Definitions, classification and characteristics of different filters; Design of passive filters: Low pass filter, high pass filter, band pass filter and band stop filter

Module:6	**Fourier Analysis and Its Applications**	**7 hours**

Trigonometric fourier series for non-sinusoidal functions: Circuit analysis; Average power and RMS values using fourier coefficients; Exponential fourier series; Fourier transform for commonly used periodic and aperiodic functions; Circuit analysis in frequency domain

Module:7	**Two Port Networks**	**7 hours**

Open circuit impedance parameters, Short circuit admittance parameters, transmission parameters, hybrid parameters; Relationship between parameter sets; Interconnections of two port networks

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

	Total Lecture hours:		**60 hours**
Text Book(s)			
1.	Charles K Alexander, Matthew Sadiku, Fundamentals of Electric Circuits, 2021, 7th edition, Mc Graw Hill Education		
2.	Ravish. R. Singh, Network Analysis &Synthesis, 2019, 2nd Edition, Mc-Graw Education		
Reference Books			
1.	William Hayt, Jack Hemmerly, Jaime Phillips, Steven Durbin, Engineering Circuit Analysis, 2019, 9thedition, Mc Graw Hill Education		
2.	M.E Van Valkenberg, Network Analysis, 2019, Revised 3rdEdition, Pearson Publishers		
3.	Abhijit Chakrabarthi, Circuit Theory (Analysis and Synthesis), 2018, 7thRevised Edition, Dhanpat Rai &Co.		
4.	V. K. Mehta, Rohit Mehta, Basic Electrical Engineering, 2017, S Chand Publishers		
5.	Mahmood Nahvi, Joseph Edminister, Electric Circuits, 2018, 7thEdition, McGraw Hill Education		
Mode of Evaluation: CAT, Digital Assignments, Quiz and FAT			
Recommended by Board of Studies	30-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BEEE206L	Digital Electronics	L	T	P	C
		3	0	0	3
Pre-requisite	**BECE101L, BECE101P**	**Syllabus version**			
		1.0			

Course Objectives

1. Comprehend the Hardware Description Language (HDL) for digital circuits.
2. Design, simulate and realize the building blocks of digital systems.
3. Analyze combinational and sequential circuit for digital system applications.

Course Outcomes

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

1. Develop digital logic circuits and apply to solve real world applications.
2. Design and analyze digital circuits using Verilog HDL.
3. Design and implement combinational circuits, sequential circuits and programmable logic devices.
4. Analyze and synthesize complex digital modules and circuits for various applications.
5. Able to identify and prevent various hazards and timing problems in a digital design.

Module:1	**Digital Fundamentals and Circuits**	**5 hours**

Digital design: Canonical and standard forms; Karnaugh Maps; Product of Sums (POS) and Sum of Products (SOP) simplification, Don't care conditions; Realization of logic circuits using NAND and NOR gates

Module:2	**Hardware Description Language**	**5 hours**

Verilog HDL: Verilog operators; Levels of design description; Concurrency, Gate level modelling, Data flow modelling, Behavioural modelling; Test benches

Module:3	**Combinational Circuits**	**7 hours**

Combinational circuits: Analysis and design procedures; Circuits for arithmetic operations; Code converters; Decoders and encoders; Multiplexers and De-multiplexers; Parity generator; Magnitude comparator; Design of seven segment display

Module:4	**Sequential Circuits**	**8 hours**

Sequential circuits: Design of sequential modules; SR, D, T and J-K Latches/Flip-flops; Shift registers; Counters; Basic state machine concepts; Mealy/Moore Models, State minimization, State assignment, Circuit Implementation

Module:5	**HDL for Combinational and Sequential Circuits**	**4 hours**

HDL based design: Blocking and non-blocking assignment statement, Procedural assignment statement; Combinational circuits using dataflow and structural modelling; Sequential circuits using behavioural modelling

Module:6	**Asynchronous Sequential Circuits**	**7 hours**

Analysis Procedure; Stable and Unstable states, output specifications, State reduction, Race free assignments, Hazards; Essential Hazards, Design of Hazard free circuits

Module:7	**Memory and Programmable Logic Devices**	**7 hours**

Basic Memory Structures: ROM, PROM, EPROM, EEPROM, RAM; Static and Dynamic RAM; Programmable Logic Devices (PLD); Programmable Logic Array (PLA), Programmable Array Logic (PAL), Implementation of Combinational Logic using PLA and PAL; Field Programmable Gate Array (FPGA)

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

	Total Lecture hours:	**45 hours**

Text Books	
1	Floyd, Thomas L., Digital Fundamentals, 2017, 11th Edition, Pearson Education
2	M Morris Mano, Michael D. Ciletti, Digital design: with an introduction to the Verilog HDL, VHDL, and system Verilog, 2017, 6th Edition, Pearson Education
Reference Books	
1	Roth, Charles, Lizy K. John, and Byeong Kil Lee, Digital systems design using Verilog,2017, 1st Edition, Cengage India Private Limited
2	Stephen, Brown, and Vranesic Zvonko, Fundamentals of digital Logic with Verilog design, 2017, 2nd Edition, McGraw Hill Education
Mode of Evaluation: CAT, Quiz, Assignments, FAT	

Recommended by Board of Studies	19-02-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BEEE206P	Digital Electronics Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**BECE101L, BECE101P**	**Syllabus version**			
		1.0			

Course Objectives

1. Create various building blocks of digital systems.
2. Comprehend and execute the CAD tools to design combinational and sequential circuits.

Course Outcomes

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

1. Design and construct various combinational circuits using gates/MSI components.
2. Design and analyze sequential circuits.
3. Implement various combinational and sequential circuits using Verilog HDL code.

Indicative Experiments

1	Simplify the given Boolean expression and verify using logic gates/Universal gates
2	Design and verification of Half-Subtractor and Full-Subtractor using logic gates
3	Design and implementation of code converters
4	Design and implementation of magnitude comparators using logic gates/ICs
5	Design and verification of given logic function using multiplexer ICs
6	Design and verification of latches
7	Perform the logic operations using Verilog operators
8	Design and verification of Half-adder and Full-adder using Verilog structural modeling
9	Design and verification of priority encoder using Verilog behavioural modelling
10	Design and verification of shift registers using Verilog HDL
11	Design and verification of 4-bit binary up/down counter with load enable
12	Design of arithmetic circuits using Verilog HDL
	Total Laboratory Hours: 30 hours

Mode of assessment: Continuous assessment, FAT

Text Book

1	M. Morris Mano, Michael D. Ciletti, Digital design: with an introduction to the Verilog HDL, VHDL, and system Verilog, 2017, 6th Edition, Pearson Education

Recommended by Board of Studies	19-02-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

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,

<table>
<tr><td colspan="4">Prentice Hall India 2016.</td></tr>
<tr><td colspan="4">Reference Books:</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="4">Mode of Evaluation: CAT, Quizzes, Digital Assignments, FAT</td></tr>
<tr><td>Recommended by Board of Studies</td><td colspan="3">15.02.2022</td></tr>
<tr><td>Approved by Academic Council</td><td>No. 65</td><td>Date</td><td>17-03-2022</td></tr>
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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

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

BEEE303L	Control Systems	L	T	P	C
		3	0	0	3
Pre-requisites	**BEEE101L, BEEE101P, BMAT102L**	**Syllabus version**			
		1.0			

Course Objectives

1. Introduce the fundamentals of physical systems modelling and control of linear time invariant systems.
2. Teach the practical control system design with realistic system specifications.
3. Impart knowledge of state variable models and state feedback design.

Course Outcome

On the completion of this course, the student will be able to:
1. Formulate mathematical models of the physical systems.
2. Analyze the system performance in time and frequency domains.
3. Determine the stability of linear time invariant system in time and frequency domains.
4. Design compensators and controllers to meet the performance specifications.
5. Perform state space analysis and design state feedback control.

