VIT®

Vellore Institute of Technology

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

SCHOOL OF INFORMATION TECHNOLOGY ENGINEERING

CURRICULUM AND SYLLABI

(2021-2022)

B.Tech Information Technology

(B.Tech IT)

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

INDEX

School of Information Technology Engineering

B.Tech Information Technology

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OFTECHNOLOGY

- **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.

School of Information Technology Engineering

B.Tech Information Technology

VISION STATEMENT OF THE SCHOOL OF INFORMATION TECHNOLOGY ENGINEERING

- "To be a centre of excellence in education and research in Information and Technology, producing global leaders for improvement of the society"

MISSION STATEMENT OF THE SCHOOL OF INFORMATION TECHNOLOGY ENGINEERING

- To provide sound fundamentals, and advances in Information Technology, Software Engineering, Digital Communications and Computer Applications by offering world class curricula.
- To create ethically strong leaders and trend setters for next generation IT.
- To nurture the desire among faculty and students from across the globe to perform outstanding and impactful research for the benefit of humanity and, to achieve meritorious and significant growth.

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology Engineering

B.Tech Information Technology

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.
3. Graduates will function in their profession with social awareness and responsibility.
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
5. Graduates will be successful in pursuing higher studies in engineering or management.
6. Graduates will pursue career paths in teaching or research.

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology Engineering

B.Tech Information Technology

PROGRAMME OUTCOMES (POs)

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

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

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

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

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

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognise the need for independent and lifelong learning

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology Engineering

B.Tech Information Technology

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B. Tech. (Electrical and Electronics Engineering) programme, graduates will be able to

PSO1: Understand and justify the adaptation of appropriate emerging technologies by imbibing contemporary core IT competencies

PSO2: Analyze complex real world problems through agile techniques for socially acceptable design and develop solutions

PSO3: Be competitively employable or be an IT entrepreneur to face local andglobal challenges through professionalism

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology Engineering

B.Tech Information Technology

CREDIT STRUCTURE

Category-wise Credit distribution

Category	Credits
Foundation Core	**55**
Discipline-linked Engineering Sciences	**11**
Discipline Core	**45**
Discipline Elective	**15**
Projects and Internship	**9**
Open Elective	**15**
Non-graded Core Requirement	**11**
Total credits	**161**

CREDIT INFO		
S.no	**Catagory**	**Credits**
1	Foundation Core	55
2	Discipline-linked Engineering Sciences	11
3	Discipline Core	45
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		161

Foundation Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCHY101L	Engineering Chemistry	Theory Only	1.0	3	0	0	0	3.0
2	BCHY101P	Engineering Chemistry Lab	Lab Only	1.0	0	0	2	0	1.0
3	BCSE101E	Computer Programming: Python	Embedded Theory and Lab	1.0	1	0	4	0	3.0
4	BCSE102L	Structured and Object-Oriented Programming	Theory Only	1.0	2	0	0	0	2.0
5	BCSE102P	Structured and Object-Oriented Programming Lab	Lab Only	1.0	0	0	4	0	2.0
6	BCSE103E	Computer Programming: Java	Embedded Theory and Lab	1.0	1	0	4	0	3.0
7	BECE101L	Basic Electronics	Theory Only	1.0	2	0	0	0	2.0
8	BECE101P	Basic Electronics Lab	Lab Only	1.0	0	0	2	0	1.0
9	BEEE101L	Basic Electrical Engineering	Theory Only	1.0	2	0	0	0	2.0
10	BEEE101P	Basic Electrical Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
11	BENG101L	Technical English Communication	Theory Only	1.0	2	0	0	0	2.0
12	BENG101P	Technical English Communication Lab	Lab Only	1.0	0	0	2	0	1.0
13	BENG102P	Technical Report Writing	Lab Only	1.0	0	0	2	0	1.0
14	BFLE200L	B.Tech. Foreign Language - 2021onwards	Basket	1.0	0	0	0	0	2.0
15	BHSM200L	B.Tech. HSM Elective - 2021 onwards	Basket	1.0	0	0	0	0	3.0
16	BMAT101L	Calculus	Theory Only	1.0	3	0	0	0	3.0
17	BMAT101P	Calculus Lab	Lab Only	1.0	0	0	2	0	1.0
18	BMAT102L	Differential Equations and Transforms	Theory Only	1.0	3	1	0	0	4.0
19	BMAT201L	Complex Variables and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0
20	BMAT202L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0
21	BMAT202P	Probability and Statistics Lab	Lab Only	1.0	0	0	2	0	1.0
22	BPHY101L	Engineering Physics	Theory Only	1.0	3	0	0	0	3.0
23	BPHY101P	Engineering Physics Lab	Lab Only	1.0	0	0	2	0	1.0
24	BSTS101P	Quantitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5
25	BSTS102P	Quantitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5
26	BSTS201P	Qualitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5

Foundation Core									
27	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	BITE202L	Digital Logic and Microprocessors	Theory Only	1.0	3	0	0	0	3.0
2	BITE202P	Digital Logic and Microprocessors Lab	Lab Only	1.0	0	0	2	0	1.0
3	BITE203L	Principles of Communication Systems	Theory Only	1.0	3	0	0	0	3.0
4	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	BITE201L	Data Structures and Algorithms	Theory Only	1.0	3	0	0	0	3.0
2	BITE201P	Data Structures and Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
3	BITE301L	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0
4	BITE302L	Database Systems	Theory Only	1.0	3	0	0	0	3.0
5	BITE302P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0
6	BITE303L	Operating Systems	Theory Only	1.0	3	0	0	0	3.0
7	BITE303P	Operating Systems Lab	Lab Only	1.0	0	0	2	0	1.0
8	BITE304L	Web Technologies	Theory Only	1.0	3	0	0	0	3.0
9	BITE304P	Web Technologies Lab	Lab Only	1.0	0	0	2	0	1.0
10	BITE305L	Computer Networks	Theory Only	1.0	3	0	0	0	3.0
11	BITE305P	Computer Networks Lab	Lab Only	1.0	0	0	2	0	1.0
12	BITE306L	Theory of Computation	Theory Only	1.0	3	1	0	0	4.0
13	BITE307L	Software Engineering	Theory Only	1.0	3	0	0	0	3.0
14	BITE307P	Software Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
15	BITE308L	Artificial Intelligence	Theory Only	1.0	3	0	0	0	3.0
16	BITE308P	Artificial Intelligence Lab	Lab Only	1.0	0	0	2	0	1.0
17	BITE401L	Network and Information Security	Theory Only	1.0	3	0	0	0	3.0
18	BITE402L	Distributed Computing	Theory Only	1.0	3	0	0	0	3.0
19	BITE403L	Embedded Systems and IoT	Theory Only	1.0	3	0	0	0	3.0
20	BITE403P	Embedded Systems and IoT 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	BECE302L	Control Systems	Theory Only	1.0	2	1	0	0	3.0
2	BITE311L	Human Computer Interaction	Theory Only	1.0	3	0	0	0	3.0

Discipline Elective									
3	BITE312E	Data Mining	Embedded Theory and Lab	1.0	2	0	2	0	3.0
4	BITE313L	Computer Graphics	Theory Only	1.0	3	0	0	0	3.0
5	BITE314L	Multimedia Systems	Theory Only	1.0	3	0	0	0	3.0
6	BITE391J	Technical Answers to Real Problems Project	Project	1.0	0	0	0	0	3.0
7	BITE392J	Design Project	Project	1.0	0	0	0	0	3.0
8	BITE393J	Laboratory Project	Project	1.0	0	0	0	0	3.0
9	BITE394J	Product Development Project	Project	1.0	0	0	0	0	3.0
10	BITE396J	Reading Course	Project	1.0	0	0	0	0	3.0
11	BITE397J	Special Project	Project	1.0	0	0	0	0	3.0
12	BITE398J	Simulation Project	Project	1.0	0	0	0	0	3.0
13	BITE404E	Object Oriented Analysis and Design	Embedded Theory and Lab	1.0	2	0	2	0	3.0
14	BITE405L	Soft Computing	Theory Only	1.0	3	0	0	0	3.0
15	BITE406L	Parallel Computing	Theory Only	1.0	3	0	0	0	3.0
16	BITE407L	Quantum Computing	Theory Only	1.0	3	0	0	0	3.0
17	BITE408L	Network Management	Theory Only	1.0	3	0	0	0	3.0
18	BITE409L	Mobile Application Development	Theory Only	1.0	3	0	0	0	3.0
19	BITE410L	Machine Learning	Theory Only	1.0	3	0	0	0	3.0
20	BITE411L	Big Data Analytics	Theory Only	1.0	3	0	0	0	3.0
21	BITE412L	Cloud Computing	Theory Only	1.0	3	0	0	0	3.0
22	BITE413L	Cyber Security	Theory Only	1.0	3	0	0	0	3.0
23	BITE414L	Blockchain Technology	Theory Only	1.0	3	0	0	0	3.0
24	BITE415L	Engineering Optimization	Theory Only	1.0	3	0	0	0	3.0

Projects and Internship									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BITE399J	Summer Industrial Internship	Project	1.0	0	0	0	0	1.0
2	BITE497J	Project - I	Project	1.0	0	0	0	0	3.0
3	BITE498J	Project - II / Internship	Project	1.0	0	0	0	0	5.0
4	BITE499J	One Semester Internship	Project	1.0	0	0	0	0	14.0

Open Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCSE353E	Information Security Analysis and Audit	Embedded Theory and Lab	1.0	1	0	2	0	2.0
2	BCSE354E	Information Security Management	Embedded Theory and Lab	1.0	1	0	2	0	2.0
3	BECE201L	Electronic Materials and Devices	Theory Only	1.0	3	0	0	0	3.0

Open Elective									
4	BECE320E	Embedded C Programming	Embedded Theory and Lab	1.0	2	0	2	0	3.0
5	BEEE202L	Electromagnetic Theory	Theory Only	1.0	2	1	0	0	3.0
6	BHUM201L	Mass Communication	Theory Only	1.0	3	0	0	0	3.0
7	BHUM202L	Rural Development	Theory Only	1.0	3	0	0	0	3.0
8	BHUM203L	Introduction to Psychology	Theory Only	1.0	3	0	0	0	3.0
9	BHUM204L	Industrial Psychology	Theory Only	1.0	3	0	0	0	3.0
10	BHUM205L	Development Economics	Theory Only	1.0	3	0	0	0	3.0
11	BHUM206L	International Economics	Theory Only	1.0	3	0	0	0	3.0
12	BHUM207L	Engineering Economics	Theory Only	1.0	3	0	0	0	3.0
13	BHUM208L	Economics of Strategy	Theory Only	1.0	3	0	0	0	3.0
14	BHUM209L	Game Theory	Theory Only	1.0	3	0	0	0	3.0
15	BHUM210E	Econometrics	Embedded Theory and Lab	1.0	2	0	2	0	3.0
16	BHUM211L	Behavioral Economics	Theory Only	1.0	3	0	0	0	3.0
17	BHUM212L	Mathematics for Economic Analysis	Theory Only	1.0	3	0	0	0	3.0
18	BHUM213L	Corporate Social Responsibility	Theory Only	1.0	3	0	0	0	3.0
19	BHUM214L	Political Science	Theory Only	1.0	3	0	0	0	3.0
20	BHUM215L	International Relations	Theory Only	1.0	3	0	0	0	3.0
21	BHUM216L	Indian Culture and Heritage	Theory Only	1.0	3	0	0	0	3.0
22	BHUM217L	Contemporary India	Theory Only	1.0	3	0	0	0	3.0
23	BHUM218L	Financial Management	Theory Only	1.0	3	0	0	0	3.0
24	BHUM219L	Principles of Accounting	Theory Only	1.0	3	0	0	0	3.0
25	BHUM220L	Financial Markets and Institutions	Theory Only	1.0	3	0	0	0	3.0
26	BHUM221L	Economics of Money, Banking and Financial Markets	Theory Only	1.0	3	0	0	0	3.0
27	BHUM222L	Security Analysis and Portfolio Management	Theory Only	1.0	3	0	0	0	3.0
28	BHUM223L	Options , Futures and other Derivatives	Theory Only	1.0	3	0	0	0	3.0
29	BHUM224L	Fixed Income Securities	Theory Only	1.0	3	0	0	0	3.0
30	BHUM225L	Personal Finance	Theory Only	1.0	3	0	0	0	3.0
31	BHUM226L	Corporate Finance	Theory Only	1.0	3	0	0	0	3.0
32	BHUM227L	Financial Statement Analysis	Theory Only	1.0	3	0	0	0	3.0
33	BHUM228L	Cost and Management Accounting	Theory Only	1.0	3	0	0	0	3.0
34	BHUM229L	Mind, Embodiment and Technology	Theory Only	1.0	3	0	0	0	3.0
35	BHUM230L	Health Humanities in Biotechnological Era	Theory Only	1.0	3	0	0	0	3.0
36	BMEE102P	Engineering Design Visualisation Lab	Lab Only	1.0	0	0	4	0	2.0
37	BMEE201L	Engineering Mechanics	Theory Only	1.0	2	1	0	0	3.0
38	BSTS301P	Advanced Competitive Coding - I	Soft Skill	1.0	0	0	3	0	1.5
39	BSTS302P	Advanced Competitive Coding - II	Soft Skill	1.0	0	0	3	0	1.5
40	CFOC103M	Introduction to Political Theory	Online Course	1.0	0	0	0	0	3.0
41	CFOC105M	Emotional Intelligence	Online Course	1.0	0	0	0	0	2.0
42	CFOC107M	Supply Chain Analytics	Online Course	1.0	0	0	0	0	2.0
43	CFOC109M	Design Thinking - A Primer	Online Course	1.0	0	0	0	0	1.0
44	CFOC119M	Training of Trainers	Online Course	1.0	0	0	0	0	3.0
45	CFOC133M	E-Business	Online Course	1.0	0	0	0	0	3.0

Open Elective									
46	CFOC134M	Innovation, Business Models and Entrepreneurship	Online Course	1.0	0	0	0	0	2.0
47	CFOC171M	Introduction to Haskell Programming	Online Course	2.0	0	0	0	0	3.0
48	CFOC188M	Ethical Hacking	Online Course	1.0	0	0	0	0	3.0
49	CFOC191M	Forests and their Management	Online Course	1.0	0	0	0	0	3.0
50	CFOC203M	Natural Hazards	Online Course	1.0	0	0	0	0	2.0
51	CFOC218M	Compiler Design	Online Course	1.0	0	0	0	0	3.0
52	CFOC235M	Rocket Propulsion	Online Course	1.0	0	0	0	0	3.0
53	CFOC284M	An Introduction to Cardiovascular Fluid Mechanics	Online Course	1.0	0	0	0	0	1.0
54	CFOC384M	Entrepreneurship Essentials	Online Course	1.0	0	0	0	0	3.0
55	CFOC400M	Language and Mind	Online Course	1.0	0	0	0	0	2.0
56	CFOC406M	Human Behaviour	Online Course	1.0	0	0	0	0	2.0
57	CFOC486M	Managerial Skills for Interpersonal Dynamics	Online Course	1.0	0	0	0	0	3.0
58	CFOC498M	Business Statistics	Online Course	1.0	0	0	0	0	3.0
59	CFOC504M	Financial Management For Managers	Online Course	1.0	0	0	0	0	3.0
60	CFOC508M	Entrepreneurship	Online Course	1.0	0	0	0	0	3.0
61	CFOC543M	International Business	Online Course	1.0	0	0	0	0	3.0
62	CFOC570M	Public Speaking	Online Course	1.0	0	0	0	0	3.0
63	CFOC575M	Wildlife Ecology	Online Course	1.0	0	0	0	0	3.0
64	CFOC587M	Economics of Banking and Finance Markets	Online Course	1.0	0	0	0	0	3.0
65	CFOC592M	Stress Management	Online Course	1.0	0	0	0	0	1.0
66	CFOC597M	Globalization And Culture	Online Course	1.0	0	0	0	0	2.0
67	CFOC599M	Leadership and Team Effectiveness	Online Course	1.0	0	0	0	0	3.0
68	CFOC601M	Advance Course in Social Psychology	Online Course	1.0	0	0	0	0	3.0
69	CFOC602M	Product and Brand Management	Online Course	1.0	0	0	0	0	3.0
70	CFOC603M	Quantitative Investment Management	Online Course	1.0	0	0	0	0	2.0
71	CFOC604M	Entrepreneurship and IP Strategy	Online Course	1.0	0	0	0	0	2.0
72	CFOC606M	Ecology and Environment	Online Course	1.0	0	0	0	0	2.0
73	CFOC616M	Applied Linguistics	Online Course	1.0	0	0	0	0	3.0

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

Non-graded Core Requirement									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCHY102N	Environmental Sciences	Online Course	1.0	0	0	0	0	2.0
2	BEXC100N	Extracurricular Activities / Co-Curricular Activities - B.Tech. Programmes	Basket	1.0	0	0	0	0	2.0
3	BHUM101N	Ethics and Values	Online Course	1.0	0	0	0	0	2.0

Non-graded Core Requirement									
4	BITE101N	Introduction to Engineering	Project	1.0	0	0	0	0	1.0
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, UK.	
6.	Lawrence S. Brown and Thomas Holme, Chemistry for engineering students, 2018, 4th edition – *Open access version*	
Mode of Evaluation: CAT, Written assignment, Quiz and FAT		
Recommended by Board of Studies	28.06.2021	
Approved by Academic Council	No. 63	Date 23.09.2021

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

Course Objective

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

Course Outcome :

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

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

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

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

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

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

Course Objectives

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

Course Outcome

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

	Total Lecture hours:	**15 hours**

Text Book(s)

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

Reference Books

1.	Martic C Brown, Python: The Complete Reference, 4th Edition, McGraw Hill Publishers, 2018.
2.	John V. Guttag, Introduction to computation and programming using python: with applications to understanding data. 2nd Edition, MIT Press, 2016.