Module:1	**Systems and their Representations**	**6 hours**

Basic elements in control systems: open loop and closed loop, transfer functions of mechanical, electrical and electro-mechanical systems, electrical analogous systems; Block diagram reduction, signal flow graphs.

Module:2	**Time Response Analysis**	**6 hours**

Standard test signals, time response of first and second order systems, time domain specifications; Steady state error, static error constants and system type.

Module:3	**Stability Analysis and Root Locus**	**6 hours**

Stability: concept and definition, characteristic equation, location of poles, Routh Hurwitz criterion; Root locus technique: construction, properties and applications.

Module:4	**Frequency Response Analysis**	**6 hours**

Frequency domain specifications; Bode plot, Polar plot; Correlation between frequency domain and time domain specifications.

Module:5	**Stability in Frequency Domain**	**5 hours**

Relative stability: gain margin, phase margin; stability analysis using frequency response methods; Nyquist stability criterion.

Module:6	**Compensators and Controllers**	**7 hours**

Realization of basic compensators, cascade compensation in time domain and frequency domain, feedback compensation, design of lag, lead, lag-lead series compensators using Bode plot; P, PI and PID controllers in frequency domain.

Module:7	**State Space Analysis**	**7 hours**

Concepts of state variable and state model, solution of state equation, state space to transfer function conversion, state space decomposition methods, controllability, observability, pole placement control, observer design.

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

	Total Lecture hours:	**45 hours**

Text Books

1. Norman S. Nise, Control System Engineering, 2019, 8th Edition, John Wiley & Sons
2. Farid Galnaraghi, Benjamin C. Kuo, Automatic Control System, 2017, 9th Edition, McGraw-Hill Education

Reference Books

1. K. Ogata, Modern Control Engineering, 2016, 5th Edition, Pearson
2. R.C. Dorf & R.H. Bishop, Modern Control Systems, 2017, 13th Edition, Pearson

	Education			
3.	M. Gopal, Control Systems- Principles and Design, 2016, 4th Edition, Tata McGraw Hill			
4.	J. Nagrath and M. Gopal, Control System Engineering, 2018, 6th Edition, New Age International Publishers			
Mode of Evaluation: CAT, Assignment, Quiz, FAT				
Recommended by Board of Studies		19-02-2022		
Approved by Academic Council		No. 65	Date	17-03-2022

BEEE303P	Control Systems Lab	L	T	P	C
		0	0	2	1
Pre-requisites	**BEEE101L, BEEE101P, BMAT102L**	**Syllabus version**			
		1.0			

Course Objectives

1. Develop transfer function and state space models of physical systems.
2. Design and implement a PID controller/State feedback controller/ Lag/Lead/Lag-lead compensators.

Course Outcomes

On the completion of this course, the student will be able to:
1. Design feedback control for meeting system specifications.
2. Analyze the stability and response of linear time invariant systems.
3. Perform the time and frequency domain analyses of first and second order systems.

Indicative Experiments

1.	Simulation study of block diagram reduction technique
2.	Determination of time domain specifications
3.	Study of first and second order electrical networks
4.	Stability analysis of linear systems
5.	PID controller design using Bode plot
6.	PID controller design using root locus
7.	Compensator design in frequency and time domains
8.	Analysis of controllability and observability properties of a system
9.	Lag compensator design for linear servo motor for speed control application
10.	Pole placement controller design for inverted pendulum
11.	PD controller design for position control of servo plant
12.	Cascade control design for ball and beam system
13.	PID controller design for magnetic levitation system
14.	Determination of transfer function of separately excited DC generator
15.	Identification of transfer function of field-controlled separately excited DC Motor
16.	Controller realization from MATLAB / SIMULINK using Embedded Coder
	Total Laboratory Hours | 30 hours

Mode of assessment: Continuous assessment, FAT

Text Book

1. Norman S. Nise, Control System Engineering, 2019, 8th Edition, John Wiley & Sons

Recommended by Board of Studies	19-02-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BEEE309L	Microprocessors and Microcontrollers	L	T	P	C
		3	0	0	3
Pre-requisite	**BEEE206L, BEEE206P**	**Syllabus version**			
		1.0			

Course Objectives

1. Emphasize on hardware functionality of Intel 8051 and ARM.
2. Create an essential knowledge of the I/O ports, Timers/Counters, control registers and various types of interrupts.
3. Demonstrate the procedure and methods to interface a microcomputer system to various devices.

Course Outcomes

1. Understand architecture of 8051 microcontroller and its instruction set.
2. Comprehend and develop programs for various blocks of 8051.
3. Design and interface microcontroller based embedded systems.
4. Interpret the architecture of ARM Processor.
5. Analyze the different ARM instructions to solve real-time problems and interface various peripherals.

Module:1	**8-bit Architecture**	**6 hours**

Hexadecimal Arithmetic, Registers, Buses, Microprocessor & Microcontroller; Overview of 8051 Architecture; Program Status Register; Structure of Random-Access Memory; Special function registers; Pin configuration and ports structure of 8051 Microcontroller.

Module:2	**Instruction Set of 8051**	**6 hours**

Data transfer instructions; Arithmetic and Logical instructions; Boolean instructions; Control transfer instruction; Programming 8051 using Assembly and Embedded C; Demonstration of HEX file generation and program execution.

Module:3	**ARM Processor**	**5 hours**

RISC philosophy; Comparison between CISC and RISC; Overview of 32-bit ARM architecture; ARM memory organization; Different modes of ARM processor; Program status register; 3-stage pipeline.

Module:4	**ARM Cortex - M Architecture**	**6 hours**

ARM Cortex-M Organization; Cortex M Registers; Cortex A/M Series; Advanced Microcontroller Bus Architecture (AMBA); Nested vectored interrupt controller.

Module:5	**Instruction Set of ARM Processor**	**8 hours**

Data transfer instructions; Arithmetic and Logical instructions; Multiply instructions; Branches and subroutines; Load/Store instructions; Swap instruction; Pre and Post Indexing; Programming of ARM.

Module:6	**General Purpose I/O, and Circuits**	**4 hours**

General Purpose Input/Output (GPIO); Basic Concepts; Port Circuitry; Peripheral Access In C; Circuit Interfacing; LED & Switch Interface.

Module:7	**Peripherals and Interfacing**	**8 hours**

Display Interface; Timer module; Pulse-width modulation (PWM) Module; Analog-to-Digital conversion; Digital-to-Analog conversion; Programming of peripherals.

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

Text Books

1. Muhammad Ali Mazidi, Janice Gillispie *Mazidi, and* Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2018, 2nd Edition, Pearson Education
2. Pyeatt, Larry D, Modern Assembly Language Programming with the ARM Processor, 2016, 1st Edition, Newnes, Elsevier

Reference Books

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<tr><td colspan="4">Muhammed Ali Mazidi, Sarmad Naimi , Sepehr Naimi, Arm Cortex-M Assembly Programming for Embedded Programmers: Using Keil, 2020, 1st Edition, Pearson
Hohl, William, ARM assembly language: fundamentals and techniques, 2016, 2nd Edition, CRC Press
Saurabh Chandrakar, Nilesh Bhaskarrao Bahadure, Microcontrollers and Embedded System Design, 2019, 1st Edition, Dreamtech Press</td></tr>
<tr><td colspan="4">Mode of Evaluation: CAT, Programming Assignment, Quiz, FAT</td></tr>
<tr><td>Recommended by Board of Studies</td><td colspan="3">19-02-2022</td></tr>
<tr><td>Approved by Academic Council</td><td>No. 65</td><td>Date</td><td>17-03-2022</td></tr>
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BEEE309P	Microprocessors and Microcontrollers Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**BEEE206L, BEEE206P**	**Syllabus version**			
		1.0			

Course Objectives

1. Familiarize and develop programs for 8051 and ARM processor.
2. Excel and implement various interfacing techniques with processor and controller.

Course Outcomes

1. Develop and demonstrate structured assembly programs using microcomputer.
2. Implement C language programming for processor and controller.
3. Design hardware using microprocessor and microcontroller for real-time applications.

Indicative Experiments

1.	Solve simple arithmetic expressions using 8051 instructions
2.	Transfer of data between different 8051 memories
3.	Introduction to ARM instructions and perform arithmetic and logical tasks
4.	Programming ARM processor using subroutines
5.	Interworking of ARM – THUMB codes
6.	Programming GPIO pins of ARM processor
7.	Generation of delay using timers of ARM processor
8.	Interfacing switch, LED, and buzzer with Cortex - M
9.	Interfacing display devices with controllers
10.	Interface sensors with controller
11.	Generation of wave forms using DAC
12.	Generation of PWM signals for MOSFET switches
	Total Laboratory Hours **30 hours**

Text Book

1. Muhammad Ali Mazidi, Janice Gillispie *Mazidi, and* Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2018, 2nd Edition, Pearson Education

Reference Book

1. Muhammed Ali Mazidi, Sarmad Naimi , Sepehr Naimi, Arm Cortex-M Assembly Programming for Embedded Programmers: Using Keil, 2020, 1st Edition, Pearson Education

Mode of assessment: Continuous assessment, FAT			
Recommended by Board of Studies	19-02-2022		
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

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

Course Code	Course Title	L	T	P	C
BECM301L	Signal Processing	3	0	0	3
Pre-requisite	BMAT102L	Syllabus version 1.0			

Course Objectives

1. To understand the characteristics of signals, systems in time and frequency domain with the corresponding transformations.
2. To analyse the signals and systems in time and transformed domains such as DTFT, Z-transform and DFT.
3. To inculcate the design concepts of digital FIR filters, analog and digital IIR Filters.
4. To instill diverse structures for realizing digital filters.
5. To provide an insight into digital signal processors.
6. To learn the usage of appropriate tools for realizing signal processing modules

Course Outcome

On studying this course, students will be able to

1. Differentiate between various types of signal and understand the systems in continuous and discrete domain.
2. Comprehend, classify and analyse signals in time and frequency domain transformations
3. Analyze of DT systems using Z-transform.
4. Comprehend various analog filter design techniques and be able to design digital filters
5. Able to realize digital filters using various system interconnections
6. Understand the types and architecture of digital signal processors.
7. Design and implement systems using the imbibed signal processing concepts

Module:1	Signal and Systems	6 hours

Signals: classification-continuous and discrete, Operations on signals, Sampling, System - classification, Discrete time convolution and correlation.

Module:2	System Analysis using Z-Transform	6 hours

Z-transform, Properties, S-plane to Z-plane mapping, Inverse z-transform, Solution to difference equations using z-transform, Region of convergence, Stability analysis

Module:3	Fourier Transforms in Discrete Domain	8 hours

Review of Continuous-time Fourier transform, Discrete-time Fourier transform - Dirichlet's Conditions, Magnitude and phase response, Parseval's theorem, Gibbs Phenomenon. Properties of FT. DFT, Radix-2 FFT Algorithms – Decimation In Time & Decimation In Frequency.

Module:4	Design of Digital FIR Filters	6 hours

Design characteristics of FIR filters with linear- phase – Frequency response of linear phase FIR filters, Design of FIR filters using windowing techniques -Rectangular, Bartlett, Hamming, Hanning and Blackmann

Module:5	Design of Digital IIR Filters	6 hours

Analog low pass filter -Butterworth and Chebyshev approximations, frequency transformation, Bilinear Transformation Technique

Module:6	Digital filter Structures	7 hours

Basic FIR and IIR digital filter structures - Direct Forms, Cascade, Parallel, Lattice and

Lattice-Ladder structures		
Module:7	**Digital Signal Processors**	**4 hours**
Fixed-point Architecture -VLIW, Fixed-point and Floating-point coefficients, finite word length effects		
Module:8	**Contemporary Topics**	**2 hours**
Guest lecture from Industries and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	John G. Proakis, Dimitris G Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 2022, 5th Edition, Pearson, USA
Reference Books	
2.	Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley Publications, 2021
3.	P. Rama Krishna Rao and Shankar Prakriya, “Signals and Systems”, 2nd edition - Mc-Graw Hill, 2017
4.	Lizhe Tan, Jean Jiang, Digital Signal Processing: Fundamentals and applications, 3rd edition, 2018, Academic Press, USA

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
BECM301P	Signal Processing Lab	0	0	2	1
Pre-requisite	BMAT102L	Syllabus version 1.0			

Course Objectives

To learn and practice appropriate software and hardware tools for implementing the building blocks in signal processing.

Course Outcome

On studying this course, students will be able to

1. Generate the various elementary signal properties using software and DSP processor.
2. Analyze system properties with simulation.
3. Design digital filters for real-time applications using DSP processor

Indicative Experiments		
Software [20 hours]		
1	Signal generation and sampling	2 hours
2	Convolution (linear and circular) and correlation	2 hours
3	Fourier transform and its properties	2 hours
4	Discrete Fourier transform and its properties	2 hours
5	Stability analysis	2 hours
6	FIR filter design (using DSP tool-kit)	2 hours
7	Analog IIR filter design	2 hours
8	Digital IIR filter design	2 hours
9	Analysis of quantization effects	2 hours
10	Signal smoothening- ECG/EEG signals	2 hours
Hardware (CCStudio&TMS6748):[10 hours]		
11	Signal generation	2 hours
12	Fast Fourier transform implementation	2 hours
13	FIR filter design for audio/speech signal	2 hours
14	IIR filter design for audio/speech signal	2 hours
15	Study of quantization effects	2 hours
	Total Laboratory Hours	30 hours

Mode of Assessment: Continuous Assessment and Final Assessment Test

Text Book(s)

1. John G. Proakis, Dimitris G Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 2022, 5th Edition, Pearson, USA
Reference Books
1. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley Publications, 2021 2. P. Rama Krishna Rao and Shankar Prakriya, “Signals and Systems”, 2nd edition - Mc-Graw Hill, 2017 3. Lizhe Tan, Jean Jiang, Digital Signal Processing: Fundamentals and applications, 3rd edition, 2018, Academic Press, USA

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
BECS301L	Electrical Machines	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. Understand the concepts and basic operation of electrical machines.
2. Comprehend the performance of DC machines, AC machines and transformers with its applications.
3. Learn various speed control techniques of DC and AC motors.

Course Outcomes:

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

1. Understand construction and working principles of different types of electrical machines.
2. Realize the performance characteristics of various electrical machines.
3. Apply speed control concepts for various electrical motors.

Module:1	Principles of Electromechanical Energy Conversion	6 hours

Magnetic circuits and induction - singly excited systems - multi excited systems - force and torque equations.

Module:2	DC Machines	10 hours

Construction - methods of excitation - armature reaction - commutation - EMF equation - torque equation - voltage regulation - performance characteristics - losses and efficiency - speed control and starting techniques.

Module:3	Transformers	9 hours

Transformer windings - EMF equation - equivalent circuit - phasor diagram - efficiency and voltage regulation - parallel operation - transformer testing.

Module:4	Induction Machines	9 hours

Construction of three phase induction machine - theory and operation - equivalent circuit - phasor diagram- starting and speed control - performance characteristics - applications.

Module:5	Synchronous Machines	9 hours

Types - principle of operation - equivalent circuit - phasor diagram - voltage regulation - methods of starting: hunting and damper windings - applications.

Module: 6	Contemporary Topics	2 hours

Recent advances in electrical machines and its applications.

	Total Lecture Hours:	45

Text Books

1	Gupta, J. B. Theory & Performance of Electrical Machines. SK Kataria and Sons, 2013.

2.	Bimbhra, P. S. Electrical Machinery. Khanna Publishers, 2010.		
Reference Books			
1.	Fitzgerald, Arthur Eugene, Charles Kingsley, and Stephen D. Umans. Electric Machinery. McGraw-Hill, 2020.		
2.	Kothari, D. P., and I. J. Nagrath. Electric Machines. McGraw-Hill, 2017.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT			
Recommended by Board of Studies	XXXX		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS302L	Digital Instrumentation	2	0	0	2
Pre-requisite	BEEE203L	Syllabus version			
		1.0			

Course Objectives:

1. Understand the basics of measurement and instrumentation technologies.
2. Provide sufficient knowledge on digital and automated instrumentation.
3. Apply the knowledge of digital instrumentation for required applications.