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

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

Course Objectives

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

Course Outcome

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Course Objectives

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

Course Outcome

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

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

Indicative Experiments

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

Text Book(s)

1. Robert C. Seacord, Effective C: An Introduction to Professional C Programming, 1st Edition, No Starch Press, 2020.

Reference Book(s)

1. Vardan Grigoryan and Shunguang Wu, Expert C++: Become a proficient programmer by learning coding best practices with C++17 and C++20's latest features, 1st Edition, Packt Publishing Limited, 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

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

BECE101L	Basic Electronics	L	T	P	C
		2	0	0	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To introduce the students to the basic concepts of electronic components, sources, measurements. and instrumentation.
2. To apply the inculcated knowledge for developing simple circuits using various electronic components and devices
3. To familiarize the students with the basic concepts of number systems and digital logic.
4. To analyse the concepts associated with multiple sensors and their sensing mechanisms.

Course Outcome

Students will be able to

1. Understand the basic electronic components, sources, and measuring equipment
2. Comprehend the characteristics of diodes, transistors and their applications
3. Design and analyse the amplifiers and oscillators
4. Design and implement simple digital circuits
5. Analyse the performance metrics of the measurement systems.
6. Comprehend the basic concept of various sensors and their sensing mechanisms.

Module:1	**Electronic Components, Sources, and Measuring Equipment**	**3 hours**

Evolution of Electronics – Impact of Electronics in Industry and Society – Familiarization of Resistors, Capacitors, Inductors – Colour Coding – types and specifications, – Electro-mechanical components – Relay and Contactors – Regulated Power supply, Function Generator – Multimeter – CRO

Module:2	**Junction Diodes**	**4 hours**

Intrinsic and extrinsic semiconductors – doping - PN Junctions, Formation of Junction, Physical operation of diode, Barrier Potential, I - V Characteristics, Rectifiers, Zener diode – I-V Characteristics, Zener diode as Voltage regulator.

Module:3	**Transistors**	**5 hours**

Bipolar Junction Transistor (BJT) - Device structure and physical operation, Concept of CB, CE and CC Configuration, Transistor as a Switch, - Metal-Oxide Field Effect Transistor (MOSFET) - Device Structure, mode of operation and Characteristics, MOSFET configurations (CS, CD, CG).

Module:4	**Amplifiers and Oscillators**	**4 hours**

BJT as an amplifier (CE configuration), MOSFET as an amplifier (CS configuration), Feedback concept, Oscillators - Barkhaunsen's criteria for sustained oscillation, RC Phase Shift Oscillator, LC Oscillator.

Module:5	**Digital Logics**	**4 hours**

Number systems, conversion of bases, Boolean algebra, Logic Gates, Concept of universal gate, Simplification and implementation of Boolean functions.

Module:6	**Principles of Measurement and Analysis**	**3 hours**

Units and standards, Errors, Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, Types of measured Quantities, Measures of Dispersion, Sample deviation and sample mean, Calibration and standard.

Module:7	**Sensors and Transducers**	**5 hours**

Sensor fundamentals and characteristics - General concepts and terminology of measurement systems, Sensors and transducers - Classification of sensors, Static and dynamic characteristics. Principle of Resistive Sensors, Capacitive Sensors, Inductive Sensors, Magnetic sensors, Optical sensor, Self-generating Sensors

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

Guest lectures from Industry and, Research and Development Organisations

	Total Lecture hours:	**30 hours**

Text Book(s)			
1.	A. P. Malvino, D. J. Bates, Electronic Principles, 2017, 7/e, Tata McGraw-Hill.		
2	Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 2016, First Edition, Pearson Education, Noida, India.		
Reference Books			
1.	David A Bell, Electronic Devices and Circuits, Oxford Press, 5th Edition, 2008		
2	Robert L. Bolysted and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall of India, 11th Edition, 2017		
3	D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003		
4	A.K. Sawhney, Puneet Sawhney, A Course In Electrical and Electronic Measurements, and Instrumentation, Dhanpat Rai & Co., 2015		
Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	08.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BECE101P	Basic Electronics Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To learn the various characteristics of diodes and transistors
2. To understand the concept of digital logic functions and verify the truth tables
3. To learn the performance metrics of measurement systems and characteristics of various sensors

Course Outcome

Students will be able to
1. Analyse the various characteristics and applications of diodes and transistors
2. Design logic circuits using logic gates and verify their truth tables
3. Measure the physical parameters using different transducers

Indicative Experiments

1	Identify, mark the terminal and find the value of a particular component from the given group of electronic components, Study of electronic measurement devices (Multimeter, DSO, function generator)
2	V-I Characteristics of PN Junction diodes and Zener diodes
3	Half Wave and Full Wave Rectifier circuits
4	Zener Diode as a voltage regulator
5	Characteristics of BJT in Common Emitter Configuration
6	Characteristics of MOSFET in Common Source Configuration
7	Frequency response of BJT single stage amplifier
8	Study of the signal generation using RC Phase Shift Oscillator
9	Study of logic gates and implementation of Boolean Functions
10	Strain gauge sensors for measurement of normal strain.
11	Displacement measurement using LVDT and LDR.
12	Temperature measurement using RTD, Thermistor and Thermocouple.

Total Laboratory Hours **30 hours**

Text Book(s)

1.	A. P. Malvino, D. J. Bates, Electronic Principles, 2017, 7/e, Tata McGraw-Hill.
2	Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 2016, First Edition, Pearson Education, Noida, India.

Reference Books

1.	Robert L. Bolysted and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall of India, 11th Edition, 2017
2	D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003

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

Recommended by Board of Studies	08.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BEEE101L	Basic Electrical Engineering	L	T	P	C
		2	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. Provide insights into relevant concepts and principles in electrical engineering
2. Facilitate understand and comprehend laws, rules and theorems to compute parameters of electric circuits
3. Enable comprehend and analyze the concepts of electrical machines and measuring instruments

Course Outcome

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

1. Evaluate DC and AC circuit parameters using various laws and theorems
2. Analyze the parameters of magnetically coupled circuits and compare various types of electrical machines
3. Comprehend the measurement techniques of electrical parameters
4. Understand the concept of electric supply system and comprehend essential electrical safety requirements

Module:1	**DC Circuits**	**6 hours**

Basic circuit elements and sources; Ohms law, Kirchhoff's laws; Series and parallel connection of circuit elements; Source transformation; Node voltage analysis; Mesh current analysis; Maximum power transfer theorem

Module:2	**AC Circuits**	**6 hours**

Alternating voltages and currents, RMS, average, form factor, peak factor; Single phase RL, RC, RLC series and parallel circuits; Power and power factor; Balanced three phase systems

Module:3	**Magnetic Circuits**	**4 hours**

Electromagnetic Induction: Self and mutual; Magnetically coupled circuits; Series and parallel magnetic circuits; Dot convention

Module:4	**Electrical Machines**	**5 hours**

Principle of operation, construction and applications of DC machines, transformers, induction motors, synchronous generators, stepper motor, Brushless DC (BLDC) motor

Module:5	**Electrical Measurements**	**4 hours**

Principle, Construction and operation of moving coil and moving iron instruments; Power and energy measurement in single phase and three phase systems

Module: 6	**Electrical Supply Systems & Safety**	**3 hours**

Concepts of electrical power generation, transmission and distribution systems; Wiring; Electrical safety; Earthing; Protective devices

Module: 7	**Contemporary Issues**	**2 hours**

Guest lectures from Industry and, Research and Development Organizations

	Total Lecture hours:	**30 hours**

Text Book(s)

1. Allan R. Hambley, Electrical Engineering: Principles & Applications, 2019, 7th edition, Pearson Education

Reference Books

1. DP Kothari & I J Nagrath, Basic Electric Engineering, 2019, 4th edition, McGraw Hill Education
2. John Bird, Electrical Circuit Theory and Technology, 2013, 5th edition, Routledge Publications
3. S. Salivahnan, R Rengaraj, G R Venkatakrishnan, Basic Electrical, Electronics and Measurement Engineering, 2018, McGraw Hill Education
4. E.W Golding, F.C Widdis, Electrical Measurements and Measuring Instruments,

	2011, Reem Publications		
5.	V K Mehta and Rohit Mehta, Principles of Power System, 2005, S. Chand		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT			
Recommended by Board of Studies	03.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BEEE101P	Basic Electrical Engineering Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. Understanding the concepts of electrical engineering for development and implementation of electrical systems
2. Impart knowledge and skill in wiring and its standards
3. Facilitate comprehend and identify appropriate measuring devices for an electric circuit

Course Outcome

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

1. Understand, analyze and validate the electric circuit parameters
2. Design and develop electrical systems for domestic and commercial applications
3. Acquire skills for interpretation of measurement during experimentation
4. Attain skills to use modern engineering tools for electrical system layout planning

Indicative Experiments	
1	Verification of Kirchhoff's voltage law
2	Verification of Kirchhoff's current law
3	Verification of maximum power transfer theorem
4	Sinusoidal steady state response of RLC circuits
5	Wiring circuit for a single lamp and a fan with regulator
6	Wiring circuit for Godown with two-way switch
7	Load test on single phase transformer/DC motor
8	Measurement of power in a single phase AC Load
9	Measurement of power and energy consumed by a given three phase AC load
10	Study of earthing and measurement of earth pit resistance
11	Cost estimation of residential electrical wiring
12	Electrical layout for a residential/commercial/industrial application using CAD software
	Total Laboratory Hours **30 hours**

Text Book(s)	
1	Allan R. Hambley, Electrical Engineering: Principles & Applications, 2019, 7th edition, Pearson Education

Mode of assessment: CAT, FAT, Oral examination

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

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

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

Course Objectives:

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

Course Outcomes:

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

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

Advanced puzzles:

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

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

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

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

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

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

Logarithms, Progressions, Geometry and Quadratic equations - Advanced

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

Concepts followed by advanced questions of CAT level

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

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

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

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

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

Mock interviews

Cracking other kinds of interviews

Skype/ Telephonic interviews Panel interviews Stress interviews **Guesstimation** 1. Best methods to approach Guesstimation questions 2. Practice with impromptu interview on Guesstimation questions **Case studies/ situational interview** 1. Scientific strategies to answer case study and situational interview questions 2. Best ways to present cases 3. Practice on presenting cases and answering situational interviews asked in recruitment rounds		
Module:8	**Problem solving and Algorithmic skills**	**18 hours**
Logical methods to solve problem statements in Programming - Basic algorithms introduced		
	Total Lecture hours:	**45 hours**

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

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

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

Course Objectives:

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

Course Outcomes:

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

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

Skill introspection - Skill acquisition - consistent practice

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

- Problem Solving
- Critical Thinking
- Lateral Thinking

Rebus puzzles, and word-link builder questions

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

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

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

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

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

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

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

Speed Maths

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

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

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

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

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

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

Course Objectives:

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

Course Outcomes:

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

Module:1	Logical Reasoning	5 hours

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

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

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

Module:3	Time and work– Advanced	5 hours

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

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

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

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

- Partnership
- Averages
- Weighted average
- Advanced problems discussed

Module:6	Number system - Advanced	4 hours

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

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

Sentence Correction - Advanced

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

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

Sentence Completion and Para-jumbles - Advanced

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

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

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

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

Essay writing

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

	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

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

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

BITE202L	Digital Logic and Microprocessors	L	T	P	C
		3	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To acquire the basic knowledge of digital logic components and circuits.
2. To prepare students to perform the design and analysis of digital electronic circuits.
3. To understand the architecture and the 8086 programming for the Intel microprocessors.

Course Outcomes

1. Understanding the structure of various number systems and Illustrate simplification of Boolean functions to achieve optimized design of digital logic circuits.
2. Demonstrate the design, and analysis of various combinational logic circuits and sequential logic circuits using flip flops and logic gates.
3. Deploy the sequential logic design techniques for developing various counters and Registers.
4. Demonstrate the knowledge of 8086 Microprocessor architecture to develop assembly language programs by applying various addressing modes, instructions sets, and assembler directives of the 8086 microprocessors.
5. Organize the working of different peripherals interfaced with 8086 Microprocessor.

Module:1	**Introduction to Digital Logic**	**6 hours**

Switching theory: Introduction to number systems, Logic gates: NAND, NOR gate as universal building blocks - Canonical Logic Forms, Simplification of two, three, four, and five -variable Boolean equations using the Karnaugh maps.

Module:2	**Combinational Logic Circuits**	**8 hours**

Design and analysis of combinational logic circuits: Standard logic (MSI) vs. programmable logic (PLD). Half adder, Full adder, Half subtractor, Full subtractor - 4-bit parallel adder-subtractor, Look ahead Carry generator and Magnitude Comparator, Decoders: 2X4, 3X8, 4X16, Decimal to BCD encoder, Multiplexers: 4-to-1, 8-to-1, 16-to-1, De-multiplexers, Binary Codes, converters and applications.

Module:3	**Sequential Logic Circuits: Design and Analysis**	**6 hours**

Latches to Flip flops: SR, JK, D and T, clock and triggering. Obtaining characteristic and excitation tables and flip flop conversions, Master-Slave flip flops. Design and analysis of sequential logic circuits and practice problems.

Module:4	**Sequential Logic Circuits: Registers and Counters**	**7 hours**

Design of counters: Asynchronous (Ripple) Counters- Up and Down Counters, counters with MOD number < 2^n Cascading Counters. Synchronous (Parallel) counters, Decade counter – Registers: registers with parallel load, Shift registers (SISO, SIPO, PISO, PIPO) – Ring, Johnson counter.

Module:5	**Microprocessor Architecture 8086**	**6 hours**

Programmer's Model, Block diagram, Pin diagram - CPU architecture – Flags, Segmentation- Minimum mode maximum mode operations.

Module:6	**Programming model of 8086**	**6 hours**

Programming model of 8086, Addressing modes, Instruction set, Assembler directives and Assembly language Programming of 8086. Practice programs.

Module:7	**Peripheral Chips**	**4 hours**

Block diagram – pin diagram, 8255 (PPI), 8254 (Timer), 8257 (DMA), 8259 (PIC), 8251 (USART)

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

	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	M. Morris Mano, Digital Logic and Computer Design, 4th edition, Pearson Education, 2015.	
2.	K Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096, PHI, 2013.	
Reference Books		
1.	D .P. Kothari and J. S. Dhillon, 'Digital circuits and Design', Pearson Education, 2016.	
2.	Abhishek Yadav, Microprocessor 8085, 8086, Laxmi Publisher 2015.	
3.	Yu Cheng Liu, Glenn A. Gibson, Microcomputer Systems: The 8086/8088 Fami, PearsonIN Pub, 2015.	
4.	Digital Electronics by Dr. k Kaushik, Dhanpat Rai Publication, August 2015.	
Mode of Evaluation: CAT, Written assignment, Quiz, FAT		
Recommended by Board of Studies	15-11-2021	
Approved by Academic Council	No. 64	Date 16-12-2021

BITE202P	Digital Logic and Microprocessors Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives

1. To acquire the basic knowledge of digital logic components and circuits.
2. To prepare students to perform the design and analysis of digital electronic circuits.
3. To understand the architecture and the 8086 programming for the Intel microprocessors.

Course Outcome

1. Understanding the structure of various number systems and Illustrate simplification of Boolean functions to achieve optimized design of digital logic circuits.
2. Demonstrate the design, and analysis of various combinational logic circuits and sequential logic circuits using flip flops and logic gates.
3. Deploy the sequential logic design techniques for developing various counters and Registers.
4. Demonstrate the knowledge of 8086 Microprocessor architecture to develop assembly language programs by applying various addressing modes, instructions sets, and assembler directives of the 8086 microprocessors.
5. Organizing working of different peripherals interfaced with 8086 Microprocessor.

Indicative Experiments

1.	Basic Logic gates verification and Boolean expression resolving.	2 hours
2.	Design Boolean function using universal gates	2 hours
3.	Design of combinational circuits: Adders and Subtractors.	2 hours
4.	Design of Parallel Adder and Magnitude Comparator	2 hours
5.	Decoder and Encoder, BCD to seven segment encoder and code converters.	2 hours
6.	De-multiplexers, multiplexer, implementing Boolean function using multiplexers and decoders.	2 hours
7.	Verification of Flip flops and conversion of flip flops.	2 hours
8.	Design of sequential circuits using various Flips-flops and logic gates.	2 hours
9.	Design of Synchronous counter and its types.	2 hours
10.	Design of Asynchronous counter and its types.	2 hours
11.	Design of various Registers.	2 hours
12.	Programs to demonstrate the application of shift registers.	2 hours
13.	8086 Assembly language sample programs-I • Program to separate odd and even number from a given sequence. • Program to convert BCD to decimal number. • Program to search the given value in an array. • Program to perform 16- bit arithmetic operation using register pair.	2 hours
14.	8086 Assembly language sample programs-II • Program to find factorial of a given number. • Program to generate the average of n numbers.	2 hours

	• Find the smallest among three numbers. • Program to transfer block of ten 16-bit data to from one location to the other location in the memory.	
15.	8086 Assembly language sample programs-III • Program to get the count of even numbers from the list of n numbers. • Program to generate a Fibonacci sequence. • Program to sort a given array of elements. • Program to perform block transfer.	2 hours
	Total Laboratory Hours	**30 hours**
Mode of assessment: Lab assessments / Lab FAT / Oral examination		
Recommended by Board of Studies	15-11-2021	
Approved by Academic Council	No. 64 Date 16-12-2021	

BITE203L	Principles of Communication Systems	L	T	P	C
		3	0	0	3
Pre-requisite	**BECE101L, BECE101P**	**Syllabus version**			
		1.0			

Course Objectives

1. To understand the various techniques used in Analog and Digital Communication.
2. To comprehend the impact of interference in signaling devices.
3. To learn the various issues in communication systems.

Course Outcome

Demonstrate the knowledge of fundamental elements and concepts related to Communication System.
Study the various modulation techniques used in Analog Communication Systems.
Address the challenges imposed on different types of Communication Systems.
Use and apply important methods in communication systems using digital transmission systems and different modulation techniques.
Understand the concepts of spread spectrum and multiple access techniques.

Module:1	**Amplitude Modulation Systems**	**7 hours**

Overview of Communication System; Channels and Their Characteristics; Modulation and its Benefits; Generation and Demodulation of AM, DSBSC, SSB and VSB Signals; Comparison of Amplitude Modulation Systems.