Course Outcomes:

On completion of the course the student will be able to:

1. Understand the basics of instrumentation and the necessity of measurement.
2. Identify the digital instruments used to measure various electrical parameters.
3. Acquire knowledge on smart instrumentation technologies for power grids.
4. Design a building with automated features.

Module:1	Analog Instruments	4 Hours

Functional elements of an instrument; construction and principle of operation of analog instruments: PMMC, MI, electrodynamometer and induction type; analog CRO; current and potential transformers; calibration and standards.

Module:2	Digital Instruments	9 Hours

Comparison of analog and digital instruments; construction and principle of operation of digital instruments: multimeter, frequency meter, LCR meter, Q meter, power factor meter, wattmeter, energy meter; function generator, RF signal generator; oscilloscopes: Digital storage oscilloscope (DSO), Mixed domain oscilloscope (MDO), Mixed signal oscilloscope (MSO); digital displays; spectrum digitizers; spectrum analysers; automation in digital instruments; virtual instruments, A/D and D/A boards.

Data acquisition system: single channel and multichannel; sensors interfacing using DAQ cards; Distributed control system (DCS); Manufacturing execution systems (MES).

Module:3	Power System Instrumentation	7 Hours

Power system instrumentation: concept, need, components; sensors for voltage and current measurements, smart meters, Phasor measurement unit (PMU), Phase lock loop (PLL), Frequency lock loop (FLL); SCADA: function, Master terminal unit (MTU), Remote terminal unit (RTU); Wide area monitoring system (WAMS); Controllers: Program logic controller (PLC), Direct digital controller (DDC); Human Machine interface (HMI).

Module:4	Instrumentation for Building Automation	6 Hours

Concept of building automation - architecture and components; basics of controllers, sensors, actuators, communication network and network protocols; instrumentation

for lighting, HVAC, fire, security and control; techniques for monitoring power consumption.			
Module:5	**Hands on Practices and Contemporary issues**		**4 Hours**
Hands on practices: energy consumption monitoring, smart home automation, virtual instrumentation for measuring electrical parameters, circuit testing using DSO, MDO; contemporary issues: guest lecture from industry experts.			
Total Lecture Hours:			**30**
Text Books			
1.	Bhuyan, M. (2010). Intelligent instrumentation: principles and applications. CRC Press.		
2.	Momoh, J. A. (2012). Smart grid: fundamentals of design and analysis (Vol. 63). Wiley-IEEE press.		
3.	So, A. T. P., & Chan, W. L. (1999). Intelligent building systems (Vol. 5). Springer Science & Business Media.		
Reference Books			
1.	Kalsi, H. S. (2010). Electronic instrumentation (Vol. 1000, p. 26). Tata McGraw-Hill, New Delhi.		
2.	Mukhopadhyay, S. C. (2013). Intelligent sensing, instrumentation and measurements (Vol. 5). Springer.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT			
Recommended by Board of Studies	09-05-2024		
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
BECS304L	Computer Aided Power System Analysis	3	0	0	3
Pre-requisite	BEEE203L	Syllabus version			
		1.0			

Course Objectives:

1. To provide knowledge on the basics of power systems.
2. To impart in depth knowledge on different methods for power system analysis.
3. To introduce computer applications in the analysis of power systems.

Course Outcomes:

On completion of the course the student will be able to:

1. Understand the power system structure and modelling of power system components.
2. Formulate the network matrices.
3. Perform load flow analysis for a given power system network.
4. Perform fault analysis and understand the impact of different types of faults.
5. Examine different power system stability issues and apply appropriate solution methods.
6. Understand the structure of distribution networks and its power flow analysis.

Module:1	Modeling of Power System Components	8 Hours

Power system structure; single line diagram; modeling of components: generator, load, transformer; transmission line parameters: resistance, inductance, capacitance of single phase and three phase transmission lines; modeling of transmission lines: short and medium transmission lines, equivalent circuits, calculation of voltage regulation and transmission efficiency; types of insulators and underground cables.

Module:2	Power System Network Matrices	6 Hours

Per unit (p.u.) analysis; reactance diagram; bus admittance (Y bus) matrix formation by direct inspection method and singular transformation method; inversion of Y bus for large systems using LDU factors; Tinney's optimal ordering; formation of bus impedance matrix (Z bus) using Z bus building algorithm.

Module:3	Power Flow Studies	8 Hours

Impact and applications of computers in power system analysis; power flow problem: derivation of power flow equation, bus classification; power flow studies: determination of bus voltages, injected active and reactive powers, line flows and line losses; algorithm for Newton-Raphson and fast decoupled load flow analysis; load flow computation in large systems.

Module:4	Short Circuit Studies	7 Hours

Introduction to protective relays and circuit breakers; types of faults; short circuit capacity; symmetrical fault analysis using bus impedance matrix; unsymmetrical fault analysis: Fortescue's theorem, positive, negative and zero sequence networks; algorithm for calculating the system conditions after faults.

Module:5	Stability Studies	8 Hours

Classification of power system stability: power angle curve, transfer reactance; swing equation: equal area criterion, critical clearing angle and time; digital solution of swing equation: Runge-Kutta method, modified Euler method.		
Module:6	**Distribution System Analysis**	**6 Hours**
Introduction to distribution systems; nature of loads ; distribution system line models; distribution feeder analysis; power flow analysis for linear and non-linear network: ladder iterative technique; effect of integration of renewable energy sources into distribution network.		
Module:7	**Contemporary Issues**	**2 Hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours:		**45**
Text Books		
1.	John J. Grainger, William D. Stevenson, Jr, Gary W Chang, 'Power System Analysis', 2016, Tata McGraw Hill Education.	
2.	George Kusic, 'Computer Aided Power Systems Analysis', Second Edition, 2008, CRC Press.	
3.	William H. Kersting, 'Distribution System Modeling and Analysis', 2002,CRC Press.	
Reference Books		
1.	D. P. Kothari,I. J. Nagrath and R K Saket, 'Modern Power System Analysis', 5th Edition, 2022, McGraw Hill.	
2.	Hadi Saadat, 'Power System Analysis', 2015, Tata McGraw Hill Education.	
3.	Glenn W. Stagg and Ahmed H. El-Abiad, 'Computer Methods in Power System Analysis', 2019, Medtech Publishers.	
4.	Mariesa L. Crow, 'Computational Methods for Electric Power Systems', 2015, CRC Press.	
Mode of Evaluation: CAT, Assignment, Quiz, FAT		
Recommended by Board of Studies	09-05-2024	
Approved by Academic Council	Date	

Course Code	Course Title	L	T	P	C
BECS304P	Computer Aided Power System Analysis Lab	0	0	2	1
Pre-requisite	BEEE203L	Syllabus version			
		1.0			

Course Objectives:

1. To impart basic skills to perform various power system studies.
2. To analyze large scale power systems using advanced methods and algorithms.

Course Outcome:

On completion of the course the student will be able to:

1. Model and simulate the various power system components.
2. Determine the system matrices for a large power system network.
3. Perform load flow study for calculation of system parameters.
4. Estimate short circuit capacity for different types of faults.
5. Understand the different numerical techniques for the solution of swing equation.
6. Perform load flow study for a distribution network.

	List of Challenging Experiments (Indicative)	Hours	
1.	Modeling and simulation of various power system components.	2	
2.	Formation of bus admittance (Y bus) matrix using singular transformation.	2	
3.	Optimal ordering of buses and calculation of LDU factors.	2	
4.	Formation of bus impedance (Z bus) matrix using Z bus building algorithm.	2	
5.	Formation of Jacobian matrix.	2	
6.	Load flow analysis using Newton-Raphson method.	2	
7.	Load flow analysis using Fast Decoupled load flow method.	2	
8.	Symmetrical fault analysis using bus impedance matrix.	2	
9.	Unsymmetrical fault analysis using symmetrical components.	2	
10.	Power system stability analysis using swing curve.	2	
11.	Determination of critical clearing angle and time.	2	
12.	Solution of swing equation using Modified Euler method.	2	
13.	Power flow analysis for a radial distribution network.	2	
14.	Simulation of power system network integrated with renewable energy sources.	2	
	Total Laboratory Hours	**28**	

Text Book(s)

1.	John J. Grainger, William D. Stevenson, Jr, Gary W Chang, 'Power System Analysis', 2016, Tata McGraw Hill Education.
2.	George Kusic, 'Computer Aided Power Systems Analysis', second edition, 2008, CRC Press.

3.	William H. Kersting, ‘Distribution System Modeling and Analysis’, 2002,CRC Press.		
Mode of Assessment: Continuous Assessment and FAT			
Recommended by Board of Studies		09-05-2024	
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
BECS305L	AI and ML for Electrical Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

- Familiarize with various AI techniques and their applications in solving complex problems.
- Explore different types of ANNs, activation functions, and the perceptron learning algorithm.
- Implement the concepts and applications of machine learning.
- Explore supervised learning, unsupervised learning and their applications in electrical systems.

Course Outcomes:

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

- Evaluate Artificial Intelligence methods and describe their foundations.
- Solve regression and classification problems.
- Analyze the training and testing processes of feed-forward and feedback networks.
- Apply the supervised/unsupervised algorithms to a real problem and report on the expected accuracy that can be achieved by applying the models.
- Implement the AI and ML models for various electrical systems applications.

Module:1	Introduction to AI	6 hours

Importance of AI for smart electrical systems - Introduction to Fuzzy Logic – Developing Fuzzy model - Fuzzification – Defuzzification – Developing fuzzy model using python.

Module:2	Artificial Neural Networks	8 hours

Artificial Neural Network algorithms- Feed Forward Back Propagation – Levenberg – Marguardt Algorithm Recurrent Neural Network (RNN); Convolutional Neural Network (CNN). Develop Neural Network model using python and PyTorch.

Module:3	Overview of machine learning	9 hours

Reinforcement Learning; Gradient Descent: Batch Gradient Descent, Stochastic Gradient Descent; Data preprocessing; Under fitting and Overfitting issues- Support Vector Machines, Decision Tree, Random Forest; Regression: Linear and Logistic, Clustering: K-means, Dimension Reduction: Principal Components Analysis, Independent Components Analysis;

Module:4	AI and ML for Electrical Machines	7 hours

AI based controllers for Induction motor and PMSM; Parameter estimation of Induction motor and PMSM- Classification algorithms for fault detection and on-line condition monitoring of electrical machines –

Module:5	AI and ML for Smart Power Systems	7 hours

AI and ML for Generation forecasting – Power Management – Energy Pricing- Protection of microgrids. AI and ML for state estimation

Module:6	AI and ML for Electric Vehicles	6 hours

AI and ML for Electric Vehicles – Autonomous cars – . AI for connected cars - Battery management system – online condition monitoring and preventive maintenance - performance enhancement			
Module:7	**Contemporary Issues**		**2 hours**
Total Lecture Hours:			**45**
Text Books			
1	Russell. S and Norvig. P, “Artificial Intelligence - A Modern Approach”, 4th edition, Pearson, 2022		
2	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 3rd edition, 2014		
3	Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997		
Reference Books			
1.	Franklin Jino R E, Thamil alagan M, Jainulafdeen A, AI and ML for Electrical and Computer Engineering, 2023,Lambert		
2.	Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, Reprint, 2016		
3.	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012		
Mode of Evaluation: CAT, Assignment, Quiz, FAT			
Recommended by Board of Studies			
Approved by Academic Council		Date	

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 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 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

Course code	Course Title	L	T	P	C
BCSE208L	Data Mining	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the fundamental processes data warehousing and major issues in data mining.
2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
3. To develop the knowledge for application of data mining and social impacts of data mining.

Course Outcome

Upon completion of the course the student will be able to

1. Interpret the contribution of data warehousing and data mining to the decision-support systems.
2. Construct the data needed for data mining using preprocessing techniques.
3. Discover interesting patterns from large amounts of data using Association Rule Mining.
4. Extract useful information from the labeled data using various classifiers and Compile unlabeled data into clusters applying various clustering algorithms.
5. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Module:1	Data Warehousing	4 hours

Introduction to Data warehouse - Data Warehouse models- Data warehouse architecture: Three-tier data warehouse architecture - Data warehouse modeling: Data cube and OLAP – Star and Snowflake Schema.

Module:2	Introduction to Data Mining	3 hours

Introduction to data mining - Data mining functionalities - Steps in data mining process- Classification of data mining systems - Major issues in data mining.

Module:3	Data Preprocessing	3 hours

Data Preprocessing: An overview - Data cleaning - Data integration -Data reduction - Data transformation.

Module:4	Frequent Pattern Mining	4 hours

Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods: Apriori algorithm, FP-Growth algorithm - Mining frequent item sets using vertical data format.

Module:5	Classification Techniques	5 hours

General approach to classification - Classification by decision tree induction - Bayes classification methods - Model evaluation and selection - Techniques to improve classification accuracy - advanced classification methods: Bayesian belief networks- Lazy learners.

Module:6	Cluster Analysis	5 hours

Types of data in cluster analysis - Partitioning methods - K Medoid Clustering - Density based methods - Grid based methods - Outlier analysis.

Module:7	Data Mining Trends and Research Frontiers	4 hours

Overview of Web mining-Temporal and Spatial mining-Other methodologies of data mining: Statistical data mining- Data mining applications.

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**30 hours**
Text Book(s)		
1.	Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition, 2013.	
Reference Books		
1.	Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, Cambridge University Press, 2019.	
2.	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, Pearson, 2nd Edition, 2019.	
Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
Recommended by Board of Studies	12-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE208P	Data Mining Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the fundamental processes data warehousing and major issues in data mining.
2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
3. To develop the knowledge for application of data mining and social impacts of data mining.

Course Outcome

1. Interpret the contribution of data warehousing and data mining to the decision-support systems.
2. Construct the data needed for data mining using preprocessing techniques.
3. Discover interesting patterns from large amounts of data using Association Rule Mining.
4. Extract useful information from the labeled data using various classifiers and Compile unlabeled data into clusters applying various clustering algorithms.
5. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Indicative Experiments	
1.	Introduction to exploratory data analysis using R.
2.	Demonstrate the Descriptive Statistics for a sample data like mean, median, variance and correlation etc.,
3.	Demonstrate Missing value analysis using sample data.
4.	Demo of Apriori algorithm on various data sets with varying confidence and support.
5.	Demo of FP Growth algorithm on various data sets with varying confidence and support.
6	Demo on Classification Techniques such as Decision Tree (ID3 / CART), Bayesian etc., and using sample data.
7.	Demonstration of Clustering Techniques K-Medoid and Hierarchical.
8.	Demonstration on Document Similarity Techniques and measurements.
9.	Simulation of Page Rank Algorithm.
10.	Demonstration on Hubs and Authorities.
	Total Laboratory Hours **30 hours**

Text Book(s)

Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition, 2013.

Reference Books

Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, Cambridge University Press, 2019.

Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, Pearson, 2nd Edition, 2019.