Module:2	**Angle Modulation Systems**	**6 hours**

Frequency Translation; Non – Linear Distortion; Phase and Frequency Modulation; Single tone, Narrow Band and Wideband FM; Transmission Bandwidth; Generation and Demodulation of FM Signal.

Module:3	**Fundamentals of Noise Theory**	**5 hours**

Overview of Probability, Random Variables and Random Process; Gaussian Process Shot noise, Thermal noise and white noise; Narrow band noise, Noise margin; Noise temperature; Noise Figure.

Module:4	**Performance of Continuous Wave Modulation Systems**	**5 hours**

Super heterodyne Radio receiver and its characteristic; SNR; Noise in DSBSC systems using coherent detection; Noise in AM system using envelope detection Envelop Detection for FM; FM threshold effect; Pre-emphasis and De-emphasis in FM; Comparison of performances.

Module:5	**Digital Transmission**	**7 hours**

Introduction, Pulse modulation, PCM sampling, sampling rate, signal to quantization noise rate, companding - analog and digital - percentage error, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission types- Intersymbol interference, eye patterns, multiplexing.

Module:6	**Digital Communication**	**7 hours**

Introduction, Shannon limit for information capacity, digital amplitude modulation, frequency shift keying, FSK bit rate and baud, FSK transmitter, BW consideration of FSK, FSK receiver, phase shift keying–binary phase shift keying QPSK, Quadrature Amplitude modulation, bandwidth efficiency, DPSK.

Module:7	**Spread Spectrum and Multiple Access**	**6 hours**

Overview of Spread Spectrum Communication. PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA, SDMA.

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

Text Book(s)			
1.	Taub, H, Schilling, D. L, Saha G, “Principles of communication systems” McGraw-Hill McGraw-Hill Higher Education, 4th Edition, 2017.		
Reference Books			
1.	B.P.Lathi, Z. Ding, H. M. Gupta, “Modern Digital and Analog Communication Systems, 4th Edition, Oxford, 2017.		
2.	J. W. Leis, “Communication system principles using MATLAB”, John Wiley & Sons, 2018.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Recommended by Board of Studies	15-11-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

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

Course Objectives:

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

Course Outcomes:

At the end of this course, students are expected to

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Text Books:

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

Prentice Hall India 2016.
Reference Books:
1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019. 2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018. 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017. 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017. 5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017. 6.Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.
Mode of Evaluation: CAT, Quizzes, Digital Assignments, FAT

Recommended by Board of Studies	15.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Course code	Course Title	L	T	P	C
BITE201L	Data Structures and Algorithms	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To impart the basic concepts of data structures and algorithms
2. To derive the time and space complexity of algorithms.
3. To develop understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

Course Outcomes:

1. Identify user defined data types, linear data structures for solving real world problems.
2. Analyse and derive time and space complexity for algorithms designed.
3. Illustrate various techniques for searching, sorting and hashing
4. Write modular programs on nonlinear data structures and algorithms for solving engineering problems efficiently.
5. Design new algorithms or modify existing algorithms for new applications and reason about the efficiency of the result.

Module:1	Linear Data Structures	7 hours

Operations on Stack - Array implementation of Stack - Applications of Stack -Role of Stack in Recursion - Towers of Hanoi problem - Operations on Queue - Array implementation of Queue - Applications of Queue - Types of Queues

Module:2	Linked List	7 hours

Singly Linked List - Doubly Linked List - Circular Singly Linked List - Linked representation of Stack and Queue - Applications of Linked List

Module:3	Algorithm Analysis	6 hours

The Problem-Solving Aspect - Analysis Framework - Asymptotic Notations - Growth rate of Functions - Complexity Analysis - Mathematical Analysis of Recursive and Non-Recursive Algorithms

Module:4	Sorting and Searching	6 hours

Sorting - Bubble Sort, Insertion Sort, Selection Sort, Radix Sort, Merge Sort, Heap Sort, Shell Sort, Searching - Linear Search, Binary Search - Time Complexity Analysis of Sorting and Searching Algorithms - Hash Table Methods

Module:5	Non-Linear Data Structures	7 hours

Basic Terminology of General Trees and Binary Trees - Expression Trees - Tree Traversing – In-order, Pre-order and Post-order Traversals - Construction of Binary Search Tree - Operations on Binary Search Tree - Height Balanced Trees (AVL) - B-Trees

Module:6	Graphs	7 hours

Basic Definitions - Representations of Directed and Undirected Graphs - Traversals and Applications of Directed and Undirected Graphs - Single Source Shortest Path Algorithm – Dijkstra's Algorithm - Minimum Spanning Trees – Prim's and Kruskal's Algorithm.

Module:7	Strategies for Algorithm Design	3 hours

Dynamic Programming - Travelling Salesman Problem, Divide and Conquer - Quick Sort, Greedy Algorithms - Huffman Coding

Module 8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**
Text Books		
1.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, 2019, 4th Edition, Pearson Education, Delhi.	
2.	J.P. Tremblay and P.G. Sorenson, “An Introduction to Data Structures with Applications”, 2017, 2nd Edition, Tata McGraw Hill, New Delhi.	
Reference Books		
1.	Cormen, T.H., Leiserson, C.D., Rivest, R.L. & Stein, C. "Introduction to Algorithms" 2009, 3rd Edition. MIT Press, USA.	
2.	Seymour Lipschutz “Data Structures with C (Schaum's Outline series)” 2017, 1st Edition, McGraw Hill Education, India.	

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE201P	Data Structures and Algorithms Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To develop programming skills to solve problems using fundamental data structures.
2. To apply appropriate data structures and algorithms in solving the real-world problems.

Course Outcomes:

1. Identify the linear data structures for solving real world problems.
2. Illustrate and analyse various searching, sorting and hashing techniques.
3. Write modular programs on nonlinear data structures and algorithms for solving engineering problems efficiently.

1.	**STACK ADT** Implement Stack and use it to convert Infix to Postfix expression Evaluate Postfix expression Implement Towers of Hanoi problem	6 hours
2.	**QUEUE ADT** Implement Queue and Circular Queue	6 hours
3.	**LIST ADT** Implement Singly and Doubly Linked Lists Implement Circular Singly Linked list Represent a Polynomial as a Linked List and write functions for Polynomial Addition	6 hours
4.	**SORTING AND SEARCHING** Implement Insertion, Bubble, and Selection sorts Implement Heap, Merge, and Radix sorts Implement Binary and Linear search Construct Hash Table and resolve collisions	6 hours
5.	**TREES AND GRAPHS** Implement a Binary tree and traverse it in Pre-order, In-order and Post-order Implement Binary Search Tree insertion and deletion operations Perform Graph Traversal Implement Dijkstra's algorithm	6 hours
	Total Laboratory Hours	30 hours

Mode of Assessment: Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE301L	Computer Architecture and Organization	3	0	0	3
Pre-requisite	BITE202L, BITE202P	Syllabus version			
		1.0			

Course Objectives:

1. To familiarize students with the basic structure of computer systems and impart knowledge on performance measurement, instruction sequencing I/O organization and interfacing techniques.
2. To impart knowledge of data representation and implementation of arithmetic operations using algorithms.
3. To acquaint the importance of memory systems, their performance metrics and to customize the hardware to improve system performance.

Course Outcomes:

1. Elucidate the arithmetic operations, addressing modes and the performance of computers.
2. Design instruction level parallelism using instruction stages. Understand pipelining concepts and identify the hazards to rectify in typical processer pipeline.
3. Analyse the arithmetic algorithms to perform ALU operations.
4. Design a memory system on understanding the chip organization and analyse its performance.
5. Understand the concepts of Parallel processing, Multiprocessors and Multicomputer.

Module:1	Basic Structure of Computers	5 hours

Computer Types - Functional Units - Basic Operational Concepts - Bus Structures - Performance - Processor, Clock, Performance Equation - Pipelining and Superscalar Operation - Clock Rate - Instruction Set: CISC and RISC, Compiler, Performance Measurement, Multiprocessors and Multicomputer - Historical Perspective

Module:2	Machine Instructions and Programs	7 hours

Numbers - Arithmetic Operations and Characters - Memory Locations and Addresses - Memory Operations - Instructions and Instruction Sequencing - Addressing Modes - Assembly Language - Basic Input/Output Operations - Stacks and Queues - Subroutines - Encoding of Machine Instructions

Module:3	Input/Output Organization	5 hours

Accessing I/O Devices – Interrupts - Processor Examples - Direct Memory Access – Buses - Interface Circuits - Standard I/O Interfaces

Module:4	Memory System	7 hours

Semiconductor RAM Memories - Read-Only Memories – Speed - Size and Cost -Cache Memories - Performance Consideration - Virtual Memories - Memory Management Requirements - Secondary Storage.

Module:5	Arithmetic	7 hours

Addition and Subtraction of Signed Numbers - Multiplication of Positive Numbers - Signed-Operand Multiplication - Integer Division - Floating Point Numbers and Operations

Module:6	Pipelining	7 hours

Basic Concepts - Data Hazards - Instruction Hazards - Influence on Instruction Sets - Data Path and Control Considerations - Performance Considerations

Module:7	Large Computer Systems	5 hours

Forms of Parallel Processing - Array Processors - Structure of General Purpose Multiprocessors - Interconnection Networks - Memory Organization in Multiprocessors -

Program Parallelism and Shared variables – Multicomputer - Performance Considerations			
Module:8	**Contemporary Issues**		**2 hours**
	Total Lecture hours:		**45 hours**
Text Book			
1.	Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", 2017(Reprint of 2011), 5th Edition, Tata Mc-Graw Hill.		
Reference Books			
1.	Patterson, D. A., and J. L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 2016, 5th Edition, Morgan Kaufman.		
2.	Hayes, J.P., "Computer Architecture and Organization", 2017, 5th Edition, Tata Mc-Graw Hill.		
3.	William Stallings "Computer Organization and architecture- Designing for Performance", 2019, 11th Edition, Prentice Hall.		
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE302L	Database Systems	3	0	0	3
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To understand, analyze and design databases.
2. To emphasize on the understanding of data models, architecture and administration
3. To appreciate the internal functioning of database management systems.

Course Outcomes:

1. Identify the basic concepts of database and various data models used in DB design
2. Design conceptual models to represent simple database application scenarios
3. Convert high-level conceptual model to relational data model and to improve a database design by normalization
4. Populate and query a database using SQL and PL/SQL. Also apply Query processing and indexing techniques to optimize the database system performance
5. Apply and relate the concept of transaction, concurrency control and security control in data

Module:1	Basics of databases	5 hours

Introduction to Database - Purpose and Applications - Data Models - Data Abstraction - Instance and Schemas - Database Languages - Database Users and User Interfaces - Database Architecture - Classification

Module:2	Conceptual database design	5 hours

High-Level Conceptual Data Models for Database Design - Entity Types - Entity Sets - Attributes and Keys - Relationship Types - Relationship Sets - Roles and Structural Constraints - Weak Entity Types - ER Diagrams - Naming Conventions and Design Issues - Relationship Types of Degree Higher than Two - EER diagrams

Module:3	Relational database design	7 hours

Relational Model Constraints - Update Operations - Dealing with Constraint Violations - Relational Algebra - Unary and Binary Relational Operations - Additional Relational Operations - Database Design Using ER - EER-to-Relational Mapping

Module:4	Design using Normalization Theory	6 hours

Informal Design Guidelines for Relation Schemas - Functional Dependencies - Inference Rules - Equivalence and Minimal Cover - Properties of Relational Decompositions - Algorithms for Relational Database Schema Design - Normal Forms Based on Primary Keys - Boyce-Codd Normal Form - 4NF - 5NF

Module:5	SQL and PL/SQL	7 hours

Data Definition and Data Types - Specifying Constraints in SQL - Basic Retrieval Queries in SQL - INSERT, DELETE, and UPDATE Statements in SQL - Virtual Tables - In-built functions - Complex Queries-nested – Correlated - PL/SQL block – Cursor – Function – Procedure – Trigger

Module:6	Query Processing and Indexing	6 hours

Query Execution plan - Basic algorithms for query execution - Heuristic Query Optimization technique - Sparse and Dense Index - Primary, Secondary and Clustered Index - B Tree Vs. Hash Index

Module:7	Transaction Processing, Concurrency Control and Recovery	7 hours

Introduction to Transaction Processing - Desirable Properties of Transactions - Characterizing Schedules Based on Serializability – Concurrency - Two-Phase Locking Techniques for Concurrency Control - Multi-version Techniques - Recovery Concepts - NO-UNDO/REDO Recovery Based on Deferred Update - Recovery Techniques Based on Immediate Update - Shadow Paging - ARIES Recovery Algorithm.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Ramez Elmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 2016, 7th Edition, Pearson Education, Delhi.
Reference Books	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database System Concepts”, 2020, 7th Edition, McGraw Hill, Delhi.
2.	Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 2007, 3rd Edition, McGraw Hill, Delhi.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE302P	Database Systems Lab	0	0	2	1
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To understand, analyze and design databases
2. To work on existing database system, and create new relational database and analyse the design.

Course Outcomes:

1. Use of SQL interface of a RDBMS package to create, secure, populate and query of DB
2. Formulate query using SQL, solutions to a usage of query and data update problem
3. Use procedural language to develop comprehensive solutions for all type of applications

	Indicative Experiments	Hours
1.	**Database creation** Viewing all databases - Creating a Database - Viewing all Tables in a Database - Creating Tables - Dropping / Truncating/Renaming Tables.	2 Hours
2	**Schema Refinement** Alter table for new column - new domain size - rename a column with new domain type - set the new constraints to the table - drop the constraints/modify constraints, etc.	4 Hours
3.	**Database manipulation** Inserting / Updating / Deleting Records in a Table - Using transaction control commands – commit, rollback and save point	2 Hours
4.	**For a given set of relational schemas, perform the following** Simple Queries - Simple Queries with Aggregate functions - Queries with Aggregate functions (group by and having clause).	4 Hours
5.	**SET Operators and Built-in Functions** Union, Intersection, Minus, and Queries involving Date Functions - String Functions and Math Functions	4 Hours
6.	**Complex Queries (Nested and Join Queries)** Join Queries-Inner Join, Outer Join - Subqueries-With IN clause - With EXISTS clause	6 Hours
7.	**Views** Creating Views (with and without check option) - Dropping views - Selecting from a view.	2 Hours
8.	**PL/SQL Programs** • Variables, Constants, loops, conditionals, etc. • Sample program using FOR loop to insert ten rows into a database table.	2 Hours
9.	**PL/SQL** Block, Cursor, Procedure, and Functions	2 Hours
10.	**PL/SQL –** Trigger	2 Hours
	Total Laboratory Hours	**30 hours**

Text Books

1	Bob Bryla, Kevin Loney, "Oracle Database 12c The Complete Reference", 2013,

2	Illustrated Edition, McGraw-Hill Education, (Oracle Press). Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming", 2014, 6th Edition, O'Reilly Media, Inc.			
Mode of Assessment: Continuous Assessments, Final Assessment Test				
Recommended by Board of Studies		20-05-2022		
Approved by Academic Council		No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE303L	Operating Systems	3	0	0	3
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To understand the Computer System Structure and Operating Systems Structure
2. To learn manage multiple tasks that execute at the same time and share resources.
3. To have a basic understanding on memory management, I/O devices and operations on files extensively.

Course Outcomes:

1. Knowledge on Operating systems and its different subsystems in controlling computer hardware.
2. Apply principles of process management, CPU scheduling and deadlocks.
3. Design the process synchronization and Inter Process Communication.
4. Develop memory management schemes.
5. Design and manipulate file system.

Module:1	Elementary concepts	6 hours

Introduction to Operating Systems - Operating System Operations - Operating System Services- User and Operating System Interface - System Calls- System Services- Operating System Design and Implementation- Operating System Structure- Building and Booting an Operating System

Module:2	Processes and Threads Management	6 hours

Process Concept – Process Scheduling – Operations on Processes – Inter-process Communication – IPC in Shared - Memory Systems – IPC in Message - Passing Systems – Threads - Multicore Programming - Multithreading Models -Thread Libraries - Implicit Threading - Threading Issues - Case Study: IPC System in Windows, Linux & Mac OS

Module:3	CPU Scheduling and Deadlocks	7 hours

Scheduling Criteria - Scheduling Algorithms – Multiple Processor Scheduling – Real Time CPU Scheduling – Deadlocks - Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock

Module:4	Process Synchronization	6 hours

The Critical Section Problem - Peterson's Solution – Hardware Support for Synchronization – Mutex Locks – Semaphores – Monitors – Classic Problems of Synchronization - Synchronization within the Kernel - POSIX Synchronization

Module:5	Memory Management	6 hours

Contiguous Memory Allocation – Paging – Structure of the Page Table – Segmentation – Paging with segmentation - Demand Paging – Page Replacement – Allocation of Frames – Thrashing - Memory Compression - Allocating Kernel Memory - Case Study: VM implementation in Windows & Solaris

Module:6	Storage Management	6 hours

Mass Storage Structure - Disk Scheduling - Error Detection and Correction – Storage Device Management – Swap Space Management - I/O Systems - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem

Module:7	File System	6 hours

File Concept – Access Methods – Directory Structure – Protection – Memory Mapped Files – File System Structure - File System Operations - Directory Implementation – Allocation

Methods – Free Space Management - Efficiency and Performance - Recovery - Case Study: NTFS, EXT4 & APFS		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Abraham Silberschatz, Greg Gagne and Peter B. Galvin, "Operating System Concepts",2018, 10th Edition, Wiley.
Reference Books	
1.	William Stallings, "Operating Systems – Internals and Design Principles", 2018, 9th Edition, Pearson Education .
2.	D. M. Dhamdhere, "Operating Systems: A Concept-Based Approach", 2017, 3rd Edition, Tata McGraw-Hill.
3.	Maurice J. Bach, "The Design of the Unix Operating System", 2015, Pearson Education India.
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test	

Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE303P	Operating Systems Lab	0	0	2	1
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To simulate and implement operating system concepts such as scheduling, deadlock management, file management and memory management.
2. To provide necessary skills for developing and debugging programs in Linux environment.

Course Outcomes:

1. Able to build shell program for process and file system management with system calls.
2. Able to implement and analyze the performance of different algorithm of Operating Systems like CPU scheduling, page replacement policies & deadlock avoidance.
3. Able to understand gcc compiler, and the high-level structure of the Linux kernel both in concept and source code.