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

Recommended by Board of Studies	12-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BEEE213L	Embedded Systems Design	3	0	0	3
Pre-requisite	BEEE309L, BEEE309P	Syllabus version			
		1.0			

Course Objectives

1. Understand the contemporary embedded systems and its design constraints
2. Acquire hardware and software skills required for the role of embedded system engineer
3. Build automated systems for real world problems using low cost embedded platforms

Course Outcomes

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

1. Identify application specific microcontrollers
2. Develop embedded software using commercial integrated development environments
3. Apply suitable communication protocols to interface sensors and actuators
4. Implement commercial tools to develop RTOS based applications
5. Build linux kernel for low cost embedded platforms

Module:1	**Embedded Systems**	**3 hours**
Embedded system components; Examples of embedded system; Attributes; Characteristics; Challenges; Typical embedded system software operations		
Module:2	**ARM Cortex-M Architecture**	**4 hours**
CPU core: Architecture, Registers; Memory; Operating modes; Instructions: Instruction formats, and addressing modes; Exceptions and Interrupts; Commercial ARM Cortex-M microcontrollers		
Module:3	**Embedded Software Development**	**8 hours**
Embedded C programming: Number systems, Data types, Data structures, Functions, Improving responsiveness; Interrupts; Finite State Machine; Embedded software development: Host and Target, Compiler, Assembler, Linker, and Loader; Hardware and Software debugging, In system programming		
Module:4	**Peripherals and Interfacing**	**8 hours**
GPIO; Timing generation and measurements: Timers, PWM; Control Applications; Analog interfacing and data acquisition: ADC, DAC, Measurement of voltage, current, and power; Analog comparator; DMA		
Module:5	**Serial Communication Protocols**	**7 hours**
Serial communication protocols: Synchronous Vs Asynchronous communication, UART, I2C: data frame, synchronization, I2C based accelerometer interfacing; SPI, and CAN: Architecture, electrical considerations, message formats, message types, transmission and arbitration; Data visualization using logic analysers		
Module:6	**Real Time Operating System**	**8 hours**
Survey of software architectures; Main memory management; Context switching; Process management and Scheduling; Shared data and semaphores; Interrupt routines in RTOS environment; Design example using open source RTOS		
Module:7	**Embedded Linux and Device Interfaces**	**5 hours**
Linux and Embedded system; Kernel modules; System configuration and boot process; Communication between kernel space and user space; Role of device driver; Classes of devices and modules; Char devices; System debugging and profiling; Application development: Using single board computers, IoT/ IIoT, Edge computing		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books	
1	Alexander G Dean, “Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach”, ARM Education Media, 2021
2	Wim Vanderbauwhede and Jeremy Singer, “Operating Systems Foundations with Linux on the Raspberry Pi”, ARM Education Media, 2021
Reference Books	
1.	Yifeng Zhu, “Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C”, E-man Press LLC, 3rd Edition, 2018
2.	Jonathan W. Valvano, “Embedded Microcomputer Systems: Real Time Interfacing”, 3rd Edition, Cengage Learning, 2010
3	Raj Kamal, “Embedded Systems- Architecture, Programming and Design”, 3rd Edition, McGraw Hill Education India, 2017
4	James K Peckol, “Embedded Systems: A Contemporary Design Tool”, 2nd Edition, Wiley, 2019
Mode of Evaluation: CAT, Quiz, Assignment, FAT	

Recommended by Board of Studies	28.05.2022		
Approved by Academic Council	No. 66	Date	16-06-2022

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. To make 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

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

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

Course Code	Course Title	L	T	P	C
BECS306L	Power Converters for Smart Electrical Systems	3	0	0	3
Pre-requisite	BECS303L, BECS303P	Syllabus version			
		1.0			

Course Objectives:

1. To comprehend the operating principle and control strategies of power converters.
2. To design power converters for specific applications in smart electrical systems.
3. To explore the integration and control challenges of power converters in smart electrical systems.
4. To understand the recent advancements and trends in power conversion for smart electrical systems.

Course Outcomes:

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

1. Understand the building-blocks of smart electrical system.
2. Design snubber and firing circuits for power converters.
3. Analyze the performance of various power converters.
4. Implement AI and ML-based control algorithms.
5. Identify suitable power converters and implement appropriate control strategies for smart electrical systems.

Module:1	Introduction to Smart Electrical Systems and Their Building-Blocks	6

Definition and characteristics of smart electrical systems: overview of various components and technologies, role of power converters in smart Electrical Systems, key challenges, and opportunities.

Intelligent power modules (IPM); wide bandgap semiconductor devices; magnetic components (transformers, inductors); switching techniques and losses; snubber circuit design.

Module:2	Isolated DC-DC Power Converters	6

Isolated converters: flyback, forward and full bridge converters, control strategies and advantages, dual-active bridge DC-DC converters; design considerations (component selection and efficiency); applications of DC-DC converters in LED lighting, energy storage, and distributed generation.

Module:3	Grid Connected DC-AC Power Converters	8

Grid synchronization and standards: single-phase and three-phase inverters for grid-connected applications, harmonic analysis and power quality considerations, applications of DC-AC power converters for renewable energy integration, IEEE an IEC standards; grid forming converters; grid-following versus grid forming converters.

Module:4	AC-DC Converters and Power Factor Correction	6

Rectifiers and their control strategies: review of input power factor of single-phase and three-phase controlled rectifiers; power factor correction (PFC) techniques:

passive and active; industrial applications with PFC: electric vehicle charging, industrial heating.		
Module:5	**Advanced Power Converters**	**7**
Introduction to multilevel inverter and matrix converter; concept of soft-switching techniques: resonant and quasi-resonant converters; power converters for emerging applications: smart grids; grid to vehicle (G2V) and vehicle to everything (V2X) technologies; communication protocols for smart grids (IEC 61850); introduction to cyber threats and security.		
Module:6	**AI and ML based Controllers**	**7**
Overview of AI and ML concepts and terminology; AI / ML techniques for power converters; applications of AI / ML control strategies: fault diagnosis, design automation, AI-powered control for renewable energy integration.		
Module:7	**Contemporary issues and Case studies**	**5**
Integrating solar PV system with the grid; bidirectional DC-DC converters for electric vehicle charging; microgrid operation and islanding; smart homes, and DC microgrids		
Total Lecture Hours:		**45**
Text Books		
1.	Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer, 3rd edition, 2020.	
2.	Ryszard Strzelecki, Grzegorz Benysek,” Power Electronics in Smart Electrical Energy Networks”, Springer, 2008.	
Reference Books		
1.	Muhammad H. Rashid, “Power Electronics: Devices, Circuits and Applications”, Pearson Education, 4th edition, 2017.	
2.	L. Umanand, “Power Electronics: Essentials and Applications”, Wiley, 2009.	
3.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 3rd edition, 2014.	
4.	Junwei Lu, Jahangir Hossain, “Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid”, IET Press, 2015.	
Mode of Evaluation: CAT, Assignment, Quiz, FAT		
Recommended by Board of Studies	09-05-2024	
Approved by Academic Council		Date

Course Code	Course Title	L	T	P	C
BECS306P	Power Converters for Smart Electrical Systems Lab	0	0	2	1
Pre-requisite	BECS303L, BECS303P			Syllabus version	
					1.0

Course Objectives:

- To choose appropriate driver ICs for the given application.
- To design, simulate and implement various power converters.
- To understand AI/ML-based control algorithms.

Course Outcome:

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

1. Employ driver ICs for high-side, low-side and half-bridge circuits.
2. Analyse the performance of various power converters.
3. Implement Python-based programs for AI/ML based control algorithms.

List of Challenging Experiments (Indicative)		Hours	
1	Generation of PWM signals using TL494 PWM IC	2 hours	
2	Generation of PWM gate pulses with duty cycle control using microcontroller / DSP controller.	2 hours	
3	Design of low-side driver circuit (TC4424, MCP1404, IR2101)	2 hours	
4	Design of high-side driver circuit (HCPL 3101, IR2117)	2 hours	
5	Design of half-bridge driver circuit using IR2110	2 hours	
6	Performance analysis of forward converter under open and closed-loop conditions	2 hours	
7	Performance analysis of flyback converter under open and closed-loop conditions	2 hours	
8	Performance analysis of full-bridge converter under open and closed-loop conditions	2 hours	
9	Performance analysis of multi-level inverter and matrix converter	2 hours	
10	Performance analysis of dual-active bridge DC-DC converter	2 hours	
11	Performance analysis of AC-DC rectifier for battery charging applications	2 hours	
12	Harmonic analysis of an inverter using a PQ analyser	2 hours	
13	AI / ML-based control algorithm implementation using Python	2 hours	
14	Hardware-in-loop (HIL) based control of a power converter (Buck, Boost, etc.)	2 hours	
15	Study of a grid-connected inverter with a simplified grid model.	2 hours	

	Total Laboratory Hours		**30**
Text Book(s)			
1.	Muhammad H. Rashid, “Power Electronics: Devices, Circuits and Applications”, Pearson Education, 4th edition, 2017.		
2.	L. Umanand, “Power Electronics: Essentials and Applications”, Wiley, 2009.		
Mode of Assessment: CAT and FAT			
Recommended by Board of Studies	09-05-2024		
Approved by Academic Council		Date	

Course Code	Energy Management Systems	L	T	P	C
BECS401L		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. To understand the techniques of energy management systems and SCADA.
2. To analyse economic dispatch problems and unit commitment methods.
3. To perform energy management studies for renewable integrated systems with smart grids and sustainable development goals.
4. To familiariaze with energy audit methods and its implementation.

Course Outcomes:

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

1. Understand the significance of energy management systems and state estimation.
2. Perform economic dispatch problems, and understand load scheduling.
3. Analyze hydrothermal scheduling, unit commitment methods and power interchange concepts.
4. Implement energy management with renewable energy sources.
5. Perform energy audits, cost analysis and get knowledge on practical scenarios.
6. Interpret sustainability concepts and perform life cycle analysis.
7. Analyze SCADA functions and automation for energy engineering.

Module:1	Introduction	7

Energy Management Systems (EMS): objectives, functions, architecture; operating states of EMS; Energy Control Centre (ECC) and its functions; power system security; state estimation; phasor measurement units and wide-area measurement systems.

Module:2	Economic Dispatch and Optimal Power Flow	7

Economic dispatch with and without loss calculation; take or pay fuel supply contract; composite generation and solution; fuel scheduling problems; optimal power flow solutions.

Module:3	Hydrothermal Coordination and Unit Commitment	7

Short term hydro scheduling; pumped storage hydro plant; unit commitment: solutions techniques of unit commitment; interchange of power and energy: economic aspects, energy interchange with unit commitment, power pool, transmission effects and issues, wheeling, transaction involving non-utility parties.

Module:4	Renewable Energy Integration and its Management	7

Basics of solar, wind, battery and their working; integration of distributed energy sources with power electronics devices; energy management systems concept for renewable energy systems; sustainable smart grid solutions.

Module:5	**Energy Management & Audit**	**7**
Energy audit: need, types of energy audit; energy management (audit) approach: understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments, metering: thermography, smart metering; Energy Management Information Systems (EMIS); case studies.		
Module:6	**Energy and Sustainability**	**5**
Sustainability: introduction, social, environmental and economic sustainability concepts; Sustainable Development Goals (SDGs); environmental management standards: ISO 14001:2015 frame work and benefits, Life Cycle Analysis (LCA); circular economy; carbon credits; zero waste concept; energy policy and regulations.		
Module:7	**Supervisory Control and Data Acquisition (SCADA)**	**5**
SCADA: general features, functions and applications, benefits; SCADA functional requirements and components; structure of a SCADA communication protocol; power Systems SCADA and SCADA in power System automation.		
Total Lecture Hours:		**45**
Text Books		
1	Wood, A. J., Wollenberg, B. F., & Sheblé, G. B. (2013). Power generation, operation, and control. John Wiley & Sons.	
Reference Books		
1.	Capehart, B. L., Turner, W. C., & Kennedy, W. J. (2011). Guide to energy management. The Fairmont Press, Inc..	
2.	Course Material for Energy Audit and Managers Exam, Vol. 1-4 Energy Audit Manual the Practitioner's Guide Jointly published by EMC and NPC (2017).	
3.	Bhatia, S. C., & Gupta, R. K. (2019). Textbook of renewable energy. Woodhead Publishing India PVT. Limited.	
4.	Rag, R. L., & Remesh Lekshmi Dinahcandran (2015). Introduction to Sustainable Engineering. PHI Learning.	
5.	Striebig, B., Ogundipe, A. A., & Papadakis, M. (2015). Engineering applications in sustainable design and development. CL Engineering.	
6.	Thomas, M. S., & McDonald, J. D. (2017). Power system SCADA and smart grids. CRC press.	
Mode of Evaluation: CAT, Assignment, Quiz, FAT		
Recommended by Board of Studies	09-05-2024	
Approved by Academic Council		Date

Course Code	Course Title	L	T	P	C
BECS403L	Big Data Analytic Applications to Electrical Systems	2	0	0	2

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives:

1. Introduce basic concepts of data analytics.
2. Explore the process involved in predictive analytics on big data.
3. Understand the problems involving big data in electrical systems and data collection methods.

Course Outcomes:

Upon completion of the course the student will be able to

1. Comprehend the basic concepts and challenges of big data analytics.
2. Apply the data preprocessing techniques on big data.
3. Apply the prediction model for decision making for a given problem.
4. Apply suitable learning methods big data problems.
5. Identify bid data sources and problems in electrical systems.
6. Analyze the data using suitable analytics model.

Module:1	Introduction to Data Analytics	3 Hours

Data Analytics – Analytics Process Model, Analytical Model Requirements; Big Data – Basic Nomenclature, Challenges in Big Data Handling;

Module:2	Data Collection and Preprocessing	3 Hours

Sampling – Types of Data Elements – Visual Data Exploration and Statistical Analysis – Missing Values – Outlier Detection and Treatment – Standardizing and Categorization – Variable Selection – Segmentation;

Module:3	Predictive Analytics	6 Hours

Target Definition – Linear Regression – Decision Trees – Support Vector Machines – Ensemble Methods – Bagging – Boosting – Evaluating Predictive Models;

Module:4	Descriptive and Social Network Analytics	6 Hours

Association Rules – Sequence Rules – Clustering – Social Network Learning – Neighbour Classifier and Collective Inferencing; Back testing – Benchmarking, Data Quality, Software Privacy; – General Example Applications;

Module:5	Probability based Learning	3 Hours

Fundamentals – Bayes' Theorem, Bayesian Prediction; Conditional Independence and Factorization – Standard Approach: The Naive Bayes Model;

Module:6	Big Data Sources in Electrical Systems	4 Hours

Data Sources – Synchro phasors, Intelligent Electronic Devices (IEDs), Automated Revenue Metering System, Transient Recorder Data, Weather Data, Geographical Information System (GIS) Data, Lightning Detection Network Data, Asset management data, Electricity Market Data;

Module:7	**Applications in Electrical Systems**	**5 Hours**
Classical State Estimation Problem – Demand Forecasting – Renewable energy Forecasting – Digital Protection – Security Assessment - Market Pricing - Robust Control of Microgrids – Optimal Coordination in EV charging – Contemporary Issues by Industry Experts;		
	Total Lecture Hours:	**30**

Text Books	
1	Vladimir Shikhman, David Muller, “Mathematical Foundations of Big Data Analytics”, Springer, 2021.
2	Ahmed F. Zobaa, Trevor J. Bihl, “Big Data Analytics in Future Power Systems”, CRC Press, 2018.
Reference Books	
1.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, “Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples and Case Studies”, MIT Press 2020, 2nd Edition.
2.	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and Its Applications”, Wiley, 2014.
3.	Reza Arghandeh and Yuxun Zhou, “Big Data Application in Power Systems”, Elsevier Science, 2017.
4.	IEEE BDA Tutorial Series – IEEE Power and Energy Society.

Mode of Evaluation: CAT, Assignment/Project, Quiz, FAT			
Recommended by Board of Studies	09/05/2024		
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
BECS403P	Big Data Analytic Applications to Electrical Systems Lab	0	0	2	1
Pre-requisite	Nil			Syllabus version	
					1.0

Course Objectives:

1. Understand and analyze how information theory, similarity score and Probability theory can be used to build prediction models.
2. To have knowledge on the big data technologies for processing the different types of data.
3. To apply the big data technologies to electrical systems problems.