	Indicative Experiments	Hours
1.	Study of various Linux Shell Commands & Monitor the behaviour of operating system (kernel) using proc (process information pseudo-file system) utility and shell programming.	2 Hours
2.	Write programs using the following system calls of Unix/Linux operating system - fork, exec, getpid, exit, wait, stat, open, read, write, close, fcntl, seek, opendir, readdir.	2 Hours
3.	Implementation of Shared memory and Inter-process communication using pipes.	3 Hours
4.	Implement multi-threading using the Pthread library.	3 Hours
5.	Simulation of CPU scheduling algorithms- FCFS, SJF, Priority and Round Robin.	3 Hours
6.	Solutions to process synchronization problems using semaphore functions like sem_wait(), sem_post etc.	3 Hours
7.	Implement Banker's algorithm for Deadlock avoidance	3 Hours
8.	Implement the following memory allocation methods for fixed partition a. First Fit b. Worst Fit c. Best Fit	2 Hours
9.	Implement the following page replacement algorithms a. FIFO b. LRU c. LFU	3 Hours
10	Simulate the following disk scheduling algorithms a. FCFS b. SSTF c. SCAN	3 Hours
11.	Implement the following File allocation methods a. Sequential b. Indexed c. Linked	3 Hours
	Total Laboratory Hours	30 hours

Mode of Assessment: Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE304L	Web Technologies	3	0	0	3
Pre-requisite	BCSE103E	Syllabus version			
		1.0			

Course Objectives:

1. To develop understanding of the web architecture and web languages.
2. To familiarize with web development tools and techniques.
3. To illustrate web development environment and methodologies.

Course Outcomes:

1. Develop interactive and responsive web pages using HTML, CSS and Bootstrap
2. Use JavaScript and JQuery to create dynamic web pages.
3. Formulate web applications that employ the MVC architecture and integrate Client and Server using the AJAX.
4. Exhibit the working of server-side scripts and open-source databases
5. Devise sophisticated full stack web applications by combining advanced web frameworks and technologies.

Module:1	Web Essentials	7 hours

Evolution of web - Web architecture - HTML5: Text tags, Graphics, Form elements, Semantic tags - CSS3: Selectors, Backgrounds and borders, Text effects, Cascading and inheritance of style properties, Box Model, Positioning - Introduction to responsive design- Bootstrap: Containers, Grids, Typography, Flex, and Forms.

Module:2	Client-side Scripting	6 hours

JavaScript basics –Arrays- Functions - JavaScript object – HTML DOM - DOM methods – Events- Form Validation-Regular expressions- JQuery.

Module:3	Web Application and Angular JS	6 hours

Web applications- Web application frameworks: MVC framework-Angular JS: Introduction, Data binding, Directives, Modules, Scopes, Controllers, Expressions, Filters, Events, Form- Single Page Application-Multiple Views and Routing – Service.

Module:4	Client/Server Communication	5 hours

HTTP- Request/Response Model- HTTP Methods- REST APIs-AJAX –AJAX calls - XMLhttp object- Data formats-JSON -AJAX with JQuery

Module:5	Server-side Web Application Development	6 hours

Node.js - NPM – Call backs - Events- Express framework: Request-Response, Routing- Template engines – Cookies - Sessions - File uploading - Sending email.

Module:6	NoSQL Database	5 hours

Introduction to NoSQL Databases - MongoDB database: Basics - Manipulating and accessing MongoDB Documents – Client/Server/Database interaction.

Module:7	Component-based front-end JS library	8 hours

Introduction to component-based front-end library: ReactJS – Environment setup – React HTML render – JSX – React Components: functional components, class components- Component Life Cycle - React State – React Props – React Forms – React Events– React Conditionals– React Lists – React Router – React CSS – Hooks - Custom hook - Create a sample React app.

Module:8	Contemporary Issues	2 hours

Expert lecture from industry and R & D organizations

	Total Lecture hours:	**45 hours**

Text Books	
1.	Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, Mongo DB and Angular JS Web Development", 2017, 2nd Edition, Addison Wesley - Oreilly, USA.
2.	Vasan Subramanian, "Pro MERN Stack: Full stack web app development", 2019, 2nd Edition, APress, Oreilly.
Reference Books	
1.	Jessica Minnick, Responsive, "Web Design with HTML 5 & CSS, Cengage Learning", 2020, 9th Edition.
2.	Ethan Brown, "Web Development with Node and Express", 2019, 2nd Edition, O'Reilly Media Inc.
3	Frank Zammetti, "Modern Full-Stack Development: Type Script, React, Node. JS", 2020, 1st Edition, Apress.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-03-2022

Course code	Course Title	L	T	P	C
BITE305L	Computer Networks	3	0	0	3
Pre-requisite	BITE203L	Syllabus version			
		1.0			

Course Objectives:

1. To develop an understanding the principles of computer networks.
2. To familiarize with OSI model and the functions of layered structure.
3. To explain networking protocols, algorithms and design perspectives.

Course Outcomes:

1. Demonstrate the knowledge of fundamental concepts related to data communication and networks.
2. Describe computer transmission media and signaling mechanisms.
3. Identify and analyze data link layer error, flow control and MAC issues.
4. Develop multiple options for host to network addressing, managing sub networks and internetworking.
5. Evaluate communication services and transport protocols.

Module:1	Networking Principle 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”, 2017, 5th Edition, McGraw-Hill, 5th Edition.		
Reference Books			
1.	Andrew S Tanenbaum and David J. Wetherall, “Computer Networks”, 2021, 6th Edition, Pearson Publisher, 2021.		
2.	William Stallings, “Data and Computer Communication”, 10th Edition, 2017, Pearson, United Kingdom.		
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE305P	Computer Networks Lab	0	0	2	1
Pre-requisite	BITE203L	Syllabus version			
		1.0			

Course Objectives:

1. To develop an understanding of data communication and computer networks related tools.
2. To familiarize with computer network simulation analysis and programming.

Course Outcomes:

1. Identify and use functionality of network commands and simulation.
2. Establish basic network connectivity using Socket Programming.
3. Analyze a given network using prescribed tools.

	Indicative Experiments	Hours
1.	Network commands to test the network functionality	4 Hours
2.	Network Topologies and Device Configurations	4 Hours
3.	Access Control Lists and Firewall Configurations	4 Hours
4.	TCP Socket Programming	7 Hours
5.	UDP Socket Programming	7 Hours
6.	Network Traffic Analysis	4 Hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE306L	Theory of Computation	3	1	0	4
Pre-requisite	BMAT205L	Syllabus version			
		1.0			

Course Objectives:

1. To introduce the mathematical foundations of computation
2. To develop mathematical proofs for computation and algorithms.
3. To prepare students in automation theory, formal languages, algorithms & logic.

Course Outcomes:

1. Analyze the deterministic finite machine and non-deterministic finite automata to accept the languages.
2. Use and apply important properties of finite automaton to derive regular expressions from finite automation and vice versa.
3. Analyze the context free grammar to simplify, remove ambiguity and perform conversion.
4. Design push down automata for information technology related applications and to perform. Conversion between context free grammar and push down automation.
5. Design unrestricted and context sensitive grammar for information technology related applications, and linear bounded automata for context sensitive languages.
6. Design Turing machine for information technology related applications; demonstrate the knowledge of decidability and undecidability.

Module:1	Deterministic Finite Automata (DFA)	8 hours

Chomsky hierarchy of languages- Introduction to Finite automata (FA) and examples – Language acceptance and string acceptance by a DFA - Closure Properties - Minimization of finite automata - Regular languages - Non regular languages.

Module:2	Non- Deterministic Finite Automata(NFA)	9 hours

Introduction and examples - Conversion from DFA to NFA Finite Automata with Epsilon transitions - Equivalence of NFA and DFA - FA with output-Moore and mealy machine.

Module:3	Regular Expression (RE)	8 hours

Recursive definition of regular expression - Regular Set-Identities of RE - Equivalence of RE-Identity Rules -Inter Conversion RE and FA, Pumping lemma.

Module:4	Context-free Grammar (CFG)	9 hours

Introduction - Definition, right linear grammar - left linear grammar - Conversion from right linear grammar to left linear grammar - Derivation and ambiguity - Simplification of CFG - Normal forms

Module:5	Push down automata (PDA)	8 hours

Definition - Construction of pushdown automata - Equivalence of push down automata and context-free grammar.

Module:6	Context Sensitive and Unrestricted Grammars	8 hours

Unrestricted Grammar - Definition, Examples - Context-Sensitive Grammars and Languages - Definition, Examples, Linear Bounded Automata

Module:7	Turing machine (TM) and Decidability	8 hours

Definition - Design of Turing machine - Types of Turing machines - Introduction to Context sensitive grammar and languages - Linear bounded automata.

Decidable Languages - Decidable problems concerning regular languages, Decidable problems concerning context-free languages Undecidability: The diagonalization method - Recursively enumerable and recursive languages - Undecidable problems - Halting and PCP problem - A Turing-unrecognizable language - Halting problem is undecidable.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**60 hours**

Text Book	
1.	Peter Linz, Jones & Bartlet, “Introduction to Formal Languages and Automata”, 2016, 6th Edition, Jones & Bartlett.
Reference Books	
1.	John E. Hopcroft, “Introduction to Automata Theory, Languages and Computation”, 2014, 3rd Edition, Pearson Education.
2.	Michael Sipser, “Introduction to the Theory of Computation”, 2014, 3rd Edition, Cengage Publisher.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE307L	Software Engineering	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To introduce software engineering methodologies and process models
2. To provide sound understanding of software development phases
3. To present software project management and related process activities

Course Outcomes:

1. Use appropriate software process models for given software project scenarios
2. Analyse software requirements and develop software requirements specification
3. Develop abstract models and architectural design for software development
4. Choose appropriate software testing and evolution strategies
5. Create an outline of software project management plan including risk, configuration and quality aspects

Module:1	Elementary concepts	6 hours

Professional software development – Software engineering ethics – Process activities – Software specification, Software design and implementation, Software validation, Software evolution - Software process models.

Module:2	Requirements Engineering	5 hours

Functional requirements – Non-Functional requirements – Requirements engineering processes – Requirements elicitation – Requirements elicitation techniques: Interviewing, Ethnography – Requirements Specification – Requirements validation – Requirements change.

Module:3	Software Design	7 hours

Context models – Interaction models, Structural models, Behavioural models, Model-drive engineering, Architectural Design- Architectural Views-Architectural Patterns: Layered, Repository, Client-Server, Pipe and Filter, Overview of Design and Implementation.

Module:4	Software Testing	5 hours

Testing Fundamentals – Test Plan creation – Test case generation – Testing techniques: Black Box and White Box, Levels of Testing, Types of Testing, Validation and Verification – Object Oriented Testing – Test-Driven development.

Module:5	Software Maintenance and Evolution	6 hours

Evolution processes – Software Maintenance – Software Reengineering – Software reuse: Reuse landscape, Application frameworks, Application system reuse – Component-based software engineering.

Module:6	Software Project Management	8 hours

Risk Management: risk identification, risk analysis, risk planning, risk monitoring – Managing People – Project Planning – Process, Scheduling, Estimation techniques, Software configuration management, Software Quality, Software standards- the ISO 9001 standards framework.

Module:7	Safety and Resilience Engineering	6 hours

Overview of dependable systems, Safety-critical systems- Safety requirements – Safety Engineering processes – Security and organizations – Cyber security – Sociotechnical resilience.

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**
Text Book		
1.	Ian Sommerville, Software Engineering, 10th Edition, Pearson Publisher, 2016.	
Reference Book		
1.	Roger Pressman, Software Engineering – A Practitioner's Approach, Ninth Edition, McGraw Hill Higher Education, 2019.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	20-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BITE307P	Software Engineering Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the concepts of process and product development.
2. To elucidate the knowledge of requirement analysis.
3. To provide the knowledge of software design and testing.

Course Outcomes:

1. Demonstrate the various software design concepts and understand different designs like architectural, structured, object oriented and user interface.
2. Apply software validation and testing for real time applications.

	Indicative Experiments	Hours
1.	Study of a requirements management tool (e.g. RequistePro) and Create requirements document for a given application scenario	4 Hours
2	Study of UML diagramming tool (e.g. ArgoUML) and Create UML models for a given application scenario.	6 Hours
3	Study of a functional testing tool (e.g. Winrunner) and test a given application software with test scripts.	4 Hours
4	Study of a web application testing tool (e.g. Selenium) and test a given web application software with test scripts.	4 Hours
5	Study of a bug tracking tool (e.g. Bugzilla) and use it for tracking outstanding problems of a given application software	4 Hours
6	Study of a project management tool (e.g. ProjectLibre) and create Gantt chart, PERT chart, WBS chart for a given project scenario	4 Hours
7	Study of a version control system (e.g. Git) and use it for keeping track of modifications to project source code files	4 Hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE308L	Artificial Intelligence	3	0	0	3
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To develop an understanding of the basic principles, models and algorithms of Artificial Intelligence.
2. To facilitate with the techniques for problem solving, knowledge representation and reasoning systems capability
3. To explain the characteristics and development steps of intelligent agents.

Course Outcomes:

1. Elucidate various Artificial Intelligence techniques and their areas of applications
2. Solve various real-world problems using Artificial Intelligence techniques
3. Apply different knowledge representations and reasoning techniques
4. Exercise probabilistic reasoning to solve problems with uncertain knowledge
5. Practice various planning and learning methods in solving real-world problems

Module:1	**Preliminaries**	**5 hours**
Foundation of AI - History-State of the Art - Applications of AI - Intelligent Agents –Agent and Environment		
Module:2	**Solving Problems by Searching**	**9 hours**
Problem Solving agents- Uninformed search- BFS, DFS, IDS, Uniform cost search - Informed search - Best First search, A* search, Local search - Hill climbing, Adversarial Search – Minimax, Alpha beta pruning		
Module:3	**Knowledge Representation**	**5 hours**
Rule based system - Semantic Net - Reasoning in Semantic Net - Frames and slots - Ontological representation		
Module:4	**Reasoning**	**8 hours**
Propositional Logic - Reasoning Patterns in propositional logic - First order logic - Inferences in First order logic - Forward and backward chaining – Unification – Resolution		
Module:5	**Uncertainty-Probabilistic Reasoning**	**6 hours**
Prior and Posterior Probabilities - Bayes' Theorem – Bayesian Network - Probabilistic reasoning over time - Inference in temporal model		
Module:6	**Planning**	**5 hours**
Representation for planning- Planning with State Space Search - Partial order Planning – Planning and Acting in the Real World - Conditional Planning – Re-planning Agents, Robotics-Action		
Module:7	**Learning**	**5 hours**
Learning - Forms of learning – Choosing the best hypothesis, Classification and regression		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1.	Stuart J. Russell and Peter Norvig, "Artificial *Intelligence*: A Modern Approach", 2020, 4th Edition, Pearson.

Reference Books				
1.	Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2018, 2nd Edition, Tata McGraw Hill.			
2	Patrick Henry Winston, “Artificial Intelligence”, 2011, 3rd Edition, Addison Wesley.			
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test				
Recommended by Board of Studies		20-05-2022		
Approved by Academic Council		No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE308P	Artificial Intelligence Lab	0	0	2	1
Pre-requisite	BITE201L, BITE201P	Syllabus version			
		1.0			

Course Objectives:

1. To develop an understanding of the basic principles, models and algorithms of Artificial Intelligence.
2. To facilitate with the techniques for problem solving, knowledge representation and reasoning systems capability.

Course Outcomes:

1. Solve various real-world problems using Artificial Intelligence techniques.
2. Apply different knowledge representations and reasoning techniques.
3. Employ planning and learning methods in solving complex problems.

Indicative Experiments		Hours
1.	Solving Missionaries and Cannibal's problem	3 Hours
2.	Water Jug Problem	3 Hours
3.	8-Queens Problem	3 Hours
4.	Travelling Salesman Problem	3 Hours
5.	Alpha Beta Pruning	3 Hours
6.	Solving Wampus Problem using Logic	3 Hours
7.	Bayesian Classification Problem	3 Hours
8.	Decision Tree Problem	3 Hours
9.	Monkeys and Bananas Problem using Planning	3 Hours
10	Regression Problem	3 Hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE401L	Network and Information Security	3	0	0	3
Pre-requisite	BITE305L, BITE305P	Syllabus version			
		1.0			

Course Objectives:

1. To introduce principles of network and information security
2. To develop workable knowledge on various cryptographic algorithms
3. To analyse Web and Internet security protocols.

Course Outcomes:

1. Understand the security principles and mechanisms.
2. Analyze and evaluate cryptographic primitives
3. Evaluate security issues in web applications
4. Design and develop security solutions.
5. Understand Web security concepts and information security mechanisms.

Module:1	Network Security Concepts	7 hours

Challenges of Network Security - OSI Security Architecture - Security Attacks - Security Services - Model for Network Security – Security Standards – Cryptography - Classical Encryption Techniques - Substitution Techniques - Transposition Techniques – Block Ciphers - Traditional Block Cipher Structure – DES – AES – Triple DES - Stream Ciphers.

Module:2	Public Key Cryptography	6 hours

Need and Principles of Public Key Cryptosystems - RSA Algorithm - El Gamal Cryptographic System - Elliptic Curve Cryptography - Public Key Distribution and Management - Diffie-Hellman Key Exchange.

Module:3	Cryptographic Hash Functions	6 hours

Applications of Cryptographic Hash Functions - Security Requirements for Cryptographic Hash Functions - Hash Functions Based on Cipher Block Chaining - Secure Hash Algorithm (SHA) – SHA3.

Module:4	MAC & Digital Signatures	6 hours

Message Authentication Requirements - Security of MACs - MACs Based on Hash Functions: HMAC - MACs Based on Block Ciphers: DAA and CMAC - Authenticated Encryption: Key Wrapping - Pseudorandom Number Generation using Hash Functions and MACs - Digital Signatures

Module:5	User Authentication	6 hours

Remote user authentication - symmetric and asymmetric encryptions for user authentications - Kerberos, identity management & verification.

Module:6	Wireless Network Security	6 hours

Wireless Network Threats - Wireless Security Measures - IEEE 802.11i Wireless LAN Security - Wireless Intrusion Detection and Prevention - Wireless Network Positioning and Secure Gateways.

Module:7	Web Security	6 hours

Web Security Considerations - Web Security Threats - Web Traffic Security Approaches - Transport Layer Security – HTTPS - Secure Shell (SSH) - Email Threats - Electronic Mail Security - IP Security - Internet Key Exchange

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**
Text Books		
1.	William Stallings, "Cryptography and Network Security- Principles and Practice", 2020, 8th Edition, Pearson Publishers.	
2.	Michael E Whitman and Herbert J Mattord, "Principles of Information Security", 2017, 6th Edition, Course Technology Inc.	
Reference Books		
1.	Jason Andress, "Foundations of Information Security: A Straightforward Introduction",2019, 1st Edition, No Starch Press.	
2.	Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in Computing", 2015, 5th Edition, Pearson Publishers.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	20-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BITE402L	Distributed Computing	3	0	0	3
Pre-Requisite	BITE303L, BITE303P	Syllabus Version			
		1.0			

Course Objectives:

1. To provide a conceptual overview of the characteristics of distributed systems and the challenges associated in their design.
2. To highlight the very demanding requirements of distributed applications.
3. To illustrate, how all the architectural concepts, algorithms and technologies can be used in the design of an application.

Course Outcomes:

1. Identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
2. Analyze the core architectural concepts to meet the challenges in implementing distributed systems.
3. Examine important approaches in distributed systems to support synchronization and fault tolerance.
4. Derive solution that ensures reliability, security, scalability and robustness in Internet.
5. Build distributed application that demonstrates file system concepts, services, concurrency control and transactions.

Module:1	Trends in Distributed Systems and System Model	5 Hours

Trends in Distributed Systems - Resource Sharing – Challenges - Introduction to Physical Models - Architectural Models - Fundamental models - Types of Networks - Network Principles - Internet Protocols.

Module:2	Inter-Process communication and Remote Invocation	7 Hours

Introduction to Inter-Process Communication - API for Internet Protocols - External Data Representation and Marshalling - Multicast communication - Request-Reply protocols - Remote Procedure Call - Remote Method Invocation

Module:3	Distributed Objects and Web Services	6 Hours

Distributed Objects - From Objects to Components - Web Services - Service Descriptions and IDL for Web Services - Coordination of Web Services - Applications of Web Services

Module:4	Synchronization (Time and Global state), Coordination and Agreement	7 Hours

Clocks - Events and Process States - Synchronizing Physical Clocks - Logical Time and Logical Clocks - Global States - Distributed Mutual Exclusion - Elections, Coordination and Agreement in Group Communication

Module:5	Operating System Support	7 Hours

The Operating System Layer - Protection, Processes and Threads - Communication and Invocation - Operating System Architecture - Virtualization at the Operating System Level.

Module:6	Distributed File Systems and Name Services	5 hours

File Service Architecture - Name Services and Domain Name System - Directory Services Case study: Sun Network File System, The Andrew File System.

Module:7	Transactions, Concurrency Control and Distributed Transactions	6 hours

Transactions - Nested Transactions – Locks - Optimistic Concurrency Control - Flat and Nested Distributed Transactions - Atomic Commit Protocols - Concurrency Control in Distributed Transactions - Distributed Deadlocks.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book		
1.	Coulouris, J. Dollimore, and T. Kindberg, "Distributed Systems: Concepts and Designs", 5th Edition, 2017, Addison Wesley.	
Reference Books		
1.	Andrew.S.Tanenbaum, Maarten Van Steen, "Distributed Systems –Principles and Paradigms", 3rd Edition, 2016, Prentice Hall.	
2.	Mukesh Singhal and N. G. Shivaratri, "Advanced Concepts in Operating Systems, Distributed, Database, and Multiprocessor Operating Systems", 2017, 1st Edition, McGraw Hill.	
3.	Vijay K. Garg, "Elements of Distributed Computing", 2014, 1st Edition, Wiley & Sons.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	20-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BITE403L	Embedded Systems and IoT	3	0	0	3
Pre-requisite	BITE301L	Syllabus version			
		1.0			

Course Objectives:

1. Understand the design level of modern embedded systems with a hardware platform.
2. Explore the IoT devices for physical world and cyber space integration.
3. Comprehend the programming skills and IT tools necessary for embedded product development

Course Outcomes:

1. Interpret embedded systems components for a real time product applying all the relevant Standards with realistic constraints across all domains.
2. Build a hardware platform encompassing microcontrollers, sensors and peripherals.
3. Make use of modern real-time operating systems in embedded systems for engineering practices.
4. Analyze complex real-world problems through challenges posed by IoT leading to new low-cost architectural models.

Module:1	Processor Trends in Embedded Systems	6 hours

Embedded Systems Vs. General Computing Systems – Architecture of Embedded Systems- Classification of Embedded Systems - Characteristics and Quality attributes of Embedded Systems. Embedded Firmware - System on Chip (SoC) -CISC and RISC Architectures- FPGA Architecture.

Module:2	RTOS Based Embedded System Design and Development	6 hours

Types of Real-time Operating Systems - Context switching mechanisms - CPU Scheduling policies; Rate-monotonic and Earliest Deadline First scheduling - Priority inversion - Embedded Firmware Development Languages – Assemblers - Compilers – Simulators – Emulators.

Module:3	Embedded Design Programming	8 hours

8051 Microcontroller and Assembly language programming - Embedded C Programming - Arithmetic, Logic Instructions and Programs - I/O port programming – Timers - Interrupts and Serial Port Programming.

Module:4	Introduction to Internet of Things	5 hours

Basic Building blocks of an IoT Device - Physical and Logical Design of IoT – Communication Protocols - IoT Deployment Levels - IoT Physical Servers and Cloud offerings - IoT and M2M.

Module:5	IoT Hardware Platforms	5 hours

Overview of PIC - AVR and ARM family of processors - Raspberry pi – Arduino – NodeMCU - Intel Galileo boards – Beagle Bone Black.

Module:6	Python in IoT Development	7 hours

Python Packages for IoT - Programming Raspberry Pi with Python - Python Web application Framework - Rapid Prototyping IoT Applications.

Module:7	Sensors and Actuators	6 hours

Data Acquisition Sensors: Temperature, Pressure, Humidity, Water Quality, Soil Moisture, Gas and Smoke, Proximity - Infrared Sensors (IR), Ultrasonic, GPS, Accelerometers – Actuators-Servo motors – Relay switches.

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

Text Books	
1.	Shibu K V, "Introduction to Embedded Systems", 2017, 2nd Edition, Mc Graw Hill, New Delhi, India.
2.	Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", 2016, 1st Edition-Reprint, Universities Press, Hyderabad, India.

Reference Books	
1.	Rajkumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", 2016, 1st Edition, Morgan Kaufmann, Elsevier, USA.
2.	Gary Smart, "Practical Python Programming for IoT: Build Advanced IoT Projects using a Raspberry Pi 4, MQTT, RESTful APIs", 2020, 1st Edition, Packt Publishing Ltd., UK.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BITE403P	Embedded Systems and IoT Lab	0	0	2	1
Pre-requisite	BITE301L			Syllabus version	
				1.0	

Course Objectives:

1. Impart the embedded programming for real world problems.
2. Explore IoT devices for physical world and cyber space integration.

Course Outcomes:

1. Build a hardware platform encompassing a microcontrollers, sensors and peripherals.
2. Apply programming skills and IT tools necessary for embedded product development.
3. Analyze complex problems through challenges posed by IoT design leading to new low-cost architectural models.

	Indicative Experiments	Hours
1.	8051 Microcontroller I/O operations: Embedded C programs	2 hours
2.	8051 Embedded C programs for Servo motor interfacing	2 hours
3.	Familiarization with Arduino Uno /Raspberry Pi to get the values from sensors and turn on/ off the actuators	2 hours
4.	Program to retrieve the sensor data using Arduino/Raspberry Pi and monitor the values through a web application	2 hours
5.	Program to control the actuators using Arduino/Raspberry Pi through a web application.	2 hours
6.	Program to control appliances using BLE	4 hours
7.	Program to implement different topologies using Zigbee protocol	4 hours
8.	Program using NFC/RFID for tracking systems	4 hours
9.	Program to implement Face Recognition using Raspberry Pi	4 hours
10.	Program to implement Voice Recognition using Raspberry Pi.	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	20-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BECE302L	Control Systems	2	1	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To study the use of transfer function model for the analysis of physical systems and to introduce the components of control system.
2. To provide adequate knowledge in the time response of systems and steady state error analysis along with the understanding of closed-loop and open-loop system analysis in frequency domain.
3. To introduce the design of controllers and compensators for the stability analysis.
4. To introduce state variable representation of physical systems and study the stability analysis in state space approach.

Course Outcomes

Students will be able to

1. Differentiate between open-loop and closed-loop control systems and obtain the transfer function from the mathematical modeling of physical systems.
2. Determine transient and steady state responses of the system with first and second order and also to analyze its error coefficients.
3. Characterize the system stability using R-H criteria and root locus techniques.
4. Analyze the frequency domain response of the control systems.
5. Design the controllers and compensators to estimate the system stability.
6. Analyze the system in state space model through the concept of controllability and observability.

Module:1	Control Systems	3 hours

Basic components of a control system, Applications, Open-loop control system and closed-loop control system, Examples of control system (air conditioner, cruise control, phase-locked loop, etc.), Effects of feedback on overall gain, Types of feedback control system, Linear and non-linear control systems.

Module:2	Mathematical Modeling of Physical Systems	8 hours

Difference and differential equations for LTI SISO and MIMO systems, Mathematical modeling of electrical and mechanical systems, Equivalence between the elements of different types of systems, Transfer function of linear systems, Open-loop transfer function and closed-loop transfer function, Block diagram representation, Block diagram reduction techniques, Signal flow graph using Mason's gain formula.

Module:3	Time Domain Response	6 hours

Transient response and steady state responses, Time domain specifications, Types of test inputs, Response of first order and second order systems, Steady state error, Static error coefficients, Generalized error coefficients.

Module:4	Characterization of Systems	5 hours

Stability – concept and definition, Poles, Zeros, Order and Type of systems; R-H criteria, Root locus analysis.

Module:5	Frequency Domain Response	7 hours

Frequency response – Performance specifications in the frequency domain, Phase margin and gain margin, Bode plot, Polar plot and Nyquist plot, Stability analysis in frequency domain.

Module:6	**Controllers and Compensators Design**	**7 hours**
Controllers – P, PI, PID, Realization of basic compensators, Cascade compensation in time domain and frequency domain, Feedback compensation, Design of lag, lead, lag-lead series compensators.		
Module:7	**State Space Analysis**	**7 hours**
Dynamic system modeling in state space representation: Diagonal canonical form, Jordan canonical form, Solutions of state equations of LTI system, Conversion from state space model to transfer function model and vice versa, Stability analysis in state spaces: Concept of eigenvalues and eigenvectors, State transition matrix using Cayley-Hamilton theorem, Controllability and observability.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Norman S. Nise, Control Systems Engineering, 2019, 8th Edition, John Wiley & Sons, New Jersey, USA
Reference Books	
1.	Farid Golnaraghi and Benjamin C. Kuo, Automatic Control Systems, 2017, 10th Edition, McGraw-Hill Education, India.
2.	I.J. Nagarth and M. Gopal, Control Systems Engineering, 2018, 6th Edition, New Age International Pvt. Ltd., New Delhi, India.
3.	Gene Franklin, J. Powell and Abbas Emami-Naeini, Feedback Control of Dynamic Systems, 2019, 8th Edition, Pearson Education, New Delhi, India.

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-02-2023		
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BITE311L	Human Computer Interaction	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To learn the basic physiological, perceptual, and cognitive components of human learning and memory
2. To analyse interaction problems from a technical, cognitive and functional perspective
3. To gain practical experience in the fundamental aspects of designing, implementing and user interfaces

Course Outcomes:

1. Apply the principles and guidelines of human-computer interaction that must be considered when designing interactive systems
2. Analyse the design process, theories, models and interaction types for the problem statement
3. Formulate suitable methodology for the problem statement using appropriate methods, procedures and tools for the various phases of product development life cycle process
4. Predict, assess, evaluate and recommend the appropriate design to the target users
5. Learn the current state of research and development in human-computer interaction and make an effective study on any computer-based application and present for the assessments as an individual or team

Module:1	Human Computer Interaction	6 hours

Introduction - Good and Poor Design - Interaction Design - The User Experience - Understanding Users - Accessibility and Inclusiveness - Usability goals - User Experience Goals - Design principles.

Module:2	Interaction Design Process and Conceptualizing Interaction	6 hours

Introduction - Design process - Conceptualizing Interaction - Conceptual Models - Interface Metaphors - Interaction Types – Paradigms – Visions – Theories - Models and Frameworks.

Module:3	Cognitive Aspects	6 hours

Cognition - Kinds of Cognitive Processes – Attention – Perception – Memory – Learning – Reading - Speaking and Listening and Problem-Solving – Planning - Reasoning and Decision-Making - Cognitive Frameworks - Mental Models - Gulfs of Execution and Evaluation - Information Processing - Distributed Cognition - External Cognition - Embodied Interaction.

Module:4	Social and Emotional Interaction	6 hours

Introduction - Face-to-Face Conversations - Remote Conversations - Co-presence - Social Engagement - Emotions and the User Experience - Expressive and Annoying Interfaces - Affective Computing and Emotional AI - Persuasive Technologies and Behavior Change – Anthropomorphism.		
Module:5	**Discovering Requirements**	**6 hours**
Interfaces Types - Data Gathering: key Issues, Types: Analysis, Interpretation, Presentation: Types and Tools - Ethical Design Concerns - Data Gathering for Requirements – Personas - Capturing Interaction with Use Cases.		
Module:6	**Interaction Design Process**	**7 hours**
Introduction, Prototyping: What and Why Prototyping – Low-fidelity Types – High-fidelity Types - Compromising in Prototyping - Conceptual Design - Concrete Design - Generating Prototypes – Construction.		
Module:7	**Evaluation**	**6 hours**
Introduction: why, what, where, and when evaluation - Types of Evaluation – Usability Testing: Methods, Tasks and Users - Labs and Equipment - Conducting Experiments - Heuristic Evaluation - Walk throughs - Analytics in evaluation: A/B Testing - Fitt's law.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Helen Sharp, Yvonne Rogers, Jennifer Preece, Interaction Design: beyond human-computer interaction, 2019, Fifth Edition, Wiley.
Reference Books	
1.	Gerard Jounghyun Kim, Human Computer Interaction – Fundamentals and Practice, – CRC press, 2015.
2.	Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson, 2009.
3.	Alan Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Human - Computer Interaction, 3rd Edition, Pearson, 2003.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE312E	Data Mining	2	0	2	3
Pre-requisite	BITE302L, BITE302P	Syllabus version			
		1.0			

Course Objectives:

1. To understand the fundamental data mining methodologies and the ability to formulate and solve problems.
2. To comprehend the overall architecture of a data warehouse, methods for data gathering and data pre-processing
3. To learn practical, efficient and statistically sound techniques, capable of solving real world issues

Course Outcomes:

1. Analyze various real-time problems and design the data visualizations
2. Apply the data mining concepts to conduct data pre-processing and to improve the quality of data for training the models
3. Use and apply important methods for finding frequent item sets and association rule Mining
4. Investigate the concept of data classification methods and advanced classification techniques
5. Understand the unsupervised learning techniques and the algorithm used for data clustering

Module:1	Introduction to Data Mining	4 hours

Data Mining – Stages of the Data Mining Process – Data Mining Knowledge Representation - Technologies – Major Issues in Data Mining- Data Warehousing- Multidimensional Data – OLAP Vs OLTP

Module:2	Data Visualization and Representation	3 hours

Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Data Visualization – Measuring Data Similarity and Dissimilarity

Module:3	Data Pre-processing	3 hours

Data Cleaning - Data Integration - Data Reduction -Data Transformation – Data Discretization

Module:4	Mining Frequent Patterns, Associations and Correlations	4 hours

Market Basket Analysis – Frequent Item Set Mining methods - Apriori Algorithm – Generating Association Rules - A Pattern Growth Approach – Association Analysis to Correlation Analysis

Module:5	Classification and Prediction Methods	5 hours

Basic Concepts – Bayesian Classification Methods - Decision Tree Induction – Rule Based Classification – Linear Regression - Nonlinear Regression - Metrics for Evaluating Classifier Performance - Model Evaluation and Selection - Techniques to improve Classification Accuracy: Bagging and Boosting

Module:6	Advanced Classification Methods	5 hours

Classification by Back propagation - Support Vector Machine - Lazy Learners - Genetic Algorithm – Rough Set Approach - Fuzzy Set Approaches.

Module:7	Clustering Methods	4 hours

Basic Issues - Partitioning Methods - K-means, K-medoids - Hierarchical Methods: Distance-based Agglomerative and Divisible Clustering - Density Based Methods - Evaluation of Clustering

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

Text Book	
1.	Jiawei Han, Jian Pei, Hanghang Tong, Data Mining: Concepts and Techniques, 2022, 4th Edition, Morgan Kaufmann Publishers, San Francisco
Reference Books	
1.	Charu C. Aggarwal, Data Mining: The Textbook, 2015, Springer.
2.	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, 2021, Second Edition, Pearson.

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

Indicative Experiments		**Hours**
1.	**Explore WEKA Data mining Toolkit** Installation of WEKA data mining toolkit, Analyze the features of WEKA toolkit Explorer, Knowledge flow interface, Experimenter, command-line interface. Load and analyze a sample data set.	3
2.	**Data Preprocessing** Use the given dataset for Data Preprocessing using Weka.	3
3.	**Apriori based Association Rule Mining** Use the given data set to generate association rules using Apriori algorithm for mining association rules in between products using Weka.	3
4.	**Decision Tree based Classification** Build a Decision tree based classification using J48 Algorithm and use it to predict the class of given cases using the given dataset and to analyze the outcome using Weka.	3
5.	**Naive Bayes Classification** Use the given data set to build a Naïve Bayes classification model and use it to predict the class of given cases using Weka.	3
6.	**Support Vector Machine based Classification** Build MLP based classification model and use it to predict the class of given cases using the given dataset and to analyze the outcome using Weka.	3
7.	**Ensemble based Classification using Random Forest** Apply Random forest based classification by on subsets of data and observe the changes in ensemble method for Confidence-weighted voting and Highest confidence wins.	3
8.	**K-means based Clustering**	3

	Find the optimal value of number of clusters (K) for K-means algorithm for a given data set using Weka.	
9.	**DBSCAN Clustering** Use the given data set to analyze DBSCAN Clustering model using Weka.	3
10.	**Real world Data Mining process** Apply and evaluate using suitable data mining techniques to identify relevant patterns and useful information for a real world data set.	3
	Total Laboratory Hours	**30 hours**
Mode of assessment: Continuous Assessments, Final Assessment Test, Oral Examination		
Recommended by Board of Studies	12-10-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BITE313L	Computer Graphics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To comprehend the fundamental concepts of computer graphics and multimedia
2. To gain and apply the acquired knowledge related to 2D and 3D concepts in graphics programming
3. To realize the importance of multimedia applications towards developing real-world problems

Course Outcomes:

1. Apply the knowledge of the fundamental concepts of computer graphics techniques and their applications
2. Illustrate and compute the output primitives using scan convert algorithms
3. Design and solve to transform various 2D and 3D objects using transformation methods
4. Demonstrate how the 2D and 3D objects are viewed and projected in computer graphics applications
5. Analyse the knowledge of display systems and interactive control of 3D computer graphics applications

Module:1	Introduction to Computer Graphics	6 hours

Basic Concepts – Applications - Overview of Graphical Systems: Input/output Devices - Raster Graphics System - Vector Graphics System – Input Devices.

Module:2	Output primitives	7 hours

Line Drawing Algorithms: DDA - Bresenham's and Midpoint Algorithms - Circle Drawing Algorithms: Bresenham's and Midpoint Circle Generation Algorithms - Filling Algorithms: Flood and Boundary Filling Algorithms - Attributes of Output Primitives.

Module:3	2D and 3D Geometric Transformations	6 hours

Basic Transformations: Translation, Rotation, Scaling, Reflection and Shearing - Matrix Representations and Homogeneous Coordinate, Composite Transformations.

Module:4	2D Viewing	6 hours

2D Viewing Pipeline - Window to Viewport Transformation - Line Clipping Algorithm - Polygon Clipping Algorithm.

Module:5	3D Viewing	6 hours

Three-dimensional Viewing Transformations: 3D Viewing Pipeline – Projection - Types of Projection - Transformation Matrix for Parallel and Perspective Projection.

Module:6	Modelling and Rendering Techniques	6 hours

Basic Curves - Bezier Curves - B-Splines - Solid modeling: Representing Solids - Boolean Set Operations - Primitive Instancing - Visible Surface Determination: Back Face Detection - Z-Buffer Method - Shading Model: Gouraud and Phong Shading.

Module:7	Computer Animation and Colouring models	6 hours

Computer Animation: Design of Animation Sequences - General Computer - Animation Functions - Raster Animations – Computer Animation Languages – Key Frame Systems Morphing - Motion Specifications - Colouring Models: Properties of light - Classification, Color Model Conversions.		
Module 8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1	Computer Graphics, Dr. Rajiv Chopra, Fourth Edition, S Chand and Company Pvt. Ltd., New Delhi, 2019.
Reference Books	
1	Hearn, Donald D. and Baker, M. Pauline, Computer Graphics using OpenGL, Fourth Edition, Prentice-Hall Professional Technical Reference, 2013.
2	Hughes, J.F. and Van Dam, A. and Foley, J.D. and McGuire, M. and Sklar, D.F. and Feiner, S.K. and Akeley, K Computer Graphics: Principles and Practice, Third Edition-, Addison-Wesley, 2015
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test	

Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE314L	Multimedia Systems	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To comprehend the fundamental concepts of multimedia
2. To learn the basics of multimedia technologies and protocols.
3. To realize the importance of multimedia applications towards developing real-world problems.

Course Outcomes:

1. Demonstrate knowledge of the fundamental elements and concepts related to multimedia systems.
2. Understand the basic ideas of compression algorithms related to multimedia components.
3. Demonstrate the principles, standards and their applications with an emphasis on underlying technologies and performance.
4. Acquire the knowledge in the implementation of inter-process communication in multimedia operating systems.
5. Deploy the right multimedia communication models.

Module:1	Introduction to Multimedia	4 hours

Branch overlapping aspects of Multimedia – Content - Global Structure – Medium - Main Properties of Multimedia System - Traditional Data Stream Characteristics - Information Units – Multimedia Architecture.

Module:2	Sound and Audio	6 hours

Basic Sound Concepts - Computer Representation of Sound - Audio Formats – MIDI - Speech Analysis - Speech Generation - Speech Transmission.

Module:3	Image and Graphics	6 hours

Digital Image Representation - Image Format - Graphics Format - Image Processing Operations: Image Enhancement, Image Segmentation, Image Synthesis, Image Analysis, Image Transmission.

Module:4	Video and Animation	6 hours

Video Signal Representation - Computer Video Format – Television - Computer Based Animation - Animation Languages - Methods of Controlling Animation - Display Animation - Transmission of Animation.

Module:5	Multimedia Compression	7 hours

Coding requirements – Source - Entropy and Hybrid Coding - JPEG Compression - MPEG 1, 2, 4 Compression - H.264 Compression Video Coding

Module:6	Multimedia Operating Systems	7 hours

Introduction - Real time and Multimedia - Resource Management - Process Management - Earliest Deadline First Scheduling - Rate Monotonic Algorithm - Traditional File Systems - Multimedia File Systems

Module:7	**Multimedia Communication Systems**	**7 hours**
Application Subsystem - Collaborative Computing - Session Management - Transport Subsystem – Requirements - Transport Layer-Network Layer - QoS and Resource Management – Multimedia Communication Protocols: RTP, RTCP, RTSP, SIP – Multimedia Database systems: Characteristics of MDBMS - Data Analysis - Data Structure - Operations on Data - Relational and Object-Oriented Database Models		
Module 8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1	Multimedia and Applications, Hemant Kapila, Evergreen Publications India Ltd., 2016.

Reference Books	
1	Fundamentals of Multimedia, Dr. Ze-Nian Li and Dr. Mark S. Drew, Dr. Jiangchuan Liu, 2nd Edition, Springer, 2015.
2	Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
3	Mario Marques da Silva, "Multimedia Communications and Networking", CRC Press, 2012.
4	Multimedia: Computing Communications &Application, Ralf Steinmetz and Klara Nahrstedt, Pearson Education, 2009.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE391J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE392J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE393J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE394J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE396J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE397J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE398J	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:

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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE404E	Object Oriented Analysis and Design	2	0	2	3
Pre-requisite	BCSE102L, BCSE102P	Syllabus version			
		1.0			

Course Objectives:

1. To learn the basic principles of object orientation and notation.
2. To familiarize Unified Modeling Language.
3. To understand the Analysis and Design workflow.

Course Outcomes:

1. Analyze the fundamentals of Object oriented design elements.
2. Comprehend the limitations of object oriented analysis and design.
3. Implement different techniques available for object modelling techniques based on the limits and features
4. Analyze the objects and elements required for efficient design.
5. Design unified modelling diagrams for various case studies

Module:1	**Introduction**	**4 hours**

The Structure of Complex Systems, The Inherent Complexity of Software–Five attributes of complex system-Organized and Disorganized Complexity-The Role of Decomposition-On designing Complex systems

Module:2	**Object Oriented Paradigm**	**4 hours**

The Evolution of the Object Model-Foundations of the Object Model-Elements of the Object model-Applying the Object Model-Classes and objects-The Nature of an Object-Relationships among objects-The Nature of a Class-Relationships among classes-The interplay of classes and objects-Building Quality classes and objects.

Module:3	**Analysis and Design Process**	**4 hours**

Design Principles-The Macro Process: The Software Development Life cycle-The Micro Process: The Analysis and Design Process, Benefits and Risks of Object Oriented Development.

Module:4	**Object Oriented Design using UML Diagram - Phase I**	**5 hours**

The Unified Modelling Language-Package Diagrams-Component Diagrams-Deployment diagrams-Use case Diagrams-Activity Diagrams-Class Diagrams.

Module:5	**Design using UML Diagrams – Phase II**	**4 hours**

Sequence Diagrams-Interaction Overview Diagram-Composite Structure Diagram-State Transition Diagram-Timing Diagram-Object diagram-Communication Diagrams.

Module:6	**Object Oriented Design Process**	**3 hours**

Classification-The importance of proper classification-Identifying Classes and objects-Key Abstraction and Mechanisms.

Module:7	**Object Oriented Methodologies**	**4 hours**

Rumbaugh et al.'s object modeling technique-The Booch Methodology-The Jacobson et al. Methodologies, Discussion on few Examples of OOAD.

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

Text Book	
1.	Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, Kelli A. Houston, Object Oriented Analysis and Design with Application, 3rd edition, Addison Wesley, 2018.
Reference Books	
1.	Ali Bahrami, Object Oriented System Development, Tata McGraw-Hill, 2018.
2.	Grady Booch, Ivar Jacobson, James Rumbaugh, The Unified Modelling Language User Guide, Second Edition, Pearson, 2017.
3.	Stephen R Schach, Object Oriented and Classical Software Engineering, Tata McGraw -Hill, 2017.

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

Indicative Experiments		Hours
1.	Introduction to Object Oriented Analysis and Object-Oriented Design	4
2.	Identify any software system and document the IEEE Software Requirements Specification (SRS) for it.	4
3.	Draw a Use Case diagram for capturing and representing requirements of the system.	2
4	Design the overall use case diagram and a detailed use case diagram for any one key use case (other than user authentication) of the system by highlighting all possible relationships like Extends, Uses, generalization and extension points for : a. E-book management b. On-line exam registration c. Conference management system d. Student information system	2
5	Draw the basic class diagrams to identify and describe key concepts like classes, types in the chosen system and their relationships	2
6	Design an activity diagram for the object with swim lane and show parallel processing	2
7	Draw the activity diagram to show the business flows based on SRS	2
8	Design sequence diagram representing your system with objects and the messages using advanced notation	2
9	Design component diagram for the system you're building with reuse of existing and new components	2
10	Draw deployment diagram to model the runtime architecture of the chosen system	2

11	Identify the User Interface, Domain objects and technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation	2
12	Improve the reusability and maintainability of the software system by applying appropriate design patterns	2
13	Construct Timing diagram	2
	Total Laboratory Hours	**30 hours**
Mode of assessment: Continuous Assessments / FAT / Oral examination		
Recommended by Board of Studies	12-10-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BITE405L	Soft Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To provide a basic understanding soft computing and its associated computational techniques
2. To facilitate real-world problem solving using soft computing approach
3. To introduce evolutionary computing and its applications

Course Outcomes:

1. Analyze various real-time problems and decide an appropriate soft computing technique
2. Apply Artificial Neural Networks for the classification/prediction in many real-world applications
3. Formulate problem-solving ideas with various soft computing tools (such as fuzzy sets and rough sets)
4. Summarize analyse the evolutionary computing tools for real-world problem solving
5. Involve in independent study and show your team-spirit in solving a real-world application of your choice and present your proposal as a solution to the application considered.

Module:1	Artificial Neural networks	8 hours

Introduction to Soft computing Artificial Neural networks: Introduction, Evolution & Classification, Terminologies - Basic Models - McCulloh Pitts neuron, Hebb network - Supervised Neural networks: Perceptron, Back-propagation network

Module:2	Memory Models	6 hours

Associative Memory networks: Introduction, Auto Associative Memory Model - Hetero Associative Memory Models, Bidirectional Associative Memory Model

Module:3	Unsupervised neural networks	6 hours

Kohenen Self-organizing Maps - LVQ Network - ART Network

Module:4	Fuzzy Sets & Relations	6 hours

Introduction to fuzzy systems - Classical Sets and Fuzzy Sets - Classical Relations & Fuzzy Relations, Membership Function Development – Fuzzification & Defuzzification

Module:5	Fuzzy Rule-based Systems	6 hours

Introduction to fuzzy logic - Linguistic Variables and Hedges - Rule-Based System – Fuzzy Propositions – Fuzzy Rules – FIS - Fuzzy Decision Making

Module:6	Rough Sets	5 hours

Fundamentals - Rough Approximations and Properties - Measures of Accuracy - Topological Characterization of Imprecision - Rough Membership Functions - Attribute

Reduction - Knowledge Representation Systems - Decision Tables - Rule Induction - Indiscernibility		
Module:7	**Evolutionary Computing**	**6 hours**
Genetic algorithm: Introduction - General GA – Operators - Problem Solving - Maximization Particle swarm optimization: Introduction – Implementation - Applications of Evolutionary Computing		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books	
1.	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 2019, 3rd edition, Wiley India.
2.	Timothy J. Ross, Fuzzy logic with Engineering Applications, 2016, 4th Edition, Wiley India.
Reference Book	
1.	B. K. Tripathy & J. Anuradha, Soft Computing: Advances and Applications, 2015, Cengage Learning India Pvt. Ltd., India.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies		12-10-2022	
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE406L	Parallel Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the parallelization of basic mathematical and engineering algorithms.
2. To learn the contemporary parallel architectures and their programming.

Course Outcomes:

1. Investigate the applicability of the basic parallel algorithms in solving complex problems
2. Design efficient algorithms for a given parallel architecture and processor network
3. Analyse the different algorithm designs for performing the key compute-intensive operations
4. Use OpenMP, MPI libraries to implement the parallel algorithms
5. Engage in individual study to write abstract of research paper related to parallel algorithms.

Module:1	PRAM Algorithms	6 hours

Basics of Parallel Processing - Introduction to Flynn's Taxonomy - PRAM Model of Parallel Computation – EREW, CREW, CRCW - Mapping Theorem - Parallel Reduction - Prefix Sums - List Ranking - Preorder Tree Traversal - Merging Two Sorted Lists - Graph Coloring - Reducing Processors - Brent's Theorem.

Module:2	Processor Networks and Processor-Task Mapping	7 hours

Mesh Networks - Binary Tree - Hyper Tree – Pyramid – Butterfly – Hypercube - Cube Connected Cycles and Shuffle Exchange Networks - De Brujin networks - Mapping Data to Processors: Embedding, Dilation, Ring to 2D mesh, 2D mesh to 2D mesh, Binary tree to 2D mesh, Binomial tree to 2D mesh - Embedding Graphs to Hypercubes: Binary Tree to Hypercubes, Binomial Tree to Hypercubes, Rings and Mesh to Hypercubes.

Module:3	Summation Algorithms	6 hours

Hypercube SIMD Model – Shuffle Exchange SIMD Summation Algorithm - 2D Mesh SIMD Summation Algorithm - UMA Summation Model – Broadcast - Binomial Tree Communication Pattern.

Module:4	Matrix Multiplication Algorithms	6 hours

Matrix Multiplication on 2D Mesh SIMD Model - Hypercube SIMD Model – Shuffle-Exchange SIMD Model - UMA Multiprocessor - Block Matrix Multiplication - Algorithms for Multicomputer - Row-column and Block-oriented Algorithms.

Module:5	Sorting	6 hours

Enumeration Sort - Lower Bounds on Parallel Sorting - Odd Even

Transposition Sort - Bitonic Merge - Sequence, Bitonic Merge on Shuffle Exchange Network - Two-dimensional Mesh Network - Hypercube Network - Parallel Quicksort - Hyperquick Sort.		
Module:6	**Graph and Search Algorithms**	**6 hours**
Minimum-spanning Tree - Single-source Shortest Path - All-pairs Shortest Path - Sequential Search Algorithms - Parallel Depth-First Search - Parallel Breadth-First Search.		
Module:7	**Parallel Computing Platforms**	**6 hours**
Programming Shared-Memory Multiprocessors with OpenMP - Programming Distributed-Memory Multiprocessors with MPI - Programming Massively Parallel Processors with CUDA.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Michael Quinn, Parallel Computing: Theory and Practice, 2017, 2nd Edition, McGraw Hill Education.
Reference Book	
1.	David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2012, 2nd Edition, Morgan Kaufmann.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE407L	Quantum Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To introduce quantum computing concepts and principles.
2. To provide comprehensive understanding and applications of quantum algorithms.

Course Outcomes:

1. Analyze various quantum computing principles and properties.
2. Apply matrix algebra techniques for quantum algorithms.
3. Design Quantum gate and circuit operations
4. Distinguish classical and quantum information theory, and analyse the techniques for quantum algorithms
5. Apply and evaluate quantum algorithms.

Module:1	Introduction	4 hours

Introduction to Quantum Computing – Motivation - Difference between Classical and Quantum Computing - Reversible Computing - Probabilistic Computing - Quantum Properties: Wave Particle Duality – Superposition – Entanglement – Coherence – Measurement.

Module:2	Mathematics of Quantum Computing	6 hours

Matrix Algebra: Basis Vectors and Orthogonality - Inner Product and Hilbert Spaces - Matrices and Tensors - Tensor Product of Vector Spaces - Dirac Notation - Density Operators - Probabilities and Measurements - Measurements in Bases.

Module:3	Quantum Computing Building Blocks	8 hours

Qubits - Bra-Ket Notation - Multi-qubits States - Bloch Sphere Representation - Superposition of Qubits - Quantum Entanglement - Operations on Qubits Quantum Gates: NOT - Hadamard, T, CNOT, Toffoli, Z. - Quantum Measuring and Transforming using Gates - Design of Quantum Circuits.

Module:4	Quantum Information	6 hours

Quantum State Machines - Comparison between Classical and Quantum Information Theory - Bell States - Quantum Teleportation - No Cloning Theorem - Quantum Key Distribution - Quantum Error Correction Codes.

Module:5	Techniques for Quantum Algorithms	6 hours

Quantum Fourier Transform - Phase Kick-back - Quantum Phase Estimation - Quantum Walks.

Module:6	Quantum Algorithms	7 hours

Deutsch-Jozsa Algorithm - Grover's Search Algorithm - Simmon's Periodicity Algorithm - Shor's Algorithm.

Module:7	Quantum Programming Models	6 hours

Quantum Programming Languages - Development Libraries for Quantum Programs - Applications and Quantum Supremacy.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book		
1.	Bernhardt. C., 2019. Quantum computing for everyone. MIT Press.	
Reference Books		
1.	Hidary. J.D., 2019. Quantum Computing: An Applied Approach Springer.	
2	Nielsen. M.A. and Chuang. I., 2010. Quantum computation and quantum information. Cambridge University Press.	
3.	Yanofsky. N.S. and Mannucci. M.A., 2008. Quantum computing for computer scientists. Cambridge University Press.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	12-10-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BITE408L	Network Management	3	0	0	3
Pre-requisite	BITE305L, BITE305P	Syllabus version			
		1.0			

Course Objectives:

1. To introduce network management models and design issues
2. To provide sound understanding of network management functions
3. To facilitate a mastery of network management protocols and standards

Course Outcomes:

1. Comprehend the network management architecture and organization
2. Analyze principles of network management models and standards
3. Investigate and manage the networked systems using SNMP protocols
4. Design a component to monitor remote networks
5. Apply network management tools for various applications

Module:1	Network Management Overview	4 hours

Goals, Organization and functions – Network Management Architecture and Organization - Current Status and Future of Network management.

Module:2	Standards, Models and Language	8 hours

Network management standards - Network management Models - Organization, Information, Communication and Functional Models.

Module:3	SNMPv1	8 hours

SNMP Model - Organization Model - System Overview - Information Model - Communication and Functional Models.

Module:4	SNMPv2	6 hours

Major changes in SNMPv2 - System architecture - Structure of Management Information – MIB – SNMPV2 protocol.

Module:5	SNMPv3	6 hours

Key features – Architecture – Applications – MIB – Security – User-based Security Model -Access Control.

Module:6	Remote Network Monitoring	5 hours

Remote Monitoring – RMON SMI and MIB – RMON1 – A Case Study on Internet Traffic.

Module:7	Network Management Tools and Applications	6 hours

System utilities for Management – Measurement of Network Statistics – Network Management Applications.

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	45 hours

Text Book

1. Mani Subramanian, Timothy A Gonsalves, N Usha Rani, "Network Management Principles and Practices", Addison Wesley New York, 2nd edition, 2012.

Reference Books				
1.	William Stallings, "SNMP, SNMPv2, SNMPv3, and RMON 1 and 2", Pearson Education, 2012			
2.	Verma, Dinesh Chandra, "Principles of Computer Systems and Network Management", Springer US, 2009			
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test				
Recommended by Board of Studies		12-10-2022		
Approved by Academic Council		No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE409L	Mobile Application Development	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To impart fundamental concepts of Mobile Application Development
2. To design user interfaces for interacting with apps and triggering actions
3. To identify options to save persistent application data

Course Outcomes:

1. Determine the design and development principles for mobile applications
2. Implement interactive user interfaces that work across a wide range of devices
3. Create, test and debug mobile application by setting up a development environment
4. Analyse the Interface operations
5. Propose methods for storing and retrieving data in mobile applications
6. Analyse performance of mobile applications and understand the role of permissions and security

Module:1	Introduction to Mobile Application	6 hours

History of mobile devices -Mobile ecosystem -Designing for context - Developing a Mobile Strategy - Mobile Information Architecture - Mobile Design -Types of mobile application.

Module:2	Integrated Development Environment	6 hours

Exploring Development Environments - Installation - Creating a New Project – Architecture - The Manifest File- Activity Class – Types of Activity – Lifecycle of Activity.

Module:3	Application Essentials	6 hours

Components: Service, Broadcast Receiver, Content Provider - Application resources and assets -Resource Management - Managing Intents and Intent Filters.

Module:4	UI Design & Operations	7 hours

UI Elements - View Class - Creating Custom Views - Using Layout - Layout types – Fragments - Dialogs – Adapters: Listview, Gridview – Menu and its types.

Module:5	Hybrid Mobile Applications	6 hours

Native vs. Hybrid Mobile Applications – Building Blocks of Hybrid Applications – Development and Packaging Frameworks- Creating Hybrid Mobile Applications.

Module:6	Services and Data Storages	6 hours

Services – Service Lifecycle – Communicating with Services - Preferences- External storage – SQLite database – Firebase.

Module:7	Securing Mobile Applications	6 hours

Security Concepts**:** Signatures and Keys, Permissions, Protecting User data – Client-side Data Encryption – Key Chain Management – Device Management API.

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

Text Book	
1.	J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt. Ltd, 2016.
Reference Books	
1.	Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt. Ltd., 2014.
2.	Brian fling, Mobile Design and Development, 2009, 1st Edition, O'Reilly Media.
3.	Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developerfundamentals-course-concepts/details (Download pdf file from the above link)
4.	Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
5.	Mahesh Panhale, "Beginning Hybrid Mobile Application Development", 1st Edition, Apress, 2016.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE410L	Machine Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To introduce the theoretical foundations, algorithms, methodologies of the Machine Learning.
2. To understand the importance and significance of Machine Learning in various applications.
3. To learn the advanced machine learning based models and ensemble models for complex problem solving

Course Outcomes:

1. Understand the various machine learning approaches and data preprocessing techniques
2. Develop the learning models for the problems using supervised and advanced supervised learning-based approaches
3. Apply the different clustering approaches to handle unsupervised based learning
4. Examine the various ensemble models
5. Infer the reinforcement Learning

Module:1	Introduction	6 hours

Types of Learning- Supervised, Unsupervised, Semi Supervised and Reinforcement Learning - A Formal Model-PAC Learning.

Module:2	Data Pre-processing	6 hours

Feature Selection- Filters and Greedy Selection Approaches- Dimensionality Reduction- Principal Component Analysis (PCA)- Random Projections- Compressed Sensing- Linear Discriminant Analysis (LDA).

Module:3	Supervised Learning	6 hours

Linear Predictors: Linear Regression, Logistic Regression, Stochastic Gradient Descent, Learning with SGD, Decision Trees-Pruning, Naïve Bayes Classifier

Module:4	Advanced Supervised Learning	7 hours

Neural Networks- Feed forward Neural Networks- SGD and Back propagation- Support Vector Machines-Linear and Non-linear-One class Kernel Machine.

Module:5	Unsupervised Learning	6 hours

Clustering- k-Means and Other Cost Minimization Clustering- Hierarchical Clustering- Spectral Clustering- K-Mode Clustering- k-Nearest Neighbor Estimator.

Module:6	Ensemble Learning	6 hours

Bias – Variance Tradeoff – Bagging and Boosting (Random forests, Adaboost, XG boost inclusive) – Metrics & Error Correction.

Module:7	Reinforcement Learning	6 hours

Basics of RL – RL Framework – Markov Decision Process – Exploration Vs Exploitation - Polices, Value Functions and Bellman Equations – Solution Methods – Q-learning.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Books		
1.	Ethem Alpaydi, Introduction to Machine Learning, Fourth Edition, The MIT Press, 2020.	
2.	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, First edition, Cambridge University Press, 2015.	
Reference Books		
1.	Tom M Mitchell, Machine Learning, Indian Edition, McGraw Hill Education, 2017.	
2.	Andriy Burkov, The Hundred-Page Machine Learning Book, First edition, Notion Press, 2019.	
3.	Miroslav Kubat, An Introduction to Machine Learning, Second Edition, Springer, 2017	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		

Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE411L	Big Data Analytics	3	0	0	3
Pre-Requisite	BITE302L, BITE302P	Syllabus version			
		1.0			

Course Objectives

1. To understand the challenges in Big Data and its analytics methods.
2. To provide an overview of Apache Hadoop and its Eco System.
3. To perform real time and batch processing using appropriate algorithms.

Course Learning Outcome

1. Identify big data systems and design for analysis.
2. Store and analyse data in Hadoop.
3. Use graph model for solving real world problems.
4. Process Data using Spark and No SQL Databases.
5. Apply MapReduce based analysis.

Module:1	**Big Data Concepts**	**5 hours**

Evolution of Big data – Types and Sources of Data – Characteristics - Analytics Cycle - Roles in Analytic Projects - Big Data Challenges and Applications in Industries - Different Types of Analytics

Module:2	**Big Data Platform- Hadoop Storage**	**5 hours**

Hadoop - History, Terminologies, DFS, HDFS - Design, Read and Write in HDFS, Commands - Cluster Architecture- Eco System and Tools

Module:3	**MapReduce Framework**	**6 hours**

MapReduce - Different Phases, Shuffle & Sort, Classic - Components - Job Tracker & Task Tracker, Yarn – Components, Workflow – Scheduling - Writing a MapReduce Application

Module:4	**Real Time Processing**	**5 hours**

Batch Vs. Real Time Processing - Spark – Architecture, Advantages, RDD Operations - Spark on YARN, Functional Programming in Spark, Lambda Architecture - Batch Serving and Stream Layers and Services

Module:5	**No SQL Database**	**7 hours**

HBase - Architecture, Create Column Store, DDL, DML commands, Hive – Architecture, Load Data, Query XML, JSON Files, Cassandra Model - Features, CQL - Map, List, Set and Indexes

Module:6	**Big Data Analytical Algorithms**	**7 hours**

Parallel Frequent Pattern mining - SON, Complementary Naïve Bayes classifier, Random Forest, Decision Tree-based Classifier, Cluster Analysis - Approaches, Parallel K-Means and BFR Algorithm

Module:7	**Graph Data Analytics**	**8 hours**

Different Types of Social Networks, Analysis of Large Graph - Link Analysis - PageRank Algorithm, Topic Sensitive PageRank, Web Spam Detection, Social Network Graphs - Distance Measures, Girvan-Newman Algorithm, Direct Discovery of Communities, Partitioning of Graphs, Finding Overlapping Communities

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

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	DT Editorial Services, “Big Data (covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visulization) Black Book” Dreamtech Press, 2017
2.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, 2020, Cambridge University Press, UK.
Reference Books	
1.	David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, No SQL, and Graph”, Morgan Kaufmann/Elsevier Publishers, 2013.
2.	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.
3.	Tom White, Hadoop, the Definitive guide, O'Reilly Media, 2015.
4.	Vignesh Prajapati, Big data analytics with R and Hadoop, PACKT Publishing Ltd. 2013.

Mode of Evaluation: CAT / written assignment / Quiz / FAT			
Recommended by Board of Studies	29-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
BITE412L	Cloud Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To expose the students to frontier areas of cloud computing and virtualization techniques
2. To provide comprehensive and in-depth knowledge of cloud technologies, architecture and applications
3. To understand the security aspects of cloud computing and build a trusted cloud computing system

Course Outcomes:

1. Apply the virtualization techniques for cloud computing services
2. Compare, contrast, and evaluate the fundamental trade-offs in planning the multi-cloud system
3. Propose solutions to complex problems using Cloud HPC systems
4. Recommend cloud security methods, the risks involved their impact and provide a secure cloud environment
5. Analyze and solve industry-related problems using modern tools

Module:1	Introduction to Cloud Computing	6 hours

Definition- Characteristics- Cloud Models- Cloud Computing Concepts & Technologies-Cloud Computing Services & Platforms - Generic Case Studies

Module:2	Virtualization	6 hours

Implementation Levels of Virtualization – Tools and Mechanisms- Virtualization of CPU, Memory and I/O Devices- Virtual Clusters and Resource Management – Virtualization for Data-Center Automation.

Module:3	Cloud Platform Architecture over Virtualized Data Centers	6 hours

Cloud Service Models- Data-center Design and Interconnection Networks-Architectural Design of Compute and Storage Clouds-Public Cloud Platforms- Inter-cloud resource management.

Module:4	Cloud Application Development	7 hours

Design Considerations for Cloud Applications-Cloud Application Design Methodologies-Reference Architectures for Cloud Applications-Python Web Application Framework – Django-Designing a RESTful Web API- Serverless computing.

Module:5	Cloud Programming and Software Environments	6 hours

Parallel and Distributed Programming Paradigms – Programming Support the Google App Engine- Programming on Amazon AWS and Microsoft Azure-Emerging cloud software environments.

Module:6	Cloud Storage	6 hours

Amazon Simple Storage Service (S3)- Buckets- Objects- Storage Classes - Cross-Region Replication - Elastic File System (EFS)- Elastic Block Store (EBS) - Storage Gateway.		
Module:7	**Cloud Security**	**6 hours**
CSA Cloud Security Architecture - Authentication – Authorization- Identity & Access Management - Data Security- Key Management- Auditing - Key Management Service (KMS)- Cloud HSM- Directory Service.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books	
1.	Arshdeep Bahga & Vijay Madisetti, "Cloud Computing Solution Architecture – A Hands-On Approach", VPT Publisher; 1st edition, 2019.
2.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
Reference Books	
1.	Rajkumar Buyya, Chirstian Vecchiola, S.Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, India , 2013.
2.	Dan C. Marinescu, "Cloud Computing Theory and Practice" Second Edition, Elsevier India, 2019.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE413L	Cyber Security	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To learn the fundamentals of the cybersecurity domain and related issues
2. To acquire practical knowledge of various tools, processes and methods to ensure security of cyber systems
3. To learn the foundational skills and knowledge of impact of security on legal, business, warfare and social domains

Course Outcomes:

1. Analyze the importance of cybersecurity and cybercrime
2. Recommend the importance of mobile and wireless device security
3. Infer the tools and methods used for cybercrime
4. Summarize the importance of computer forensics and legal perspectives of cybercrimes and cybersecurity
5. Engage awareness on cybercrime and cyber terrorism in social, political, ethical and psychological Dimensions, forensics analysis using hand-held devices

Module:1	Cybercrime and Cyber Terrorism	6 hours

Cybercrime: Definition – Classification of Cybercrimes – Global Perspective on Cybercrimes – Cyberoffenses: How Criminals Plan the Attacks – Social Engineering – Cybertalking – Botnets – Attack Vector - Intellectual Property in the Cyberspace – Copyright – Patent – Trademarks – Trade Secret – Trade Name – The Ethical Dimension of Cybercrimes – Ethical Hackers – Sociology of Cybercriminals – Information Warfare.

Module:2	Security Challenges: Mobile and Wireless Devices	6 hours

Trends in Mobility – Credit Card Frauds in Mobile and Wireless Computing Era – Security Challenges Posed by Mobile Devices – Attacks on Mobile/Cell Phones – Mobile Devices: Security Implications for Organizations – Organizational Measures for Handling Mobile Devices Related Security Issues – Organizational Security Policies and Measures in Mobile Computing Era.

Module:3	Tools and Methods used in Cybercrime	6 hours

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks – SQL Injection – Buffer Overflow.

Module:4	Cybercrimes and Cybersecurity: The Legal Perspectives	6 hours

Cybercrime and the Legal Landscape around the World – Cyberlaws: The Indian Context – The Indian IT Act – Challenges to Indian Law and Cybercrime Scenario in India – Consequences of not Addressing the Weakness in Information Technology Act – Amendments to the Indian IT Act – Cybercrime and Punishment.

Module:5	**Understanding Computer Forensics**	**6 hours**
Historical Background of Computer Forensics – Digital Forensics Science – The Need for Computer Forensics – Cyberforensics and Digital Evidence – Forensics analysis of E-Mail – Digital Forensics Life Cycle – Network Forensics – Approaching a Computer Forensics Investigation – Relevance of the OSI 7 Layer Model to Computer Forensics – Challenges in Computer Forensics – Special Tools and Techniques – Forensics Auditing – Antiforensics.		
Module:6	**Forensics of Hand-Held Devices**	**7 hours**
Toolkits for Hand-Held Device Forensics – Forensics of iPods and Digital Music Devices – An Illustration on Real Life use of Forensics – Techno Legal Challenges with Evidence from Hand-Held Devices – Organizational Guidelines on Cell Phone Forensics.		
Module:7	**Cybersecurity: Organizational Implications**	**6 hours**
Web Threats for Organizations – Security and Privacy Implications for Cloud Computing – Social Media Marketing – Social Computing and the Associated Challenges for Organizations – Protecting People's Privacy in the Organizations – Organizational Guidelines for Internet Usage, Safe Computing Guidelines and Computer usage Policy – Media and Asset Protection – Importance of Endpoint Security in Organizations.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	"Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Wiley, 2018.
Reference Books	
1.	"Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives" by Nina Godbole, Sunit Belapure, Wiley, 2011.
2.	Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, Security in Computing, Fifth Edition, Pearson Publishers, 2015.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE414L	Blockchain Technology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To impart an in-depth understanding of Blockchain technologies
2. To apply and analyze the concepts, tools, and frameworks for building blockchain decentralized applications
3. To articulate the technical aspects of Blockchain networks and explore application areas, current practices, and research activity

Course Outcomes:

1. Analyze and determine the decentralization and cryptographic concepts
2. Determine different crypto transaction in blockchain
3. Apply and implement various applications using Proof of Stake Blockchain
4. Investigate the Hyperledger Fabric development environment
5. Design blockchain based solutions for the real time problems

Module:1	Introduction to Blockchain Technology	7 hours

Introduction of Blockchain - History of Blockchain - Features of a Blockchain- Tier of Blockchain – Types of Blockchain – Architectures - Base technologies – Hashing - Benefits and Limitations of Blockchain

Module:2	Decentralization and Cryptography	6 hours

Decentralization using Blockchain - Methods of Decentralization - Routes to Decentralization -Decentralized Organizations - Cryptography and Technical Foundations: Cryptographic Primitives - Asymmetric Cryptography - Public and Private keys

Module:3	Proof of Work Blockchain	6 hours

Fundamentals - Properties of Proof of work - Proof of work Transactions - Transaction Life Cycle - Types of Transaction – Block Generation at Proof of works - Consensus Algorithms

Module:4	Proof of Stake	7 hours

Introduction to Proof of Stake -The Proof of Stake Stack - Proof of Stake Blockchain – Cryptocurrency - Transactions - Elements of Proof of Stake Blockchain - Transaction Validation and Execution – Mining/Staking – Applications

Module:5	Hyperledger	6 hours

Introduction to Hyperledger - Reference Architecture - Blockchain Services - Distributed Ledger Technology – Challenges - Hyperledger Fabric - Hyperledger Composer - Fabric Architecture –Implementation –Networking - Fabric Transactions - Demonstration

Module:6	Solidity Programming	7 hours

Solidity - Language of Smart Contracts - Installing Solidity and Proof of Stake Wallet - Basics of Solidity - Layout of a Solidity Source File - Structure of Smart Contracts - General Value Types - Control Structures – Events – Libraries -Functions		
Module:7	**Blockchain Applications**	**4 hours**
Blockchain Applications - e-Governance -Smart Cities -Smart Industries - Anomaly Detections -Use Cases -Trends on Blockchains -Serverless Blocks -Scalability Issues -Blockchain on Clouds		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Bashir, I. (2017). Mastering blockchain Distributed ledgers, Decentralization and Smart Contracts Explained. Packt Publishing Ltd.
Reference Books	
1.	Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. (2016). Proof of work and cryptocurrency technologies: a comprehensive introduction. Princeton University Press.
2.	Josh Thompson (2017), 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform.

Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test			
Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE415L	Engineering Optimization	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the role of optimization in engineering design and its importance
2. To introduce the different optimization algorithms in linear as well as non-linear programming problems
3. To understand the application of non-traditional optimization algorithms

Course Outcomes:

1. Identify appropriate optimization method to solve complex problems involved in various industries and understand the concept of single variable and multi variable optimization methods
2. Recognize and solve linear and nonlinear optimization methods
3. Enumerate fundamentals of quadratic programming technique to solve various optimization problems of engineering
4. Design the various bio inspired optimization methods
5. Apply various advanced non-linear and fuzzy based optimization

Module:1	Classical Optimization Techniques	9 hours

Introduction - Engineering Applications of Optimization - Classification of Optimization Problems-Single Variable and Multivariable Optimization with no Constraints - Multivariable Optimization with Equality and Inequality Constraints: Lagrange Multipliers Method - Kuhn-Tucker conditions

Module:2	Linear Programming Problem	5 hours

Linear Programming Problem – Graphical Methods – Simplex Algorithms – Two Phase Simplex Method – Revised Simplex Method – Dual Simplex Method.

Module:3	Unconstrained Nonlinear Direct Optimization	4 hours

Direct Search Methods - Univariate Method - Pattern Directions - Hook and Jeeves' Method

Module:4	Unconstrained Nonlinear Indirect Optimization	8 hours

Indirect Search Methods - Gradient of a Function - Cauchy Method - Fletcher-Reeves Method.

Module:5	Constrained Non-linear Optimization	8 hours

Characteristics of a Constrained Optimization Problem - Direct Methods: Cutting Plane Method, Methods of Feasible Directions – Indirect Methods - Interior and Exterior Penalty Function Methods

Module:6	Quadratic programming	4 hours

Introduction – Applications - Necessary Conditions - Solution to Quadratic Programming Problem using Wolfe's Method.

Module:7	Bio Inspired Optimization	5 hours

Introduction - Particle Swarm Optimization - Ant Colony Optimization - Firefly Algorithm - Cuckoo Search Optimization		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book		
1.	Singiresu S. Rao, (2019), Engineering Optimization - Theory and Practice, John Wiley & Sons, Inc., 4th edition	
Reference Books		
1.	C. B Gupta, Optimization Techniques in Operation Research, I.K. International House Pvt. Ltd. 2012.	
2.	Sherali, H.D., Shetty, C.M., Optimization with Disjunctive Constraints, Springer, 2016.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	12-10-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BITE399J	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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE497J	Project-I	0	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. 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 multi-disciplinary work.

Module Content **(Project Duration: One Semester)**

Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

Can be individual work or a group project, with a maximum of 3 students.

In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

Carried out inside or outside the university, in any relevant industry or research institution.

Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C
BITE498J	Project-II / Internship	0	0	0	5
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. 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 ill-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	12-10-2022		
Approved by Academic Council	No. 68	Date	19-12-2022

BENG101N	Effective English Communication	L	T	P	C
		0	0	4	2
Pre-requisite	**Nil**	**Syllabus Version**			
		1.0			

Course Objectives:

1. To hone LSRW skills for effective communication
2. To enhance communication skills for future career aspirations
3. To gain critical communication skills in writing and public speaking

Course Outcomes:

1. Write effective sentences using appropriate grammar and vocabulary
2. Express clearly in everyday conversations with lucid pronunciation
3. Analyse the given listening inputs for effective comprehension
4. Apply different reading strategies to various texts and use them appropriately

Indicative Experiments	
1.	**Fundamentals of Grammar**: Parts of Speech, Articles, Tenses, Sentence Structure, Types of Sentences, Subject-Verb Agreement **Activity:** Exercises and worksheets
2.	**Speaking for Self-Expression**: Formal Self-Introduction, Expressing Oneself **Activity:** Self-Introduction, Just a Minute (JAM)
3.	**Basic Listening:** Listening to Simple Conversations, Short Speeches/Stories **Activity:** Gap fill exercises
4.	**Reading Skills:** Reading Strategies, Skimming and Scanning **Activity:** Cloze reading, Reading comprehension, Reading newspaper articles
5.	**Drafting Paragraphs:** Keywords Development, Writing Paragraphs using Connectives **Activity:** Picture and poster interpretation
6.	**Vocabulary Enrichment:** Synonyms and Antonyms, Prefixes and Suffixes, Word Formation, One Word Substitution, Frequently used Idioms and Phrases, Homophones and Homonyms **Activity:** Crossword puzzles and worksheets
7.	**Listening for Pronunciation:** Introduction to Phonemes, Listening to Native Speakers, Listening to Various Accents **Activity:** Listening and imitating, Spell Bee
8.	**Interactive Speaking:** Everyday Conversations, Team Interactions, Simulations **Activity:** Situational role plays
9.	**Email and Letter Writing:** Types and Format of Emails and Letters **Activity:** Official e-mails and letters, personal letters
10.	**Reading for Comprehension:** Short Stories by Indian Writers **Activity:** Summarising, loud reading
	Total Laboratory Hours **60 hours**

Mode of Evaluation: Continuous assessment / FAT / Written assignments / Quiz/ Oral examination / Group activity

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

BCHY102N	Environmental Sciences	L	T	P	C
		0	0	0	2
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

The course is aimed at students to

1. Understand and appreciate the unity of life in all its forms and their implications of life style on the environment.
2. Identify the different causes for environmental degradation.
3. Analyze individual's contribution to environmental pollution.
4. Evaluate the impact of pollution at the global/local level and find solutions for remediation.

Course Outcomes

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

1. Recognize the environmental issues in a problem-oriented, interdisciplinary perspective.
2. Classify the key environmental issues, the science behind those problems and potential solutions.
3. Demonstrate the significance of biodiversity and its preservation.
4. Identify various environmental hazards.
5. Design various methods for the conservation of resources.
6. Formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects.

Module: 1	**Environment and Ecosystem**	**5 hours**

Environment: definition; Earth–life support system. Ecosystem definition, components and types. Key environmental problems, their basic causes and sustainable solutions. Food chain, food web and their significance, Energy flow in ecosystem; Ecological succession-stages involved, primary and secondary succession - hydrarch, mesarch, xerarch.

Module: 2	**Biodiversity**	**4 hours**

Biodiversity-definition, levels and importance. Species: roles: types: extinct, endemic, endangered and rare species. Hot-spots –Significance, Mega-biodiversity. Threats to biodiversity due to natural and anthropogenic activities, Conservation methods. GM crops-advantages and disadvantages.

Module: 3	**Sustaining Environmental Quality**	**4 hours**

Environmental hazards: definition, types, causes and solutions: Biological (Malaria, COVID-19), Chemical (BPA, heavy metals), and Nuclear (Chernobyl); Air, water and soil quality management and conservation; Solid waste management methods.

Module: 4	**Clean and Green Energy**	**5 hours**

Renewable energy resources: Solar energy-thermal and photovoltaic; Hydroelectric energy. Wind energy, Ocean thermal energy; Geothermal energy; Energy from biomass; Hydrogen energy; Solar-hydrogen revolution. Electric and CNG vehicles.

Module: 5	**Environmental Protection Policies**	**4 hours**

Environmental Protection (EPA) objectives; Air Act, water Act, Forest conservation Act and Wild life protection Act. Environmental Impact Analysis: guidelines, core values. Impact assessment methodologies.

Module: 6	**Sustainable development**	**4 hours**

Effect of population-urban environmental problems; Population age structure; Sustainable human societies: tools in economics, sustainable development goals SDGs and promoting awareness. Women and child welfare, Women empowerment.

Module: 7	**Global Climate Change**	**4 hours**
Global climate change and green-house effect. Kyoto Protocol-carbon credits, The Paris Agreement, carbon sequestration: definition, types and methodologies. Ozone layer depletion: causes and impacts. Mitigation of ozone layer depletion- Montreal Protocol. Role of Information Technology in environment.		
Total Lecture hours:		**30 hours**
Assessment: Seminars, Quiz, Case Studies, Final Assessment Test.		
Text Books		
1. G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengagelearning. 2. Benny Joseph, (2012), Environmental Science and Engineering, 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, India.		
Reference Book(s)		
1. David M. Hassenzahl, Mary Catherine Hager, Linda. R. Berg (2011), Visualizing Environmental Science, 4th Edition, John Wiley & Sons, USA. 2. Raj Kumar Singh, (2012), Environmental Studies, Tata McGraw Hill Education Private Limited, New Delhi, India. 3. George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.		

Recommended by Board of Studies	14-02-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BHUM101N	Ethics and Values	L	T	P	C
		0	0	0	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity.
2. To understand the negative health impacts of certain unhealthy behavior.
3. To appreciate the need and importance of physical, emotional health and social health.

Expected Course Outcomes:

1. Students will be able to:
2. Follow sound morals and ethical values scrupulously to prove as good citizens.
3. Understand various social problems and learn to act ethically.
4. Understand the concept of addiction and how it will affect the physical and mental health.
5. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects.
6. Identify the main typologies, characteristics, activities, actors and forms of cybercrime.

Module:1	**Being Good and Responsible**	
Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society.		
Module:2	**Social Issues 1**	
Harassment – Types - Prevention of harassment, Violence and Terrorism.		
Module:3	**Social Issues 2**	
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices.		
Module:4	**Addiction and Health**	
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases.		
Module:5	**Drug Abuse**	
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.		
Module:6	**Personal and Professional Ethics**	
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism.		
Module:7	**Abuse of Technologies**	
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites.		
Total Lecture Hours:		**60 hours**

Text Books :

1.	R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2019, 2nd Revised Edition, Excel Books, New Delhi.
2.	Hartmann, N., "Moral Values" , 2017, United Kingdom: Taylor & Francis.

Reference Books :

1.	Rachels, James & Stuart Rachels, "The Elements of Moral Philosophy", 9th edition, 2019, New York: McGraw-Hill Education.

2.	Blackburn, S. “Ethics: A Very Short Introduction”, 2001, Oxford University Press.
3.	Dhaliwal, K.K , “Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts”, 2016, Writers Choice, New Delhi, India.
4	Ministry of Social Justice and Empowerment, “Magnitude of Substance Use in India”, 2019, Government of India.
5.	Ministry of Home Affairs, “Accidental Deaths and Suicides in India”, 2019, Government of India.
6.	Ministry of Home Affairs, “A Handbook for Adolescents/ Students on Cyber Safety”, 2018, Government of India.
Mode of Evaluation: Poster making, Quiz and Term End - Quiz	

Recommended by Board of Studies	27-10-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BITE101N	Introduction to Engineering	L	T	P	C
		0	0	0	1
Pre-requisite	Nil	**Syllabus version**			
		1.0			

Course Objective:

- To make the student comfortable and get familiarized with the facilities available on campus
- To make the student aware of the exciting opportunities and usefulness of engineering to society
- To make the student understand the philosophy of engineering

Course Outcome:

- To know the infrastructure facilities available on campus
- To rationally utilize the facilities during their term for their professional growth
- To appreciate the engineering principles, involve in life-long learning and take up engineering practice as a service to society

General Guidelines

1. Student should observe and involve in the activities during the induction programme. Both general activities and those which are discipline-specific should be included here.
2. Student should get familiarized with the infrastructure facilities available on campus during the general induction, school induction programme and also from the institutional website.
3. Student should attend the lecture by industries, including those on career opportunities, organized by the School and probably involve in 'Do-it-yourself' projects or projects involving reverse-engineering.
4. Activities under 'Do-it-Yourself' will be detailed by the School.
5. Student should prepare a report on the activities and observations, as per the specified format, and submit the same in institutional LMS, VTOP for further evaluation

   General instruction on formatting: Document to be prepared with the titles given in the template; Arial type with font size of 12 to be used; photographs can be included in the document as per the requirement; 1.5 line spacing to be used.

Mode of Evaluation: Evaluation of the submitted report and interaction with the students

Recommended by Board of Studies	02.07.2021		
Approved by Academic Council	No. 63	Date	23.09.2021

BSSC101N	Essence of Traditional Knowledge	L	T	P	C
		0	0	0	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives:

1. To impart the knowledge on Indian tradition and Culture.
2. To enable the students to acquire the traditional knowledge in different sectors.
3. To analyze and understand the Science, Management and Indian Knowledge System.

Course Outcomes:

1. Familiarize the concept of Traditional Indian Culture and Knowledge.
2. Explore the Indian religion, philosophy and practices.
3. Analyze and understand the Indian Languages, Culture, Literature and Arts.
4. Gives a clear understanding on the Indian perspective of modern scientific world and basic principles of Yoga and holistic health care system of India.
5. Enable knowledge on Legal framework and traditional knowledge.

Module:1	**Introduction to Traditional Knowledge**

Traditional knowledge: Definition, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge, characteristics, Traditional knowledge vis-a-vis Indigenous knowledge, Traditional knowledge Vs Western Knowledge.

Module:2	**Culture and Civilization**

Introduction to Culture and Civilization, Culture and Heritage, Characteristics features of Indian Culture, Importance of Culture, Cultural practices in Ancient India, Medieval India and Modern India.

Module:3	**Languages and Literature**

Indian Languages and Literature: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature and literatures of South India.

Module:4	**Religion and Philosophy**

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only).

Module:5	**Fine Arts in India**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama. Science and Technology in India, Development of science in ancient, medieval and modern India. Traditional Medicine – Herbal Healing - Yoga and Pranayama practices.

Module:6	**Traditional Knowledge in different sectors**

Traditional knowledge and engineering, Traditional medicine system, Traditional knowledge in agriculture, Dependence of Traditional Societies on food and healthcare needs; Importance of conservation and sustainable development of environment, Management of biodiversity and Protection of Traditional knowledge.

Module:7	**Legal framework and Traditional Knowledge**

Introduction on Legal framework and Traditional Knowledge: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, The protection of traditional knowledge bill, 2016.

Total Lecture Hours:	**60 hours**

Text Books :

1. Shikha Jain, Parul G Munjal And Somya Joshi,(2020) Traditional Knowledge Systems And Cultural Heritage, Aryan Books International, India.
2. Anindya Bhukta(2020), Legal Protection for Traditional Knowledge: Towards A New

	Law for Indigenous Intellectual Property, Emerald Publishing Limited, United Kingdom.
Reference Books :	
1.	Traditional Knowledge System in India, by Amit Jha, 2009.
2.	Basant Kumar Mohanta & Vipin Kumar Singh (2012), "Traditional Knowledge System & Technology in India", Pratibha Prakashan, India.
3.	S. Baliyan, Indian Art and Culture, Oxford University Press, India.
4	http://indiafacts.org/author/michel-danino/
5.	GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi,2016.
Mode of Evaluation: Quiz and Term End – Quiz	

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

Course Code	Course Title	L	T	P	C
BSSC102N	Indian Constitution	0	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

This Course is an introduction of Indian Constitution and basic concepts highlighted in this course for understanding the Constitution of India.

Course Outcome

At the end of the course, the student will acquire:

1. A basic understanding of Constitution of India.
2. The ability to understand the contemporary challenges and apply the knowledge gained from the course to current social contemporary legal issues.
3. The understanding of constitutional remedies.

Module:1	Introduction to Indian Constitution	5 hours

Introduction to the constitution of India and the Preamble - Sources of Indian Constitution - Features of Indian Constitution - Citizenship - Fundamental Rights and Duties - Directive Principles of state policy

Module:2	Union Government and its Administration Structure of the Indian Union	8 hours

Federalism, Centre- State relationship - President: Role, Power and Position - Prime Minister and Council of ministers - Cabinet and Central Secretariat - Lok Sabha - Rajya Sabha- The Supreme Court and High Court: Powers and Functions

Module:3	State Government and its Administration	4 hours

Governor- Role and Position - Chief Minister and Council of Ministers - State Legislative Assembly - State secretariat: Organization, Structure and Functions

Module:4	Local Administration	7 hours

District's Administration Head- Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative - Panchayati Raj: Composition and Functions Evolution and 73rd and 74th Amendments - Zila Parishad and district administration: Composition and Functions Elected officials and their roles, CEO Zila Panchayat: Position and role- Panchayat Samiti: Composition and Functions - Gram Panchayat: Composition and Functions Importance of grass root democracy

Module:5	Election Commission	6 hours

Role of Chief Election Commissioner - State Election Commission - Functions of Commissions for the welfare of SC/ST/OBC and women.

	Total Lecture hours:	30 hours

Reference Books				
1.	Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)			
2.	M.V.Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)			
3.	J.C Johari, Indian Government and Politics, Shoban Lal & Co., 2012			
4.	Noorani, A.G , Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.			
5.	R. Bhargava, (2008) 'Introduction: Outline of a Political Theory of the Indian Constitution', in R. Bhargava (ed.) Politics and Ethics of the Indian Constitution, New Delhi: Oxford University Press.			
6.	Bidyut Chakrabarty & Rajendra Kumar Pandey, Indian Government and Politics, SAGE, New Delhi, 2008			
7.	G. Austin, The Indian Constitution: CornerStone of a Nation, Oxford, Oxford University Press, 1966			
Mode of Evaluation**:** CAT, Written assignment, Quiz and FAT				
Recommended by Board of Studies		27-10-2021		
Approved by Academic Council		No. 68	Date	19-08-2022