Course Outcome:

Upon completion of the course the student will be able to

1. Analyse the different data preprocessing techniques.
2. Apply the prediction model for decision making for a given set of problems.
3. Apply regression algorithms for finding relationships between data variables.
4. Implement and evaluate the data manipulation procedures using pig, hive and spark on Hadoop frame work.

	List of Challenging Experiments (Indicative)	Hours	
1.	Find the statistical measures of central tendency and dispersion such as min(), max(), mean(), median(), quantile(), sd() ,var() and summary() for real world datasets.	2 hours	
2.	Demonstrate the different data visualization techniques. (Scatter Plot, Horizontal Bar Chart, Histogram, Visualization of Time Series data (Line Graphs) for applications such as weather analysis. Perform the chi-square test.	2 hours	
3.	Introduction to Hadoop Framework.	2 hours	
4.	Introduction to Apache PIG/HIVE.	2 hours	
5.	Introduction to Spark Application.	2 hours	
6.	Implement the PCA method for dimensionality reduction on datasets. Implement the RFE method and show the importance of features.	2 hours	
7.	Implement the Decision Tree for given datasets and compute the accuracy of model.	2 hours	
8	Implement the K-Nearest Neighbor Algorithm for given datasets and analyse the results.	2 hours	
9.	Implement the Naïve Bayes method.	2 hours	
10.	Implement simple linear regression program to predict the future values and analyse the goodness of fit.	2 hours	

11.	State Estimation Solution	2 hours	
12.	Load Forecasting and Energy Forecasting	2 hours	
13.	Fault Classification and Security Assessment	2 hours	
14.	Market Pricing Application	2 hours	

	Total Laboratory Hours	**28**

Text Book(s)			
1.	Jason Brownlee, “Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python”, First Edition, 2020.		
2.	Mike Frampton “Mastering Apache Spark”, Packt Publishing, 2015.		
3.	Tom White, “Hadoop – The Definitive Guide”, O’Relly, 4th Edition 2015.		
4.	Nick Pentreath, “Machine Learning with Spark” Pract Publishing 2015.		
5.	Mohammed Gulle , “Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis”, Apress, 2015.		
Mode of Assessment: CAT and FAT			
Recommended by Board of Studies	09-05-2024		
Approved by Academic Council		Date	

Course Code	Course Title	L	T	P	C
BECS391J	Technical Answers to Real Problems Project	0	0	0	3

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives:

1. To gain an understanding of real-life issues faced by society.
2. To study appropriate technologies in order to find a solution to real life issues.
3. Students will design system components intended to solve a real-life issue.

Course Outcomes:

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

1. Identify real life issue(s) faced by society.
2. Apply appropriate technologies to suggest a solution to the identified issue(s).
3. Design the related system components/processes intended to provide a solution to the identified issue(s).

Module Content (Project Duration: Two Semesters)

1. Students are expected to perform a survey and interact with society to find out the real life issues.
2. Logical steps with the application of appropriate technologies should be suggested to solve the identified issues.
3. Subsequently the student should design the related system components or processes which is intended to provide the solution to the identified real-life issues.

General Guidelines:

1. Identification of real-life problems.
2. Field visits can be arranged by the faculty concerned.
3. Maximum of 3 students can form a team (within the same/different discipline).
4. Minimum of eight hours on self-managed team activity.
5. Appropriate scientific methodologies to be utilized to solve the identified issue
6. Solution should be in the form of fabrication/coding/modelling/product design/process design/relevant scientific methodology(ies).
7. Consolidated report to be submitted for assessment.
8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component.
9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility.
10. Contribution of each group member to be assessed.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-05-2024

Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS392J	Design Project	0	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. Students will be able to upgrade a prototype to a design prototype.
2. Describe and demonstrate the techniques and skills necessary for the project.
3. Acquire knowledge and better understanding of design systems.

Course Outcomes:

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

1. Develop new skills and demonstrate the ability to upgrade a prototype to a design prototype or working model.
2. Utilize the techniques, skills, and modern tools necessary for the project.
3. Synthesize knowledge and use insight and creativity to better understand and improve design systems.

Module Content (Project Duration: One Semester)

Students are expected to develop new skills and demonstrate the ability to develop prototypes to design prototype or working models related to an engineering product or a process.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BEC393J	Laboratory Project	0	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. The student will be able to conduct experiments on the concepts already learnt.
2. Analyse experimental data.
3. Present the results with appropriate interpretation.

Course Outcomes:

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

1. Design and conduct experiments in order to gain hands-on experience on the concepts already studied.
2. Analyse and interpret experimental data.
3. Write clear and concise technical reports and research articles.

Module Content (Project Duration: One Semester)

Students are expected to perform experiments and gain hands-on experience on the theory courses they have already studied or registered in the ongoing semester. The theory course registered is not expected to have laboratory component and the student is expected to register with the same faculty who handled the theory course. This is mostly applicable to the elective courses. The nature of the laboratory experiments is depended on the course.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS394J	Product Development Project	0	0	0	3

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives:

1. Students will be able to translate a prototype to a useful product.
2. Apply relevant codes and standards during product development.
3. The student will be able to present his results by means of clear technical reports.

Course Outcomes:

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

1. Demonstrate the ability to translate the developed prototype/working model to a viable product useful to society/industry.
2. Apply the appropriate codes/regulations/standards during product development.
3. Write clear and concise technical reports and research articles.

Module Content (Project Duration: Two Semesters)

Students are expected to translate the developed prototypes / working models into a product which has application to society or industry.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09.05.2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS396J	Reading Course	0	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. The student will be able to analyse and interpret published literature for information pertaining to niche areas.
2. Scrutinize technical literature and arrive at conclusions.
3. Use insight and creativity for a better understanding of the domain of interest.

Course Outcomes:

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

1. Retrieve, analyse, and interpret published literature/books providing information related to niche areas/focused domains.
2. Examine technical literature, resolve ambiguity, and develop conclusions.
3. Synthesize knowledge and use insight and creativity to better understand the domain of interest.

Module Content	(Project Duration: One Semester)

This is oriented towards reading published literature or books related to niche areas or focussed domains under the guidance of a faculty.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09.05.2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS397J	Special Project	0	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. Students will be able to identify and solve problems in a time-bound manner.
2. Describe major approaches and findings in the area of interest.
3. Present the results in a clear and concise manner.

Course Outcomes:

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

1. To identify, formulate, and solve problems using appropriate information and approaches in a time-bound manner.
2. To demonstrate an understanding of major approaches, concepts, and current research findings in the area of interest.
3. Write clear and concise research articles for publication in conference proceedings/peer-reviewed journals.

Module Content (Project Duration: Three Semesters)

This is an open-ended course in which the student is expected to work on a time bound research project under the supervision of a faculty. The result may be a tangible output in terms of publication of research articles in a conference proceeding or in a peer-reviewed Scopus indexed journal.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS398J	Simulation Project	0	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. Students will be able to simulate a real system.
2. Identify the variables which affect the system.
3. Describe the performance of a real system.

Course Outcomes:

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

1. Demonstrate the ability to simulate and critically analyse the working of a real system.
2. Identify and study the different variables which affect the system elaborately.
3. Evaluate the impact and performance of the real system.

Module Content (Project Duration: One Semester)

The student is expected to simulate and critically analyse the working of a real system. Role of different variables which affect the system has to be studied extensively such that the impact of each step in the process is understood, thereby the performance of each step of the engineering process is evaluated.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS399J	Summer Industrial Internship	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 Outcomes:

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	4 Weeks (28 hours)

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	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS497J	Project – I	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 Outcomes:

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 multidisciplinary work.

Module Content (Project Duration: One Semester)

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. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. 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	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course Code	Course Title	L	T	P	C
BECS498J	Project – II/ Internship				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 Outcomes:

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 (Project Duration: One Semester)

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	09-05-2024		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY