



VIT[®]

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

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2023 – 2024)

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



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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- **World class Education:** Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- **Cutting edge Research:** An innovation ecosystem to extend knowledge and solve critical problems.
- **Impactful People:** Happy, accountable, caring and effective workforce and students.
- **Rewarding Co-creations:** Active collaboration with national & international industries & universities for productivity and economic development.
- **Service to Society:** Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

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

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.



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School of Computer Science and Engineering

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

Programme Educational Objectives (PEOs)

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



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

Programme Outcomes (POs)

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

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

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

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

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

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

PO_07: Having adaptive thinking and adaptability

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working in teams

PO_10: Having a good working knowledge of communicating in English

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

PO_12: Having interest in lifelong learning



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Programme Specific Outcomes (PSOs)

1. Design and develop intelligent automated systems applying mathematical, analytical, programming and operational skills to solve real world problems.
2. Apply machine learning techniques, software tools to conduct experiments, interpret data and to solve complex problems.
3. Implement engineering solutions for the benefit of society by the use of Artificial Intelligence and Machine Learning.



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School of Computer Science and Engineering

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

**Curriculum
B.Tech. (CSE) - AI and ML
(2023 - 2024)**



CURRICULUM

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

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

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

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

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

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

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

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

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

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

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

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

Basic Sciences and Mathematics

Course Code	Course Title	L	T	P	C
BPHY101L	Engineering Physics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To explain the dual nature of radiation and matter. To apply Schrödinger's equation to solve finite and infinite potential problems and apply quantum ideas at the nanoscale. 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					
<ol style="list-style-type: none"> Comprehend the phenomenon of waves and electromagnetic waves. Understand the principles of quantum mechanics. Apply quantum mechanical ideas to subatomic domain. Appreciate the fundamental principles of a laser and its types. 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 CO ₂ 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, 15 th Edition, Pearson, USA.		
2.	D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011, 1 st Edition, Pearson, USA		
Reference Books			
1.	H. J. Pain, The Physics of vibrations and waves, 2013, 6 th Edition, Wiley Publications, India.		
2.	R. A. Serway, J. W. Jewett, Jr, Physics for Scientists and Engineers with Modern Physics, 2019, 10 th Edition, Cengage Learning, USA.		
3.	K. Krane, Modern Physics, 2020, 4 th Edition, Wiley Edition, India.		
4.	M.N.O. Sadiku, Principles of Electromagnetics, 2015, 6 th Edition, Oxford University Press, India.		
5.	W. Silfvast, Laser Fundamentals, 2012, 2 nd 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						
<ol style="list-style-type: none"> 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	

BCHY101L	Engineering Chemistry	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 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 :					
<ol style="list-style-type: none"> 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.	Angèle 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, 4 th edition – <i>Open access version</i>		
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 ₂ O 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	

BMAT101L		Calculus		L	T	P	C
				3	0	0	3
Pre-requisite	Nil	Syllabus version					
		1.0					
Course Objectives							
<p>1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.</p> <p>2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.</p> <p>3. Enhance to use technology to model the physical situations into mathematical problems, experiment, interpret results, and verify conclusions.</p>							
Course Outcomes							
<p>At the end of the course the student should be able to:</p> <p>1. Apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions</p> <p>2. Evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints</p> <p>3. Evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.</p> <p>4. Use special functions to evaluate various types of integrals.</p> <p>5. Understand gradient, directional derivatives, divergence, curl, Green's, Stokes and Gauss Divergence theorems.</p>							
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					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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:	45 hours
		Total Tutorial hours :	15 hours
Text Book(s)			
<ol style="list-style-type: none"> 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			
<ol style="list-style-type: none"> 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					
<ol style="list-style-type: none"> 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					
<ol style="list-style-type: none"> 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	7 hours			
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:	45 hours
	Total Tutorial hours :	15 hours
Text Book(s)		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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 :					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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, 9 th Edition, Pearson Education.			
Reference Books			
1. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, 2016, 6 th Edition, John Wiley & Sons.			
2. E. Balagurusamy, Reliability Engineering, 2017, Tata McGraw Hill, Tenth reprint.			
3. J. L. Devore, Probability and Statistics, 2012, 8 th 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, 3 rd 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:							
<ol style="list-style-type: none"> 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:							
<ol style="list-style-type: none"> 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:							
<ol style="list-style-type: none"> 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 Golemund, 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	

Engineering Sciences

Course Code	Course Title	L	T	P	C
BEEE102L	Basic Electrical and Electronics Engineering	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. Familiarize with various laws and theorems to solve electric and electronic circuits 2. Provide an overview on working principle of machines 3. Excel the concepts of semiconductor devices, op-amps and digital circuits					
Course Outcomes					
On completion of the course, the students will be able to:					
1. Evaluate DC and AC circuit parameters using various laws and theorems 2. Comprehend the parameters of magnetic circuits 3. Classify and compare various types of electrical machines and its applications 4. Design basic combinational circuits in digital system 5. Analyze the characteristics and applications of semiconductor devices					
Module:1	DC Circuits	7 hours			
Basic circuit elements and sources; Ohms law; Kirchhoff's laws; Series and Parallel connection of circuit elements; Star-delta transformation; Mesh current analysis; Node voltage analysis; Theorems: Thevenin's, Maximum power transfer and Superposition theorem.					
Module:2	AC Circuits	8 hours			
Alternating voltages and currents, RMS, average, maximum values, Single Phase RL, RC, RLC series circuits, Power in AC circuits, Power Factor, Three phase balanced systems, Star and delta Connections, Electrical Safety, Fuses and Earthing.					
Module:3	Magnetic Circuits	7 hours			
Magnetic field; Toroidal core: Flux density, Flux linkage; Magnetic circuit with airgap; Reluctance in series and parallel circuits; Self and mutual inductance; Transformer: turn ratio determination.					
Module:4	Electrical Machines	7 hours			
Construction, working principle and applications of DC Machines, Transformers, Three phase Induction motors, synchronous generators, single phase induction motors, special machines stepper motor, universal motor and BLDC motor.					
Module:5	Digital Systems	7 hours			
Binary arithmetic; Number base conversion; Boolean algebra: simplification of Boolean functions using K-maps; Logic gates; Design of basic combinational circuits: adders, multiplexers, de-multiplexers.					
Module:6	Semiconductor Devices and Applications	7 hours			
Characteristics: PN junction diode, Zener diode, BJT, MOSFET; Applications: Rectifier, Voltage regulator, Operational amplifier.					
Module:7	Contemporary Issues	2 hours			
		Total Lecture hours:			45 hours
Text Books					
1	Allan R. Hambley, "Electrical Engineering -Principles & Applications", 2019, 6 th Edition, Pearson Education				
2	V. D. Toro, Electrical Engineering Fundamentals, 2 nd edition. PHI, 2014				
Reference Books					
1	R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11 th edition.				

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

Course code	Course Title	L	T	P	C
BEEE102P	Basic Electrical and Electronics Engineering Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objective					
1. Design and solve the fundamental electrical and electronics circuits					
Course Outcomes					
1. Identify appropriate method of solving the fundamental electrical and electronics circuits					
2. Design and conduct experiments on electrical and electronics circuits					
Experiments (Indicative)					
1	Verification of Kirchoff's law				
2	Verification of Maximum Power Transfer Theorem				
3	Staircase wiring circuit layout for multi storage building				
4	Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars.				
5	Measurement of Earth resistance using Megger				
6	Sinusoidal steady state response of RLC circuits				
7	Three phase power measurement for ac loads				
8	Design of half-adder and full-adder digital circuits				
9	Synthesis of 8x1 multiplexer and 1x8 de-multiplexers				
10	Characteristics of PN diode and acts as switch				
11	Realization of single-phase rectifier				
12	Design of regulated power supply using Zener diode.				
13	Characteristics of MOSFET				
14	Characteristics of BJT				
15	Measurement of energy using single-phase energy meter				
16	Measurement of power in a 1-phase circuit by using CTs and PTs				
Total Laboratory Hours				30 hours	
Mode of assessment: Continuous assessment, FAT					
Recommended by Board of Studies		28-05-2022			
Approved by Academic Council		No. 67	Date	08-08-2022	

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, 2 nd Edition, Packt Publishing Limited, 2021.		
Reference Books			
1.	Harsh Bhasin, Python for beginners, 1 st 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					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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 programming 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, 4 th Edition, McGraw Hill Education, 2017		
2.	Herbert Schildt, C++: The Complete Reference, 4 th Edition, McGraw Hill Education, 2017.		
Reference Books			
1.	Yashavant Kanetkar, Let Us C: 17 th Edition, BPB Publicaitons, 2020.		
2.	Stanley Lippman and Josee Lajoie, C++ Primer, 5 th 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					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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 programming 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, 1 st 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:					
<ol style="list-style-type: none"> To introduce the core language features of Java and understand the fundamentals of Object -Oriented programming in Java. 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:					
<ol style="list-style-type: none"> Understand basic programming constructs; realize the fundamentals of Object Orientated Programming in Java; apply inheritance and interface concepts for enhancing code reusability. 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-11 th Edition, Pearson publisher, 2017.				
Reference Books					
1.	Herbert Schildt , The Complete Reference -Java, Tata McGraw-Hill publisher, 10 th Edition, 2017.				
2	Cay Horstmann, “Big Java”, 4th edition, John Wiley & Sons publisher, 5 th edition, 2015				
3	E.Balagurusamy, “Programming with Java”, Tata McGraw-Hill publishers, 6 th 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., 5 th Edition, 2020.		
Reference Books			
1.	Dhruti Shah, 100+ Solutions in Java: A Hands-On Introduction to Programming in Java, BPB Publications, 1 st 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

Humanities, Social Sciences and Management

BENG101L	Technical English Communication	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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). <i>Technical Communication: Principles and Practice</i> , (3 rd Edition). India: Oxford University Press.				
Reference Books					
1.	Taylor, Shirley & Chandra .V. (2010). <i>Communication for Business A Practical Approach</i> 4 th Edition. India: Pearson Longman.				
2.	Kumar, Sanjay & Pushpalatha. (2018). <i>English Language and Communication Skills for Engineers</i> . India: Oxford University Press.				
3.	Koneru Aruna. (2020). <i>English Language Skills for Engineers</i> . India: McGraw Hill Education.				
4.	Rizvi, M. Ashraf. (2018). <i>Effective Technical Communication</i> 2 nd Edition. Chennai: McGraw Hill Education.				
5.	Mishra, Sunitha & Muralikrishna,C. (2014). <i>Communication Skills for Engineers</i> . India: Pearson Education.				

6.	Watkins, P. (2018). <i>Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers</i> . 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	

BSTS101P	Quantitative Skills Practice I	L	T	P	C
		0	0	3	1.5
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> To enhance the logical reasoning skills of the students and help them improve problem-solving abilities To acquire skills required to solve quantitative aptitude problems To boost the verbal ability of the students for academic and professional purposes 					
Course Outcomes:					
<ol style="list-style-type: none"> Exhibit sound knowledge to solve problems of Quantitative Aptitude Demonstrate ability to solve problems of Logical Reasoning 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					
Cryptarithmic					
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			
<ul style="list-style-type: none"> 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). <i>Place Mentor 1st</i> (Ed.). Chennai: Oxford University Press.				
2.	Aggarwal R.S. (2017). <i>Quantitative Aptitude for Competitive Examinations 3rd</i> (Ed.). New Delhi: S. Chand Publishing.				

3.	FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley Publications.		
4.	ETHNUS. (2016). <i>Aptimithra</i> , 1 st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.		
Reference Books			
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (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:							
<ol style="list-style-type: none"> 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:							
<ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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). <i>Place Mentor</i> 1 st (Ed.). Chennai: Oxford University Press.		
2.	Aggarwal R.S. (2017). <i>Quantitative Aptitude for Competitive Examinations</i> 3 rd (Ed.). New Delhi: S. Chand Publishing.		
3.	FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley Publications.		
4.	ETHNUS. (2016). <i>Aptimithra</i> , 1 st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.		
Reference Books			
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (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:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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			
<ul style="list-style-type: none"> • Problem Solving • Critical Thinking • Lateral Thinking Rebus puzzles, and word-link builder questions					
Module:3	Logical Reasoning	6 hours			
<ul style="list-style-type: none"> • 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					
<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Grooming, dressing • Body Language and other non-verbal signs • Displaying the right behaviour 			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	SMART. (2018). <i>Place Mentor</i> 1 st (Ed.). Chennai: Oxford University Press.		
2.	Aggarwal R.S. (2017). <i>Quantitative Aptitude for Competitive Examinations</i> 3 rd (Ed.). New Delhi: S. Chand Publishing.		
3.	FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley Publications.		
4.	ETHNUS. (2016). <i>Aptimithra</i> , 1 st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.		
Reference Books			
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (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:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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			
<ul style="list-style-type: none"> • Clocks • Calendars • Direction Sense • Cubes Practice on advanced problems					
Module:2	Data interpretation and Data sufficiency - Advanced	5 hours			
<ul style="list-style-type: none"> • Advanced Data Interpretation and Data Sufficiency questions of CAT level • Multiple chart problems • Caselet problems 					
Module:3	Time and work– Advanced	5 hours			
<ul style="list-style-type: none"> • 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			
<ul style="list-style-type: none"> • 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			
<ul style="list-style-type: none"> • 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		
<ul style="list-style-type: none"> • 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		
<ul style="list-style-type: none"> • 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		
<ul style="list-style-type: none"> • Idea generation for topics • Best practices • Practice and feedback 		
Total Lecture hours:		45 hours
Text Book(s)		
1.	SMART. (2018). <i>Place Mentor</i> 1 st (Ed.). Chennai: Oxford University Press.	
2.	Aggarwal R.S. (2017). <i>Quantitative Aptitude for Competitive Examinations</i> 3 rd (Ed.). New Delhi: S. Chand Publishing.	
3.	FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley Publications.	
4.	ETHNUS. (2016). <i>Aptimithra</i> , 1 st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.	
Reference Books		
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.	

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

Discipline Linked Engineering Science Course

Course Code	Course Title	L	T	P	C
BECE102L	Digital Systems Design	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Provide an understanding of Boolean algebra and logic functions. 2. Develop the knowledge of combinational and sequential logic circuit design. 3. Design and model the data path circuits for digital systems. 4. Establish a strong understanding of programmable logic. 5. Enable the student to design and model the logic circuits using Verilog HDL. 					
Course Outcome					
At the end of the course the student will be able to					
<ol style="list-style-type: none"> 1. Optimize the logic functions using and Boolean principles and K-map. 2. Model the Combinational and Sequential logic circuits using Verilog HDL. 3. Design the various combinational logic circuits and data path circuits. 4. Analyze and apply the design aspects of sequential logic circuits. 5. Analyze and apply the design aspects of Finite state machines. 6. Examine the basic architectures of programmable logic devices. 					
Module:1	Digital Logic	8 hours			
Boolean Algebra: Basic definitions, Axiomatic definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Simplification of Boolean functions. Gate-Level Minimization: The Map Method (K-map up to 4 variable), Product of Sums and Sum of Products Simplification, NAND and NOR Implementation. Logic Families: Digital Logic Gates, TTL and CMOS logic families.					
Module:2	Verilog HDL	5 hours			
Lexical Conventions, Ports and Modules, Operators, Dataflow Modelling, Gate Level Modelling, Behavioural Modeling, Test Bench.					
Module:3	Design of Combinational Logic Circuits	8 hours			
Design Procedure, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Decoders, Encoders, Multiplexers, De-multiplexers, Parity generator and checker, Applications of Decoder, Multiplexer and De-multiplexer. Modeling of Combinational logic circuits using Verilog HDL.					
Module:4	Design of data path circuits	6 hours			
N-bit Parallel Adder/Subtractor, Carry Look Ahead Adder, Unsigned Array Multiplier, Booth Multiplier, 4-Bit Magnitude comparator. Modeling of data path circuits using Verilog HDL.					
Module:5	Design of Sequential Logic Circuits	8 hours			
Latches, Flip-Flops - SR, D, JK & T, Buffer Registers, Shift Registers - SISO, SIPO, PISO, PIPO, Design of synchronous sequential circuits: state table and state diagrams, Design of counters: Modulo-n, Johnson, Ring, Up/Down, Asynchronous counter. Modeling of sequential logic circuits using Verilog HDL.					
Module:6	Design of FSM	4 hours			
Finite state Machine(FSM):Mealy FSM and Moore FSM , Design Example : Sequence detection, Modeling of FSM using Verilog HDL.					
Module:7	Programmable Logic Devices	4 hours			
Types of Programmable Logic Devices: PLA, PAL, CPLD, FPGA Generic Architecture.					

Module:8	Contemporary issues			2 hours
Total Lecture hours:				45 hours
Textbook(s)				
1.	M. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL and System Verilog, 2018, 6 th Edition, Pearson Pvt. Ltd.			
Reference Books				
1.	Ming-Bo Lin, Digital Systems Design and Practice: Using Verilog HDL and FPGAs, 2015, 2nd Edition, Create Space Independent Publishing Platform.			
2.	Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2009, 2nd edition, Prentice Hall of India Pvt. Ltd.			
3.	Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 2013, 3rd Edition, McGraw-Hill Higher Education.			
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test				
Recommended by Board of Studies		14-05-2022		
Approved by Academic Council		No. 66	Date	16-06-2022

Course Code	Course Title	L	T	P	C
BECE102P	Digital Systems Design Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objective					
<ul style="list-style-type: none"> 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					
<ol style="list-style-type: none"> Design, simulate and synthesize combinational logic circuits, data path circuits and sequential logic circuits using Verilog HDL. Design and implement FSM on FPGA. Design and implement small digital systems on FPGA. 					
Indicative Experiments					
1.	Characteristics of Digital ICs, Realization of Boolean expressions	2 hours			
2.	Design and Verilog modeling of Combinational Logic circuits	4 hours			
3.	Design and Verilog modeling of various data path elements - Adders	2 hours			
4.	Design and Verilog modeling of various data path elements - Multipliers	2 hours			
5.	Implementation of combinational circuits – (FPGA / Trainer Kit)	2 hours			
6.	Implementation of data path circuit - (FPGA / Trainer Kit)	2 hours			
7.	Design and Verilog modeling of simple sequential circuits like Counters and Shift registers	2 hours			
8.	Design and Verilog modeling of complex sequential circuits	2 hours			
9.	Implementation of Sequential circuits - (FPGA / Trainer Kit)	2 hours			
10.	Design and Verilog modeling of FSM based design – Serial Adder	2 hours			
11.	Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine	4 hours			
12.	Design of ALU	4 hours			
Total Laboratory Hours					30 hours
Mode of Assessment: Continuous Assessment and Final Assessment Test					
Recommended by Board of Studies		14-05-2022			
Approved by Academic Council		No. 66	Date	16-06-2022	

Course Code	Course Title	L	T	P	C
BECE204L	Microprocessors and Microcontrollers	3	0	0	3
Pre-requisite	BECE102L	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> To acquaint students with architectures of Intel microprocessors, microcontroller and ARM processors. To familiarize the students with assembly language programming in 8051 microcontroller and ARM processor. To interface peripherals and I/O devices with the 8051 microcontroller. 					
Course Outcome:					
At the end of the course, the student should be able to					
<ol style="list-style-type: none"> Comprehend the various microprocessors including Intel Pentium Processors Infer the architecture and Programming of Intel 8086 Microprocessor. Comprehend the architectures and programming of 8051 microcontroller. Deploy the implementation of various peripherals such as general purpose input/output, timers, serial communication, LCD, keypad and ADC with 8051 microcontroller Infer the architecture of ARM Processor Develop the simple application using ARM processor. 					
Module:1	Overview of Microprocessors	3 hours			
Introduction to Microprocessors, 8-bit/16-bit Microprocessor, Overview of Intel Pentium, I (i3, i5, i7) Series Processor.					
Module:2	Microprocessor Architecture and Interfacing: Intel x86	8 hours			
16-bit Microprocessor: 8086 - Architecture and Addressing modes, Memory Segmentation, Instruction Set, Assembly Language Processing, Programming with DOS and BIOS function calls, minimum and maximum mode configuration, Programmable Peripheral Interface (8255), Programmable Timer Controller (8254), Memory Interface to 8086.					
Module:3	Microcontroller Architecture: Intel 8051	7 hours			
Microcontroller 8051 - Organization and Architecture, RAM-ROM Organization, Machine Cycle, Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional, Assembly programming.					
Module:4	Microcontroller 8051 Peripherals	5 hours			
I/O Ports, Timers-Counters, Serial Communication and Interrupts.					
Module:5	I/O interfacing with Microcontroller 8051	7 hours			
LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface.					
Module:6	ARM Processor Architecture	5 hours			
ARM Design Philosophy; Overview of ARM architecture; States [ARM, Thumb, Jazelle]; Registers, Modes; Conditional Execution; Pipelining; Vector Tables; Exception handling.					
Module:7	ARM Instruction Set	8 hours			
ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI Instruction, Loading instructions, conditional Execution, Assembly Programming.					
Module:8	Contemporary issues	2 hours			

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

Course Code	Course Title	L	T	P	C
BECE204P	Microprocessors and Microcontrollers Lab	0	0	2	1
Pre-requisite	BECE102L	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To familiarize the students with assembly language programming using microprocessor and microcontroller. 2. To familiarize the students with Embedded C language programming using microcontroller. 3. To interface peripherals and I/O devices with the microcontroller and microprocessor. 					
Course Outcome					
Student will be able to <ol style="list-style-type: none"> 1. Showcase the skill, knowledge and ability of programming microcontroller and microprocessor using its instruction set. 2. Expertise with microcontroller and interfaces including general purpose input/ output, timers, serial communication, LCD, keypad and ADC. 					
Indicative Experiments [Experiments using 8086/8051/ARM]					
1	Assembly language programming of Arithmetic/logical operations.	6 hours			
2	Assembly language programming of memory operations.	4 hours			
3	Assembly language programming/ Embedded C programming for interfacing the peripherals: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	10 hours			
4	Hardware implementation of peripheral interfacing: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	10 hours			
Total Laboratory Hours					30 hours
Mode of Assessment: Continuous Assessment and Final Assessment Test					
Recommended by Board of Studies		14-05-2022			
Approved by Academic Council		No. 66	Date	16-06-2022	

BMAT205L	Discrete Mathematics and Graph Theory	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. To address the challenges of the relevance of lattice theory and 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					
<ol style="list-style-type: none"> 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	6 hours			
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:					
<ol style="list-style-type: none"> 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, 8 th Edition, Tata McGraw Hill, 2019.			
2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6 th Edition, PHI, 2018.			
3. Discrete Mathematics, Richard Johnsonbaugh, 8 th 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, 3 rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.			
Mode of Evaluation: CAT, Quizzes, Digital Assignments, FAT			
Recommended by Board of Studies	15.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

Discipline Core Course

BCSE202L	Data Structures and Algorithms	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To impart basic concepts of data structures and algorithms. To differentiate linear, non-linear data structures and their operations. To comprehend the necessity of time complexity in algorithms. 					
Course Outcomes					
On completion of this course, students should be able to:					
<ol style="list-style-type: none"> Understand the fundamental analysis and time complexity for a given problem. Articulate linear, non-linear data structures and legal operations permitted on them. Identify and apply suitable algorithms for searching and sorting. Discover various tree and graph traversals. Explicate hashing, heaps and AVL trees and realize their applications. 					
Module:1	Algorithm Analysis	8 hours			
Importance of algorithms and data structures - Fundamentals of algorithm analysis: Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth - Algorithm efficiency – best case, worst case, average case - Analysis of non-recursive and recursive algorithms - Asymptotic analysis for recurrence relation: Iteration Method, Substitution Method, Master Method and Recursive Tree Method.					
Module:2	Linear Data Structures	7 hours			
Arrays: 1D and 2D array- Stack - Applications of stack: Expression Evaluation, Conversion of Infix to postfix and prefix expression, Tower of Hanoi – Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue) - Applications – List: Singly linked lists, Doubly linked lists, Circular linked lists- Applications: Polynomial Manipulation.					
Module:3	Searching and Sorting	7 hours			
Searching: Linear Search and binary search – Applications. Sorting: Insertion sort, Selection sort, Bubble sort, Counting sort, Quick sort, Merge sort - Analysis of sorting algorithms.					
Module:4	Trees	6 hours			
Introduction - Binary Tree: Definition and Properties - Tree Traversals- Expression Trees:- Binary Search Trees - Operations in BST: insertion, deletion, finding min and max, finding the k th minimum element.					
Module:5	Graphs	6 hours			
Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's - Single Source Shortest Path: Dijkstra's Algorithm.					
Module:6	Hashing	4 hours			
Hash functions - Separate chaining - Open hashing: Linear probing, Quadratic probing, Double hashing - Closed hashing - Random probing – Rehashing - Extendible hashing.					
Module:7	Heaps and AVL Trees	5 hours			
Heaps - Heap sort- Applications -Priority Queue using Heaps. AVL trees: Terminology, basic operations (rotation, insertion and deletion).					
Module:8	Contemporary Issues	2 hours			
		Total Lecture hours:		45 hours	
Text Book					
1.	Mark A. Weiss, Data Structures & Algorithm Analysis in C++, 4 th Edition, 2013, Pearson Education.				

Reference Books			
1.	Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft, Data Structures and Algorithms, 1983, Pearson Education.		
2.	Horowitz, Sahni and S. Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2 nd Edition, Universities Press.		
3.	Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, 2009, 3 rd Edition, MIT Press.		
Mode of Evaluation: CAT, Assignment, Quiz and FAT			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE202P	Data Structures and Algorithms Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To impart basic concepts of data structures and algorithms. 2. To differentiate linear, non-linear data structures and their operations. 3. To comprehend the necessity of time complexity in algorithms.					
Course Outcomes					
On completion of this course, students should be able to: 1. Apply appropriate data structures to find solutions to practical problems. 2. Identify suitable algorithms for solving the given problems.					
Indicative Experiments					
1.	Implementation of stack data structure and its applications				
2.	Implementation of queue data structure and its applications				
3.	Implementation linked list and its application				
4.	Implementation of searching algorithms				
5.	Implementation of sorting algorithms				
6.	Binary Tree Traversal implementation				
7.	Binary Search Tree implementation				
8.	Graph Traversal – Depth First Search and Breadth First Search algorithm				
9.	Minimum Spanning Tree – Prim's and Kruskal's algorithm				
10.	Single Source Shortest Path Algorithm - Dijkstra's algorithm				
Total Laboratory Hours					30 hours
Text Book					
1.	Mark A. Weiss, Data Structures & Algorithm Analysis in C++, 2013, 4 th Edition, Pearson.				
Reference Books					
1.	Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft, Data Structures and Algorithms, 1983, Pearson Education.				
2.	Horowitz, Sahni and S. Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2 nd Edition, Universities Press.				
3.	Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, 2009, 3 rd Edition, MIT Press.				
Mode of assessment: Continuous assessments and FAT.					
Recommended by Board of Studies			04-03-2022		
Approved by Academic Council		No. 65	Date	17-03-2022	

Course Code	Course Title	L	T	P	C
BCSE203E	Web Programming	1	0	4	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To convey the Internet and Its Application in Real world. To introduce the fundamentals of web programming through HTML and CSS. To establish the application of Javascript in designing interactive web pages. To investigate various elements of ReactJS and design user interfaces to deploy in the real time. 					
Course Outcomes					
At the end of this course students will be able to:					
<ol style="list-style-type: none"> Apply various elements of HTML and CSS. Design interactive web pages using JavaScript. Create Dynamic Web Applications using ReactJS. Deploy and host web applications in Local Servers or Cloud platforms. 					
Module:1 Introduction					
				2 hours	
World wide web and its evolution - E-mail, Telnet, FTP, E-commerce, Cloud Computing, Video conferencing - Internet service providers, IP Address, URL, Domain Name Servers - Web Browsers, Search Engine -Web Server vs Application Server.					
Module:2 Hypertext Markup Language					
				2 hours	
HTML Tags, Structure, HTML Coding Conventions - Block Elements, Text Elements, Code-Related Elements, Character References - Lists, Images, section, article, and aside Elements - nav and a Elements - header and footer Elements.					
Module:3 Cascading Style Sheets					
				2 hours	
CSS Overview - CSS Rules, CSS Syntax and Style - Class Selectors, ID Selectors, span and div Elements - Cascading, style Attribute, style Container, External CSS Files - CSS Properties: Color Properties, Font Properties, line-height Property, Text Properties, Border Properties. Element Box, padding Property, margin Property - Hosting a Website and GIT.					
Module:4 JavaScript					
				3 hours	
Hello World Web Page - Buttons, Functions, Variables, Identifiers - Assignment Statements and Objects - Document Object Model, Forms: form Element, Controls, Text Control Accessing a Form's Control Values, reset and focus Methods – Event Handler Attributes: onchange, onmouseover, onmouseout.					
Module:5 Advanced JavaScript					
				2 hours	
While Loop, External JavaScript Files, do Loop, Radio Buttons, Checkboxes, for Loop - fieldset and legend Elements- Manipulating CSS with JavaScript- Using z-index to Stack Elements-Textarea Controls - Pull-Down Menus- List Boxes- Canvas and Drawing - Event Handler and Listener.					
Module:6 ReactJS					
				2 hours	
React Environment Setup - ReactJS Basics - React JSX - React Components: React Component API - React Component Life Cycle - React Constructors - React Dev Tools - React Native vs ReactJS.					
Module:7 Advanced ReactJS					
				2 hours	
React Dataflow: React State - React Props - React Props Validation - Styling React - Hooks and Routing - Deploying React - Case Studies for building dynamic web applications.					
				Total Lecture hours:	
				15 hours	
Text Book(s)					
1.	Dean, J., Web Programming with HTML5, CSS, and JavaScript. Jones & Bartlett Learning 2018				

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

BCSE204L	Design and Analysis of Algorithms	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To provide mathematical foundations for analyzing the complexity of the algorithms 2. To impart the knowledge on various design strategies that can help in solving the real world problems effectively 3. To synthesize efficient algorithms in various engineering design situations					
Course Outcomes					
On completion of this course, student should be able to:					
1. Apply the mathematical tools to analyze and derive the running time of the algorithms 2. Demonstrate the major algorithm design paradigms. 3. Explain major graph algorithms, string matching and geometric algorithms along with their analysis. 4. Articulating Randomized Algorithms. 5. Explain the hardness of real-world problems with respect to algorithmic efficiency and learning to cope with it.					
Module:1	Design Paradigms: Greedy, Divide and Conquer Techniques	6 hours			
Overview and Importance of Algorithms - Stages of algorithm development: Describing the problem, Identifying a suitable technique, Design of an algorithm, Derive Time Complexity, Proof of Correctness of the algorithm, Illustration of Design Stages - Greedy techniques: Fractional Knapsack Problem, and Huffman coding - Divide and Conquer: Maximum Subarray, Karatsuba faster integer multiplication algorithm.					
Module:2	Design Paradigms: Dynamic Programming, Backtracking and Branch & Bound Techniques	10 hours			
Dynamic programming: Assembly Line Scheduling, Matrix Chain Multiplication, Longest Common Subsequence, 0-1 Knapsack, TSP- Backtracking: N-Queens problem, Subset Sum, Graph Coloring- Branch & Bound: LIFO-BB and FIFO BB methods: Job Selection problem, 0-1 Knapsack Problem					
Module:3	String Matching Algorithms	5 hours			
Naïve String-matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, Suffix Trees.					
Module:4	Graph Algorithms	6 hours			
All pair shortest path: Bellman Ford Algorithm, Floyd-Warshall Algorithm - Network Flows: Flow Networks, Maximum Flows: Ford-Fulkerson, Edmond-Karp, Push Re-label Algorithm – Application of Max Flow to maximum matching problem					
Module:5	Geometric Algorithms	4 hours			
Line Segments: Properties, Intersection, sweeping lines - Convex Hull finding algorithms: Graham's Scan, Jarvis' March Algorithm.					
Module:6	Randomized algorithms	5 hours			
Randomized quick sort - The hiring problem - Finding the global Minimum Cut.					
Module:7	Classes of Complexity and Approximation Algorithms	7 hours			
The Class P - The Class NP - Reducibility and NP-completeness – SAT (Problem Definition and statement), 3SAT, Independent Set, Clique, Approximation Algorithm – Vertex Cover, Set Cover and Travelling salesman					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 hours
Text Book					
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.				

Reference Books			
1.	Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education, 1 st Edition, 2014.		
2.	Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press, 1995 (Online Print – 2013)		
3.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1 st Edition, Pearson Education, 2014.		
Mode of Evaluation: CAT, Written assignments, Quiz, FAT.			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE204P	Design and Analysis of Algorithms Lab	L	T	P	C
		0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
1. To provide mathematical foundations for analyzing the complexity of the algorithms 2. To impart the knowledge on various design strategies that can help in solving the real world problems effectively 3. Synthesize efficient algorithms in various engineering design situations					
Course Outcome					
On completion of this course, student should be able to: 1. Demonstrate the major algorithm design paradigms. 2. Explain major graph algorithms, string matching and geometric algorithms along with their analysis.					
Indicative Experiments					
1.	Greedy Strategy : Activity Selection & Huffman coding				
2.	Dynamic Programming : ALS, Matrix Chain Multiplication , Longest Common Subsequence, 0-1 Knapsack				
3.	Divide and Conquer : Maximum Subarray and Karatsuba faster integer multiplication algorithm				
4.	Backtracking: N-queens				
5.	Branch and Bound: Job selection				
6.	String matching algorithms : Naïve, KMP and Rabin Karp,suffix trees				
7.	MST and all pair shortest path algorithms				
8.	Network Flows : Ford –Fulkerson and Edmond - Karp				
9.	Intersection of line segments & Finding Convexhull, Finding closest pair of points				
10.	Polynomial time algorithm for verification of NPC problems				
11.	Approximation and Randomized algorithms				
Total Laboratory Hours					30 Hours
Text Book					
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.				
Reference Books					
1.	Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education, 1 st Edition, 2014.				
2.	Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press, 1995 (Online Print – 2013)				
3.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1 st Edition, Pearson Education, 2014.				
Mode of assessment: Continuous assessments, FAT.					
Recommended by Board of Studies		04-03-2022			
Approved by Academic Council		No. 65	Date	17-03-2022	

BCSE205L	Computer Architecture and Organization	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer and to impart the knowledge of data representation in binary and to understand the implementation of arithmetic algorithms in a typical computer. 2. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machine level programming. 3. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. And explore various alternate techniques for improving the performance of a processor. 					
Course Outcomes					
On completion of this course, student should be able to:					
<ol style="list-style-type: none"> 1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machine with different capabilities. Recognize different instruction formats and addressing modes. Validate efficient algorithm for fixed point and floating point arithmetic operations. 2. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction. 3. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration. 4. Assess the performance of IO and external storage systems. Classify parallel machine models. Analyze the pipeline hazards and solutions. 					
Module:1	Introduction To Computer Architecture and Organization	5 Hours			
Overview of Organization and Architecture –Functional components of a computer: Registers and register files - Interconnection of components - Overview of IAS computer function - Organization of the von Neumann machine - Harvard architecture - CISC & RISC Architectures.					
Module:2	Data Representation and Computer Arithmetic	5 Hours			
Algorithms for fixed point arithmetic operations: Multiplication (Booths, Modified Booths), Division (restoring and non-restoring) - Algorithms for floating point arithmetic operations - Representation of nonnumeric data (character codes).					
Module:3	Instruction Sets and Control Unit	9 Hours			
Computer Instructions: Instruction sets, Instruction Set Architecture, Instruction formats, Instruction set categories - Addressing modes - Phases of instruction cycle – ALU - Data-path and control unit: Hardwired control unit and Micro programmed control unit - Performance metrics: Execution time calculation, MIPS, MFLOPS.					
Module:4	Memory System Organization and Architecture	7 Hours			
Memory systems hierarchy: Characteristics, Byte Storage methods, Conceptual view of memory cell - Design of scalable memory using RAM's- ROM's chips - Construction of larger size memories - Memory Interleaving - Memory interface address map- Cache memory: principles, Cache memory management techniques, Types of caches, caches misses, Mean					

memory access time evaluation of cache.			
Module:5			
Interfacing and Communication			5 Hours
I/O fundamentals: handshaking, buffering, I/O Modules - I/O techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access, Direct Cache Access - Interrupt structures: Vectored and Prioritized-interrupt overhead - Buses: Synchronous and asynchronous - Arbitration.			
Module:6			
Subsystems			5 Hours
External storage systems: Solid state drivers - Organization and Structure of disk drives: Electronic- magnetic and optical technologies - Reliability of memory systems - Error detecting and error correcting systems - RAID Levels - I/O Performance			
Module:7			
High Performance Processors			7 Hours
Classification of models - Flynn's taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD) - Pipelining: Two stages, Multi stage pipelining, Basic performance issues in pipelining, Hazards, Methods to prevent and resolve hazards and their drawbacks - Approaches to deal branches - Superscalar architecture: Limitations of scalar pipelines, superscalar versus super pipeline architecture, superscalar techniques, performance evaluation of superscalar architecture - performance evaluation of parallel processors: Amdahl's law, speed-up and efficiency.			
Module:8			
Contemporary Issues			2 Hours
Total Lecture Hours			45 Hours
Text Book(s)			
1	David A. Patterson and John L. Hennessy, Computer Organization and Design -The Hardware / Software Interface 6 th Edition, Morgan Kaufmann, 2020		
Reference Book(s)			
1	Computer Architecture and Organization-Designing for Performance, William Stallings, Tenth edition, Pearson Education series, 2016		
2	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.		
Mode of Evaluation: CAT, Written Assignments, Quiz and FAT.			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE301L	Software Engineering	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the essential Software Engineering concepts. 2. To impart concepts and skills for performing analysis, design ,develop, test and evolve efficient software systems of various disciplines and applications 3. To make familiar about engineering practices, standards and metrics for developing software components and products. 					
Course Outcomes					
<p>On completion of this course, student should be able to:</p> <ol style="list-style-type: none"> 1. Apply and assess the principles of various process models for the software development. 2. Demonstrate various software project management activities that include planning , Estimations, Risk assessment and Configuration Management 3. Perform Requirements modelling and apply appropriate design and testing heuristics to produce quality software systems. 4. Demonstrate the complete Software life cycle activities from requirements analysis to maintenance using the modern tools and techniques. 5. Escalate the use of various standards and metrics in evaluating the process and product. 					
Module:1	Overview Of Software Engineering	6 hours			
<p>Nature of Software, Software Engineering, Software process, project, product, Process Models Classical Evolutionary models, Introduction to Agility - Agile Process-Extreme programming - XP Process – Principles of Agile Software Development framework - Overview of System Engineering</p>					
Module:2	Introduction To Software Project Management	6 hours			
<p>Planning, Scope, Work break-down structure, Milestones, Deliverables, Cost and Estimates - (Human Resources, Time-scale, Costs), Risk Management, RMMM Plan, CASE TOOLS, Agile Project Management, Managing team dynamics and communication, Metrics and Measurement</p>					
Module:3	Modelling Requirements	8 hours			
<p>Software requirements and its types, Requirements Engineering process, Requirement Elicitation, System Modeling – Requirements Specification and Requirement Validation, Requirements Elicitation techniques, Requirements management in Agile.</p>					
Module:4	Software Design	8 hours			
<p>Design concepts and principles - Abstraction - Refinement - Modularity Cohesion coupling, Architectural design, Detailed Design Transaction Transformation, Refactoring of designs, Object oriented Design User-Interface Design</p>					
Module:5	Validation And Verification	7 hours			
<p>Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection and Auditing – Regression Testing – Mutation Testing - Object oriented testing - Testing Web based System - Mobile App testing – Mobile test Automation and tools – DevOps Testing – Cloud and Big Data Testing</p>					
Module:6	Software Evolution	4 hours			

Software Maintenance, Types of Maintenance, - Software Configuration Management – Overview – SCM Tools. Re-Engineering, Reverse Engineering, Software Reuse			
Module:7	Quality Assurance	4 hours	
Product and Process Metrics, Quality Standards Models ISO, TQM, Six-Sigma, Process improvement Models: CMM & CMMI. Quality Control and Quality Assurance - Quality Management - Quality Factors - Methods of Quality Management			
Module:8	Contemporary Issues	2 hours	
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Ian Somerville, Software Engineering, 10 th Edition, Addison-Wesley, 2015		
Reference Books			
1.	Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 10 th edition, McGraw Hill Education, 2019		
2.	William E. Lewis , Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT.			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE301P	Software Engineering Lab			L	T	P	C
				0	0	2	1
Pre-requisite	NIL	Syllabus version					
		1.0					
Course Objectives							
<ol style="list-style-type: none"> To introduce the essential Software Engineering concepts. To impart concepts and skills for performing analysis, design, develop, test and evolve efficient software systems of various disciplines and applications To make familiar about engineering practices, standards and metrics for developing software components and products. 							
Course Outcome							
On completion of this course, student should be able to:							
<ol style="list-style-type: none"> Demonstrate the complete Software life cycle activities from requirements analysis to maintenance using the modern tools and techniques. 							
Indicative Experiments							
1.	Analysis and Identification of the suitable process models						
2.	Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based) and Estimations						
3.	Requirement modelling using Entity Relationship Diagram (Structural Modeling)						
4.	Requirement modelling using Context flow diagram, DFD (Functional Modeling)						
5.	Requirement modelling using State Transition Diagram (Behavioral Modeling)						
6.	OO design – Use case Model, Class Model						
7.	OO design – Interaction Models						
8.	OO design – Package, Component and deployment models						
9.	Design and demonstration of test cases. Functional Testing and Non- Functional Testing (using any open source tools)						
10.	Story Boarding and User Interface design Modelling						
						Total Laboratory Hours	30 hours
Text Book(s)							
1.	Ian Somerville, Software Engineering, 10 th Edition, Addison-Wesley, 2015						
Reference Books							
1.	Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 10 th edition, McGraw Hill Education, 2019						
2.	William E. Lewis, Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017						
Mode of assessment: Continuous assessments, FAT.							
Recommended by Board of Studies				04-03-2022			
Approved by Academic Council			No. 65		Date	17-03-2022	

BCSE302L	Database Systems	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the concepts of File system and structure of the database; Designing an Entity-Relationship model for a real-life application and Mapping a database schema from the ER model. 2. To differentiate various normal forms, evaluate relational schemas for design qualities and optimize a query. 3. To impart the working methodologies of transaction management, understand concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management. 					
Course Outcomes					
On completion of this course, student should be able to:					
<ol style="list-style-type: none"> 1. Comprehend the role of database management system in an organization and design the structure and operation of the relational data model. 2. Develop a database project depending on the business requirements, considering various design issues. 3. List the concepts of indexing and accessing methods. 4. Explain the concept of a database transaction processing and comprehend the concept of database facilities including concurrency control, backup and recovery. 5. Review the fundamental view on unstructured data and describe other emerging database technologies. 					
Module:1	Database Systems Concepts and Architecture	4 hours			
Need for database systems – Characteristics of Database Approach – Advantages of using DBMS approach - Actors on the Database Management Scene: Database Administrator - Classification of database management systems - Data Models - Schemas and Instances - Three-Schema Architecture - The Database System Environment - Centralized and Client/Server Architectures for DBMSs – Overall Architecture of Database Management Systems					
Module:2	Relational Model and E-R Modeling	6 hours			
Relational Model: Candidate Keys, Primary Keys, Foreign Keys - Integrity Constraints - Handling of Nulls - Entity Relationship Model: Types of Attributes, Relationships, Structural Constraints, Relational model Constraints – Mapping ER model to a relational schema – Extended ER Model - Generalization – Specialization – Aggregations.					
Module:3	Relational Database Design	6 hours			
Database Design – Schema Refinement - Guidelines for Relational Schema - Functional dependencies - Axioms on Functional Dependencies- Normalization: First, Second and Third Normal Forms - Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form - Join dependency and Fifth Normal form					
Module:4	Physical Database Design and Query Processing	8 hours			
File Organization - Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing - B+ Tree Indexing – Hashing Techniques: Static and Dynamic Hashing – Relational Algebra - Translating SQL Queries into Relational Algebra - Query Processing – Query Optimization: Algebraic Query Optimization, Heuristic query optimization Rules, Join Query Optimization using Indexing and Hashing - Tuple Relational Calculus.					
Module:5	Transaction Processing and Recovery	8 hours			

Introduction to Transaction Processing – Transaction concepts: ACID Properties of Transactions, Transaction States - Serial and Serializable Schedules - Schedules based on recoverability – Schedules based on Serializability - Conflict Serializability - Recovery Concepts: Log Based Recovery Protocols, Recovery based on deferred update, Recovery techniques based on immediate update – Shadow Paging Algorithm			
Module:6	Concurrency Control In Transaction Processing		8 hours
Concurrent Transactions – Lost Update Problem - Concurrency Control Techniques: Time Stamp Based Protocols, Thomas Write Rule, Lock Based Protocols, Lock Compatibility Matrix, - Two-Phase Locking Protocol - Lock Conversions - Graph Based Protocols for Concurrency Control - Tree Protocol for Concurrency Control – Deadlocks Based on Locks in Transactions – Deadlock Handling Techniques – Transaction Deadlock Detection Techniques – Transaction Deadlock Prevention Techniques – Multi-Granularity Locking for avoiding Transaction Deadlocks			
Module:7	NOSQL Database Management		3 hours
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data bases: Key-value data stores, Columnar families, Document databases, Graph databases			
Module:8	Contemporary Issues		2 Hours
Total Lecture hours:			45 hours
Text Book			
1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7 th Edition, 2016		
Reference Books			
1.	A. Silberschatz, H. F. Korth & S. Sudarshan, Database System Concepts, McGraw Hill, 7 th Edition 2019.		
2.	Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4 th Edition, 2018		
3.	C.J.Date, A.Kannan, S.Swamynathan, " An Introduction to Database Systems", Pearson, Eighth Edition, 2006.		
4.	Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCOOKS, 2021		
Mode of Evaluation: CAT, Written assignments, Quiz and FAT.			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE302P	Database Systems Lab	L	T	P	C
		0	0	2	1
Pre-requisite		Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Basic ability to understand the concepts of File system and structure of the database; Designing an Entity-Relationship model for a real-life application and Mapping a database schema from the ER model. 2. Differentiate various normal forms, evaluate relational schemas for design qualities and optimize a query. 3. Explain the working methodologies of transaction management and give a solution during a transaction failure. Understand the basic concepts on concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management. 					
Course Outcome					
On completion of this course, student should be able to:					
<ol style="list-style-type: none"> 1. Design the structure and operation of the relational data model. 2. Examine the data requirements of the real world and design a database management system. 					
Indicative Experiments					
1.	Data Definition and Data Manipulation Language				
2.	Constraints				
3.	Single row functions				
4.	Operators and group functions				
5.	Sub query, views and joins				
6.	High Level Language Extensions - Procedures, Functions, Cursors and Triggers				
Total Laboratory Hours					30 hours
Text Book					
1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7 th Edition, 2016				
Reference Books					
1.	A. Silberschatz, H. F. Korth & S. Sudarshan, Database System Concepts, McGraw Hill, 7 th Edition 2019.				
2.	Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4 th Edition, 2018				
3.	C.J.Date, A.Kannan, S.Swamynathan," An Introduction to Database Systems", Pearson, Eighth Edition, 2006.				
4.	Gerardus Blokydyk, NoSQL Databases A Complete Guide, 5STARCOoks, 2021				
Mode of assessment: Continuous assessments, FAT					
Recommended by Board of Studies			04-03-2022		
Approved by Academic Council			No. 65	Date	17-03-2022

BCSE303L	Operating Systems			L	T	P	C
				3	0	0	3
Pre-requisite	NIL			Syllabus version			
				1.0			
Course Objectives							
<ol style="list-style-type: none"> 1. To introduce the operating system concepts, designs and provide skills required to implement the services. 2. To describe the trade-offs between conflicting objectives in large scale system design. 3. To develop the knowledge for application of the various design issues and services. 							
Course Outcomes							
On completion of this course, student should be able to:							
<ol style="list-style-type: none"> 1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states. 2. Design scheduling algorithms to compute and compare various scheduling criteria. 3. Apply and analyze communication between inter process and synchronization techniques. 4. Implement page replacement algorithms, memory management problems and segmentation. 5. Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS. 							
Module:1	Introduction			3 hours			
Introduction to OS: Functionality of OS - OS design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, resources - Influence of security, networking, and multimedia.							
Module:2	OS Principles			4 hours			
System calls, System/Application Call Interface – Protection: User/Kernel modes - Interrupts -Processes - Structures (Process Control Block, Ready List etc.), Process creation, management in Unix – Threads: User level, kernel level threads and thread models.							
Module:3	Scheduling			9 hours			
Processes Scheduling - CPU Scheduling: Pre-emptive, non-pre-emptive - Multiprocessor scheduling – Deadlocks - Resource allocation and management - Deadlock handling mechanisms: prevention, avoidance, detection, recovery.							
Module:4	Concurrency			8 hours			
Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson’s solution, Bakery algorithm, synchronization hardware) - Semaphores – Classical synchronization problems, Monitors: Solution to Dining Philosophers problem – IPC in Unix, Multiprocessors and Locking - Scalable Locks - Lock-free coordination.							
Module:5	Memory Management			7 hours			
Main memory management, Memory allocation strategies, Virtual memory: Hardware support for virtual memory (caching, TLB) – Paging - Segmentation - Demand Paging - Page Faults - Page Replacement -Thrashing - Working Set.							
Module:6	Virtualization and File System Management			6 hours			
Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.							
Module:7	Storage Management, Protection and Security			6 hours			
Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication -							

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

BCSE303P	Operating Systems Lab			L	T	P	C
				0	0	2	1
Pre-requisite	Nil			Syllabus version			
				1.0			
Course Objectives							
<ol style="list-style-type: none"> 1. To introduce the operating system concepts, designs and provide skills required to implement the services. 2. To describe the trade-offs between conflicting objectives in large scale system design. 3. To develop the knowledge for application of the various design issues and services. 							
Course Outcome							
On completion of this course, student should be able to:							
<ol style="list-style-type: none"> 1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states. 2. Design scheduling algorithms to compute and compare various scheduling criteria. 3. Apply and analyze communication between inter process and synchronization techniques. 4. Implement page replacement algorithms, memory management problems and segmentation. Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS. 							
Indicative Experiments							
1.	Study of Basic Linux Commands						
2.	Implement your own bootloader program that helps a computer to boot an OS.						
3.	Shell Programming (I/O, Decision making, Looping, Multi-level branching)						
4.	Creating child process using fork () system call, Orphan and Zombie process creation						
5.	Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin)						
6.	Implement process synchronization using semaphores / monitors.						
7.	Simulation of Banker s algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately						
8.	Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading						
9.	Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms						
10.	Page Replacement Algorithms FIFO, LRU and Optimal						
11.	Implement a file locking mechanism.						
12.	Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report)						
						Total Laboratory Hours	30 hours
Text Book							
1.	Fox, Richard, "Linux with Operating System Concepts", 2022, 2 nd Edition, Chapman and Hall/CRC, UK.						
Reference Books							
1.	Love, Robert, "Linux System Programming: talking directly to the kernel and C library", 2013, 2 nd Edition, O'Reilly Media, Inc, United States.						
2.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 2018, 10 th Edition, Wiley, United States.						
Mode of Assessment: Continuous Assessments, FAT							
Recommended by Board of Studies				04-03-2022			
Approved by Academic Council			No. 65	Date	17-03-2022		

BCSE304L	Theory of Computation	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
1. Types of grammars and models of automata. 2. Limitation of computation: What can be and what cannot be computed. 3. Establishing connections among grammars, automata and formal languages.					
Course Outcome					
On completion of this course, student should be able to: 1. Compare and analyse different computational models 2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata. 3. Identify limitations of some computational models and possible methods of proving them. 4. Represent the abstract concepts mathematically with notations.					
Module:1	Introduction to Languages and Grammars	4 hours			
Recall on Proof techniques in Mathematics - Overview of a Computational Models - Languages and Grammars - Alphabets - Strings - Operations on Languages, Overview on Automata					
Module:2	Finite State Automata	8 hours			
Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) - NFA with epsilon transitions – NFA without epsilon transition, conversion of NFA to DFA, Equivalence of NFA and DFA – minimization of DFA					
Module:3	Regular Expressions and Languages	7 hours			
Regular Expression - FA and Regular Expressions: FA to regular expression and regular expression to FA - Pattern matching and regular expressions - Regular grammar and FA - Pumping lemma for regular languages - Closure properties of regular languages					
Module:4	Context Free Grammars	7 hours			
Context-Free Grammar (CFG) – Derivations - Parse Trees - Ambiguity in CFG - CYK algorithm – Simplification of CFG – Elimination of Useless symbols, Unit productions, Null productions - Normal forms for CFG: CNF and GNF - Pumping Lemma for CFL - Closure Properties of CFL					
Module:5	Pushdown Automata	5 hours			
Definition of the Pushdown automata - Languages of a Pushdown automata – Power of Non-Deterministic Pushdown Automata and Deterministic pushdown automata					
Module:6	Turing Machine	6 hours			
Turing Machines as acceptor and transducer - Multi head and Multi tape Turing Machines – Universal Turing Machine - The Halting problem - Turing-Church thesis					
Module:7	Recursive and Recursively Enumerable Languages	6 hours			
Recursive and Recursively Enumerable Languages, Language that is not Recursively Enumerable (RE) – computable functions – Chomsky Hierarchy – Undecidable problems - Post's Correspondence Problem					
Module:8	Contemporary Issues	2 hours			
		Total Lecture hours:		45 hours	
Text Book					
1.	J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, India 2008. ISBN: 978-8131720479				
Reference Books					

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

BCSE305L	Embedded Systems		L	T	P	C
			3	0	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				
Course Objectives						
<p>1. To expose students to various challenges and constraints of special purpose computing systems in terms of resources and functional requirements.</p> <p>2. To introduce students to various components of typical embedded systems viz., sensors and actuators, data converters, UART etc., their interfacing, programming environment for developing any smart systems and various serial communication protocols for optimal components interfacing and communication.</p> <p>3. To make students understand the importance of program modeling, optimization techniques and debugging tools for product development and explore various solutions for real time scheduling issues in terms of resources and deadline.</p>						
Course Outcomes						
<p>On completion of this course, students should be able to:</p> <ol style="list-style-type: none"> 1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces. 2. To summaries the functionality of any special purpose computing system, and to propose smart solutions to engineering challenges at the prototype level. 3. To examine the working principle and interface of typical embedded system components, create programme models, apply various optimization approaches including simulation environment and demonstration using debugging tools. 4. To evaluate the working principle of serial communication protocols and their proper use, as well as to analyze the benefits and drawbacks of real-time scheduling algorithms and to recommend acceptable solutions for specific challenges. 						
Module:1	Introduction		5 hours			
Overview of Embedded Systems, Design challenges, Embedded processor technology, Hardware Design, Micro-controller architecture -8051, PIC, and ARM.						
Module:2	I/O Interfacing Techniques		8 hours			
Memory interfacing, A/D, D/A, Timers, Watch-dog timer, Counters, Encoder & Decoder, UART, Sensors and actuators interfacing.						
Module:3	Architecture of Special Purpose Computing System		6 hours			
ATM, Handheld devices, Data Compressor, Image Capturing Devices–Architecture and Requirements, Challenges & Constraints of special purpose computing system.						
Module:4	Programming Tools		7 hours			
Evolution of embedded programming tools, Modelling programs, Code optimization, Logic analyzers, Programming environment.						
Module:5	Real Time Operating System		8 hours			
Classification of Real time system, Issues & challenges in RTS, Real time scheduling schemes- EDF-RMS & Hybrid techniques, eCOS, POSIX, Protothreads.						
Module:6	Embedded Networking Protocols		5 hours			
Inter Integrated Circuits (I2C), Controller Area Network, Embedded Ethernet Controller, RS232, Bluetooth, Zigbee, Wifi.						
Module:7	Applications of Embedded Systems		4 hours			
Introduction to embedded system applications using case studies – Role in Agriculture sector, Automotive electronics, Consumer Electronics, Industrial controls, Medical Electronics.						
Module:8	Contemporary Issues		2 hours			

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

BCSE306L	Artificial Intelligence	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To impart artificial intelligence principles, techniques and its history. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems To develop intelligent systems by assembling solutions to concrete computational problems 					
Course Outcomes					
On completion of this course, student should be able to:					
<ol style="list-style-type: none"> Evaluate Artificial Intelligence (AI) methods and describe their foundations. Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning. Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems Analyse and illustrate how search algorithms play a vital role in problem-solving 					
Module:1	Introduction	6 hours			
Introduction- Evolution of AI, State of Art -Different Types of Artificial Intelligence- Applications of AI-Subfields of AI-Intelligent Agents- Structure of Intelligent Agents- Environments					
Module:2	Problem Solving based on Searching	6 hours			
Introduction to Problem Solving by searching Methods-State Space search, Uninformed Search Methods – Uniform Cost Search, Breadth First Search- Depth First Search-Depth-limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search					
Module 3	Local Search and Adversarial Search	5 hours			
Local Search algorithms – Hill-climbing search, Simulated annealing, Genetic Algorithm, Adversarial Search: Game Trees and Minimax Evaluation, Elementary two-players games: tic-tac-toe, Minimax with Alpha-Beta Pruning.					
Module:4	Logic and Reasoning	8 hours			
Introduction to Logic and Reasoning -Propositional Logic-First Order Logic-Inference in First Order Logic- Unification, Forward Chaining, Backward Chaining, Resolution.					
Module:5	Uncertain Knowledge and Reasoning	5 hours			
Quantifying Uncertainty- Bayes Rule -Bayesian Belief Network- Approximate Inference in Bayesian networks					
Module:6	Planning	7 hours			
Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning and acting in Nondeterministic domains – Sensor-less Planning, Multiagent planning					
Module:7	Communicating, Perceiving and Acting	6 hours			
Communication-Fundamentals of Language -Probabilistic Language Processing -Information Retrieval- Information Extraction-Perception-Image Formation- Object Recognition.					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 hours
Text Book					
1.	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3 rd Edition, Prentice Hall.				

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

BCSE307L	Compiler Design	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To provide fundamental knowledge of various language translators. 2. To make students familiar with lexical analysis and parsing techniques. 3. To understand the various actions carried out in semantic analysis. 4. To make the students get familiar with how the intermediate code is generated. 5. To understand the principles of code optimization techniques and code generation. 6. To provide foundation for study of high-performance compiler design. 					
Course Outcomes					
<ol style="list-style-type: none"> 1. Apply the skills on devising, selecting, and using tools and techniques towards compiler design 2. Develop language specifications using context free grammars (CFG). 3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems. 4. Constructing symbol tables and generating intermediate code. 5. Obtain insights on compiler optimization and code generation. 					
Module:1	INTRODUCTION TO COMPILATION AND LEXICAL ANALYSIS	7 hours			
Introduction to LLVM - Structure and Phases of a Compiler-Design Issues-Patterns-Lexemes-Tokens-Attributes-Specification of Tokens-Extended Regular Expression- Regular expression to Deterministic Finite Automata (Direct method) - Lex - A Lexical Analyzer Generator.					
Module:2	SYNTAX ANALYSIS	8 hours			
Role of Parser- Parse Tree - Elimination of Ambiguity – Top Down Parsing - Recursive Descent Parsing - LL (1) Grammars – Shift Reduce Parsers- Operator Precedence Parsing - LR Parsers, Construction of SLR Parser Tables and Parsing- CLR Parsing- LALR Parsing.					
Module:3	SEMANTICS ANALYSIS	5 hours			
Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation - Syntax Directed Translation Schemes - Implementation of L-attributed Syntax Directed Definition.					
Module:4	INTERMEDIATE CODE GENERATION	5 hours			
Variants of Syntax trees - Three Address Code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.					
Module:5	CODE OPTIMIZATION	6 hours			
Loop optimizations- Principal Sources of Optimization -Introduction to Data Flow Analysis - Basic Blocks - Optimization of Basic Blocks - Peephole Optimization- The DAG Representation of Basic Blocks -Loops in Flow Graphs - Machine Independent Optimization- Implementation of a naïve code generator for a virtual Machine- Security checking of virtual machine code.					
Module:6	CODE GENERATION	5 hours			
Issues in the design of a code generator- Target Machine- Next-Use Information - Register Allocation and Assignment- Runtime Organization- Activation Records.					
Module:7	PARALLELISM	7 hours			
Parallelization- Automatic Parallelization- Optimizations for Cache Locality and Vectorization- Domain Specific Languages-Compilation- Instruction Scheduling and Software Pipelining- Impact of Language Design and Architecture Evolution on Compilers- Static Single Assignment					
Module:8	Contemporary Issues	2 hours			

	Total Lecture hours:		45 hours
Text Book(s)			
1.	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, techniques, & tools, 2007, Second Edition, Pearson Education, Boston.		
Reference Books			
1.	Watson, Des. A Practical Approach to Compiler Construction. Germany, Springer International Publishing, 2017.		
Mode of Evaluation: CAT, Quiz, Written assignment and FAT			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE307P	Compiler Design Lab			L	T	P	C
				0	0	2	1
Pre-requisite				Syllabus version			
				1.0			
Course Objectives							
<ol style="list-style-type: none"> 1. To provide fundamental knowledge of various language translators. 2. To make students familiar with phases of compiler. 3. To provide foundation for study of high-performance compiler design. 							
Course Outcome							
<ol style="list-style-type: none"> 1. Apply the skills on devising, selecting and using tools and techniques towards compiler design 2. Develop language specifications using context free grammars (CFG). 3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems. 4. Constructing symbol tables and generating intermediate code. 5. Obtain insights on compiler optimization and code generation. 							
Indicative Experiments							
1.	Implementation of LEXR using LLVM.						
2.	Implementation of handwritten parser using LLVM						
3.	Generating code with the LLVM backend.						
4.	Defining a real programming language.						
5.	Write a recursive descent parser for the CFG language and implement it using LLVM.						
6.	Write a LR parser for the CFG language and implement it in the using LLVM.						
7.	Intro to Flex and Bison Modify the scanner and parser so that terminating a statement with ";" b" instead of ";" results in the output being printed in binary.						
8.	Using LLVM-style RTTI for the AST and Generating IR from the AST.						
9.	Converting types from an AST description to LLVM types.						
10.	Emitting assembler text and object code.						
						Total Laboratory Hours	30 hours
Mode of assessment: CAT, FAT							
Text Book(s)							
1	Learn LLVM 12: A beginner's guide to learning LLVM compiler tools and core libraries with C++						
Reference Books							
1.	Watson, Des. A Practical Approach to Compiler Construction. Germany, Springer International Publishing, 2017.						
Recommended by Board of Studies				04-03-2022			
Approved by Academic Council				No. 65	Date	17-03-2022	

BCSE308L	Computer Networks	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures. To identify the suitable application layer protocols for specific applications and its respective security mechanisms. 					
Course Outcomes					
On completion of this course, student should be able to:					
<ol style="list-style-type: none"> Interpret the different building blocks of Communication network and its architecture. Contrast different types of switching networks and analyze the performance of network Identify and analyze error and flow control mechanisms in data link layer. Design sub-netting and analyze the performance of network layer with various routing protocols. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism. 					
Module:1	Networking Principles and Layered Architecture	6 hours			
Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)					
Module:2	Circuit and Packet Switching	7 hours			
Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)					
Module:3	Data Link Layer	8 hours			
Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – IEEE Standards(IEEE802.3 (Ethernet), IEEE802.11(WLAN))- RFID- Bluetooth Standards					
Module:4	Network Layer	8 hours			
IPv4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format					
Module:5	Routing Protocols	6 hours			
Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer					
Module:6	Transport Layer	5 hours			
TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters					
Module:7	Application layer	3 hours			
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP					
Module:8	Contemporary Issues	2 hours			
		Total Lecture hours:	45 hours		
Text Book					
1. Behrouz A. Forouzan, Data communication and Networking, 5th Edition, 2017,					

	McGraw Hill Education.		
Reference Books			
1.	James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6th Edition, 2017, Pearson Education.		
2.	William Stallings, "Data and Computer Communication", 10th Edition, 2017, Pearson, United Kingdom.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT			
Recommended by Board of Studies		04-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022

BCSE308P	Computer Networks Lab			L	T	P	C
				0	0	2	1
Pre-requisite	NIL	Syllabus version					
		1.0					
Course Objectives							
<ol style="list-style-type: none"> To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures. To identify the suitable application layer protocols for specific applications and its respective security mechanisms 							
Course Outcome							
On completion of this course, student should be able to:							
<ol style="list-style-type: none"> Interpret the different building blocks of Communication network and its architecture. Contrast different types of switching networks and analyze the performance of network Identify and analyze error and flow control mechanisms in data link layer. Design sub-netting and analyze the performance of network layer with various routing protocols. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism. 							
Indicative Experiments							
1.	Study of Basic Network Commands, Demo session of all networking hardware and Functionalities						
2.	Error detection and correction mechanisms						
3.	Flow control mechanisms						
4.	IP addressing Classless addressing						
5.	Observing Packets across the network and Performance Analysis of Routing protocols						
6.	Socket programming(TCP and UDP) - Some challenging experiments can be given on Socket programming						
7.	Simulation of unicast routing protocols						
8.	Simulation of Transport layer Protocols and analysis of congestion control techniques in network						
9.	Develop a DNS client server to resolve the given host name or IP address						
Total Laboratory Hours						30 hours	
Text book							
1	W.Richard Stevens, Uix Network Programming, 2ndEdition, Pearson Education, 2015.						
Mode of assessment: Continuous assessment, FAT							
Recommended by Board of Studies				04-03-2022			
Approved by Academic Council			No. 65		Date		17-03-2022

BCSE309L	Cryptography and Network Security	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To explore the concepts of basic number theory and cryptographic techniques. 2. To impart concept of Hash and Message Authentication, Digital Signatures and authentication protocols. 3. To reveal the basics of transport layer security, Web Security and various types of System Security. 					
Course Outcomes					
On completion of this course, students should be able to:					
<ol style="list-style-type: none"> 1. To know the fundamental mathematical concepts related to security. 2. To understand concept of various cryptographic techniques. 3. To apprehend the authentication and integrity process of data for various applications 4. To know fundamentals of Transport layer security, web security, E-Mail Security and IP Security 					
Module:1	Fundamentals of Number Theory	5 hours			
Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing: Fermats and Eulers theorem, Chinese Remainder theorem, Discrete Logarithms.					
Module:2	Symmetric Encryption Algorithms	7 hours			
Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA, Block Cipher Operation, Random Bit Generation and RC4					
Module:3	Asymmetric Encryption Algorithm and Key Exchange	8 hours			
Asymmetric key cryptographic techniques: principles, RSA, ElGamal, Elliptic Curve cryptography, Homomorphic Encryption and Secret Sharing, Key distribution and Key exchange protocols, Diffie-Hellman Key Exchange, Man-in-the-Meddle Attack					
Module:4	Message Digest and Hash Functions	5 hours			
Requirements for Hash Functions, Security of Hash Functions, Message Digest (MD5), Secure Hash Function (SHA), Birthday Attack, HMAC					
Module:5	Digital Signature and Authentication Protocols	7 hours			
Authentication Requirements, Authentication Functions, Message Authentication Codes, Digital Signature Authentication, Authentication Protocols, Digital Signature Standards, RSA Digital Signature, Elgamal based Digital Signature, Authentication Applications: Kerberos, X.509 Authentication Service, Public Key Infrastructure (PKI)					
Module:6	Transport Layer Security and IP Security	4 hours			
Transport-Layer Security, Secure Socket Layer(SSL),TLS, IP Security: Overview: IP Security Architecture, Encapsulating Payload Security					
Module:7	E-mail, Web and System Security	7 hours			
Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME, Web Security: Web Security Considerations, Secure Electronic Transaction Protocol Intruders, Intrusion Detection, Password Management, Firewalls: Firewall Design Principles, Trusted Systems.					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 hours
Text Book					
1. Cryptography and Network Security-Principles and Practice, 8 th Edition, by Stallings					

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

BCSE309P	Cryptography and Network Security Lab			L	T	P	C
				0	0	2	1
Pre-requisite	NIL	Syllabus version					
		1.0					
Course Objectives							
<ol style="list-style-type: none"> 1. Understand various Private and Public Key cryptographic algorithms. 2. To learn about hash functions and digital signature algorithms 3. Acquire knowledge in various network security models 							
Course Outcome							
On completion of this course, students should be able to:							
<ol style="list-style-type: none"> 1. Implement various cipher techniques without using standard cryptographic library functions 2. Develop the various hash functions and digital signature algorithms for different applications 3. Develop various secured networking-based application 							
Indicative Experiments							
1.	Consider a sender and receiver who need to exchange data confidentially using symmetric encryption. Write program that implements DES encryption and decryption using a 64 bit key size and 64 bit block size						
2.	Consider a sender and receiver who need to exchange data confidentially using symmetric encryption. Write program that implements AES encryption and decryption using a 64/128/256 bits key size and 64 bit block size.						
3	Develop an chipper scheme by using RSA						
4.	Develop a MD5 hash algorithm that finds the Message Authentication Code (MAC)						
5	Find a Message Authentication Code (MAC) for given variable size message by using SHA-128 and SHA-256 Hash algorithm Measure the Time consumptions for varying message size for both SHA-128 and SHA-256.						
6	Develop the Digital Siganture standard(DSS)for verifying the legal communicating parties						
7	Design a Diffie Hellman multiparty key exchange protocol and perform Man-in-the-Middle Attack.						
8	Develop a simple client and server application using SSL socket communication						
9	Develop a simple client server model using telnet and capture the packets transmitted with tshark Analyze the pcap file and get the transmitted data (plain text) using any packet capturing library. Implement the above scenario using SSH and observe the data						
10	Develop a web application that implements JSON web token						
Total Laboratory Hours						30 hours	
Mode of assessment: Continuous Assessment, FAT							
Recommended by Board of Studies				04-03-2022			
Approved by Academic Council			No. 65		Date	17-03-2022	

Specialization Elective Courses

Course code	Course Title	L	T	P	C
BCSE209L	Machine Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To teach the theoretical foundations of various learning algorithms. To train the students better understand the context of supervised and unsupervised learning through real-life examples. To understand the need for Reinforcement learning in real – time problems. Apply all learning algorithms over appropriate real-time dataset. Evaluate the algorithms based on corresponding metrics identified. 					
Course Outcome					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> Understand, visualize, analyze and preprocess the data from a real-time source. Apply appropriate algorithm to the data. Analyze the results of algorithm and convert to appropriate information required for the real – time application. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment. 					
Module:1	Introduction to Machine Learning and Pre-requisites	4 hours			
Introduction to Machine Learning – Learning Paradigms – PAC learning – Version Spaces – Role of Machine Learning in Artificial Intelligence applications.					
Module:2	Supervised Learning – I	7 hours			
Linear and Non-Linear examples – Multi-Class & Multi-Label classification – Linear Regression – Multiple Linear Regression – Naïve Bayes Classifier – Decision Trees – ID3 – CART – Error bounds.					
Module:3	Supervised Learning – II	8 hours			
K-NN classifier – Logistic regression – Perceptron – Single layer & Multi-layer – Support Vector Machines – Linear & Non-linear – Metrics & Error Correction.					
Module:4	Unsupervised Learning	9 hours			
Clustering basics (Partitioned, Hierarchical and Density based) - K-Means clustering – K-Mode clustering – Self organizing maps – Expectation maximization – Principal Component Analysis – Kernel PCA – tSNE (t-distributed stochastic neighbor embedding) - Metrics & Error Correction.					
Module:5	Ensemble Learning	5 hours			
Bias – Variance Tradeoff – Bagging and Boosting (Random forests, Adaboost, XG boost inclusive) – Metrics & Error Correction.					
Module:6	Machine Learning in Practice	3 hours			
Class Imbalance – SMOTE – One Class SVM – Optimization of hyper parameters.					
Module:7	Reinforcement Learning (RL)	8 hours			
Basics of RL – RL Framework – Markov Decision Process – Exploration Vs Exploitation - Policies, Value Functions and Bellman Equations – Solution Methods – Q-learning.					
Module:8	Contemporary Issues	1 hour			
	Total Lecture hours:	45 hours			
Text Book(s)					
1.	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014.				

2.	Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2 nd edition, A Bradford Book; 2018.		
Reference Books			
1.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, Foundations of Machine Learning, MIT Press, 2012.		
2.	Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition, 1997.		
3.	Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014		
Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		09-05-2022	
Approved by Academic Council		No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE209P	Machine Learning Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To teach the theoretical foundations of various learning algorithms. 2. To train the students better understand the context of supervised and unsupervised learning through real-life examples. 3. To understand the need for Reinforcement learning in real – time problems. 4. Apply all learning algorithms over appropriate real-time dataset. 5. Evaluate the algorithms based on corresponding metrics identified. 					
Course Outcome					
<ol style="list-style-type: none"> 1. At the end of this course, student will be able to: 2. Understand, visualize, analyze and preprocess the data from a real-time source. 3. Apply appropriate algorithm to the data. 4. Analyze the results of algorithm and convert to appropriate information required for the real – time application. 5. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment. 					
Indicative Experiments					
1.	Linear & Multiple Linear Regression				
2.	Naïve Bayes classifier				
3.	Decision trees – ID3 & CART				
4.	Logistic regression				
5.	Support Vector Machines – Linear & Non-linear				
6.	Single & Multilayer Perceptron				
7.	K-NN, K-Means & K-mode clustering				
8.	Random – forest				
9.	Adaboost, XGboost				
10.	Principal component analysis				
11.	Self – Organizing maps				
12.	Q-Learning				
Total Laboratory Hours					30 hours
Mode of Evaluation: CAT / Mid-Term Lab/ FAT					
Recommended by Board of Studies		09-05-2022			
Approved by Academic Council		No. 66	Date	16-06-2022	

Course code	Course Title	L	T	P	C
BCSE332L	Deep Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Introduce major deep neural network frameworks and issues in basic neural networks. 2. To solve real world applications using Deep learning. 					
Course Outcomes					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> 1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets. 2. Identify and apply suitable deep learning approaches for given application. 3. Design and develop custom Deep-nets for human intuitive applications. 4. Design of test procedures to assess the efficiency of the developed model. 5. To understand the need for Reinforcement learning in real – time problems. 					
Module:1	Introduction to neural networks and deep neural networks	7 hours			
Neural Networks Basics - Functions in Neural networks – Activation function, Loss function - Function approximation - Classification and Clustering problems - Deep networks basics - Shallow neural networks – Activation Functions – Gradient Descent – Back Propagation – Deep Neural Networks – Forward and Back Propagation – Parameters – Hyperparameters.					
Module:2	Improving deep neural networks	8 hours			
Mini-batch Gradient Descent – Exponential Weighted Averages – Gradient Descent with Momentum – RMSProp and Adam Optimization – Hyperparameter tuning – Batch Normalization – Softmax Regression – Softmax classifier – Deep Learning Frameworks – Data Augmentation - Under-fitting Vs Over-fitting.					
Module:3	Convolution neural networks	6 hours			
Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, InceptionNet and others.					
Module:4	Recurrent networks	6 hours			
Recurrent Neural Networks - Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders - Bidirectional Encoder Representations from Transformers (BERT).					
Module:5	Recursive neural networks	6 hours			
Long-Term Dependencies - Echo State Networks - Long Short-Term Memory and Other Gated RNNs - Optimization for Long-Term Dependencies - Explicit Memory.					
Module:6	Advanced Neural networks	6 hours			
Transfer Learning – Transfer Learning Models – Generative Adversarial Network and their variants – Region based CNN – Fast RCNN - You Only Look Once – Single shot detector.					
Module:7	Deep reinforcement learning	5 hours			
Deep Reinforcement Learning – Q-Learning – Deep Q-Learning – Policy Gradients - Advantage Actor Critic (A2C) and Asynchronous Advantage Actor Critic (A3C) – Model based Reinforcement Learning – Challenges.					
Module:8	Contemporary issues	1 hour			
Total Lecture hours:					45 Hours
Text Book(s)					

1.	Ian Goodfellow Yoshua Bengio Aaron Courville, Deep Learning, MIT Press, 2017.		
2	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, first Edition, 2013.		
Reference Books			
1.	N D Lewis, Deep Learning Step by Step with Python, 2016.		
2.	Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Media, 2017.		
3	Umberto Michelucci, Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Apress, 2018.		
4	Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Deep Learning with TensorFlow: Explore neural networks with Python, Packt Publisher, 2017.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies		09-05-2022	
Approved by Academic Council		No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE332P	Deep Learning Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. Introduce major deep neural network frameworks and issues in basic neural networks. 2. To solve real world applications using Deep learning.					
Course Outcomes					
At the end of this course, student will be able to:					
1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets. 2. Identify and apply suitable deep learning approaches for given application. 3. Design and develop custom Deep-nets for human intuitive applications. 4. Design of test procedures to assess the efficiency of the developed model. 5. Understand the need for Reinforcement learning in real – time problems.					
Indicative Experiments					
1.	Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras. <ul style="list-style-type: none"> Google Colaboratory - Cloning GitHub repository, Upload Data, Importing Kaggle's dataset, Basic File operations Implementing Perceptron, Digit Classification : Neural network to classify MNIST dataset 	10 hours			
2.	Hyper parameter tuning and regularization practice - <ul style="list-style-type: none"> Multilayer Perceptron (BPN) Mini-batch gradient descent, 	4 hours			
3.	Convolution Neural Network application using Tensorflow and Keras, <ul style="list-style-type: none"> Classification of MNIST Dataset using CNN Face recognition using CNN 	4 hours			
4.	Object detection using Transfer Learning of CNN architectures	2 hours			
5.	Image denoising (Fashion dataset) using Auto Encoders <ul style="list-style-type: none"> Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising) 	2 hours			
6.	Text processing, Language Modeling using RNN	2 hours			
7.	Transfer Learning models for classification problems	2 hours			
8.	Sentiment Analysis using LSTM	2 hours			
9.	Image generation using GAN	2 hours			
Total Laboratory Hours					30 hours
Mode of Evaluation: CAT / Mid-Term Lab/ FAT					
Recommended by Board of Studies		09-05-2022			
Approved by Academic Council		No. 66	Date	16-06-2022	

Course code	Course Title	L	T	P	C
BCSE416L	Game Programming	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To provide an in-depth introduction to technologies and techniques currently used in the game industry To understand game design and development To understand the processes, mechanics, issues in game design, and game engine development To understand modeling, techniques, handling situations, and logic To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive & immersive game application. 					
Course Outcomes:					
<ol style="list-style-type: none"> Design, develop, test, evaluate, debug, and modify code to meet design specifications for games. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends. Create and document the games by applying programming concepts using various tools to meet requirements of the current marketplace. 					
Module:1	Introduction to Game Programming & Game engine architecture	5 Hours			
Overview of game programming, Structure of a typical game team, game industry- game engine history- Real Time Game Architecture, Engine Support: Subsystem Start-Up and Shut-Down, Memory Management, Containers and Strings					
Module:2	Basics of 2D & 3D Graphics and Mathematics in Gaming & Rendering engine	6 Hours			
2D Graphics: Sprites, Tiled Images and Backgrounds - 3D Graphics: 3D Graphics Pipeline, 3D Math, Coordinates and Coordinate Systems, Quaternion Mathematics, Transformations & Geometry - Rendering Pipeline					
Module:3	Lighting and Texturing Effects in game environment	7 Hours			
Ray Tracing, Lighting in Computer Graphics, Types of Light Sources, Light Models - Materials: Lambert Diffuse, Phong -Bump Mapping - Lighting Technique: Point Lights, Bloom - Shadows in Games: Real-Time Versus Preprocessed Shadows - Types of Shadows - Texture mapping techniques - Special Effects: Blurring, Particle Systems, Weapon Effects					
Module:4	Game Physics	5 hours			
Basic Newtonian Mechanics- Forces: Gravitational Force, Friction, Centripetal Force - Energy: Kinetic Energy, Potential Energy - Basic Kinematics: The Relationship Between Force, Acceleration, Velocity and Location - Rigid Body Motion and Collision					
Module:5	Artificial Intelligence in Game for move prediction and optimization	7 Hours			
Games for Artificial Intelligence, Game AI Panoram; AI Methods: Tree Search, Evolutionary Computation, Supervised Learning & Reinforcement Learning.					
Module:6	Virtual and Augmented Reality	7 Hours			
Immersive reality application areas - Entertainment, Education, Training, Medical, Industrial, Military. VR: Position and Motion Trackers - Magnetic, Mechanical and Ultrasonic Trackers - Navigation and Manipulation Interfaces; AR: Selection of AR Platform, Integrating Hardware and Software , Optical & Inertial Calibration – Tracking – AR Computer Vision					

Module:7	Game Design & Management	6 Hours
Game design, Differing game types, modes, and perspectives, scripting, audio engineering, Sound and Music, level design; Game project management, Game design documentation, Rapid prototyping and game testing		
Module:8	Contemporary Issues	2 Hours
Total Lecture hours:		45 Hours
Text Book(s)		
1.	Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019	
2.	Palmer G. Physics for game programmers. Berkeley: Apress; 2005	
3	Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer	
References Books:		
1	Sherrod A. Game Graphic Programming. Cengage Learning; 2008.	
2	McShaffry M. Game coding complete. Nelson Education; 2014	
3	Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering	
4	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013	
5	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009	
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT		
Recommended by Board of Studies	09-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE416P	Game Programming Lab	0	0	2	1
Prerequisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To provide an in-depth introduction to technologies and techniques currently used in the game industry To understand game design and development To understand the processes, mechanics, issues in game design, and game engine development To understand modeling, techniques, handling situations, and logic To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive game application. 					
Course Outcome					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> Classify different Sensors & Actuators based on various physical phenomena and learn various sensor calibration techniques Select the relevant sensors and actuators to design real-time data acquisition from ambience via case studies 					
Indicative Experiments					
1.	Game engines - UNITY Basics/ Unreal/ Scratch, etc.,	2 Hours			
2.	Model Creation – Unity/ MAYA	4 Hours			
3.	2D Game environment	2 Hours			
4.	3D Game environment	2 Hours			
5.	Create a game environment to apply different types of light effects.	2 Hours			
6.	Create a physics based game play to realize all basic Newtonian effects	2 Hours			
7.	Create a Tile map based Game environment	2 Hours			
8.	Apply Multiple Levels for any of the Games developed	2 Hours			
9.	AI as Player	2 Hours			
10.	AI as Non Player Character (NPC) – Navigation Mesh creation	2 Hours			
11.	Create a racing game	2 Hours			
12.	Create a board game using AR/VR	4 Hours			
Total Laboratory Hours					30 hours
Text Book(s)					
1.	Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019				
2.	Palmer G. Physics for game programmers. Berkeley: Apress; 2005				
3.	Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer				
Reference Books					
1.	Sherrod A. Game Graphic Programming. Cengage Learning; 2008.				
2.	McShaffry M. Game coding complete. Nelson Education; 2014				
3.	Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering				
4.	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013				
5.	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009				
Mode of Evaluation: CAT / Mid-Term Lab/ FAT					
Recommended by Board of Studies		09-05-2022			
Approved by Academic Council		No. 66	Date	16-06-2022	

Course code	Course Title	L	T	P	C
BCSE417L	Machine Vision	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To enhance and restore the images acquired from cameras 2. To educate in taking the individual steps that leads to final inspection result based on the acquired image data. 3. To analyze the real-world problems and provide solutions to automated visual inspection 					
Course Outcomes					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> 1. Understand the basics of how an image is processed 2. Enhance, Analyze and segment the image using algorithms 3. To interpret the image and transform it using the mathematical knowledge 4. Extract the features from the image and represent using morphological operations 5. Apply the concept in understanding the scene and process the background part of the image 					
Module:1	Basics of Image Processing	4 hours			
Image Formation Physics, Image Digitization – Sampling and Quantization, Digital Image Properties, Color Image, Color spaces/ conversions, Cameras					
Module:2	Preprocessing and Image Enhancement	8 hours			
Image enhancement methods: Contrast Adjustment-Histogram Manipulation-Image Smoothing-Image Sharpening; Image Enhancement using Linear Filters – Ideal Low Pass Filter - Gaussian Filter – Ideal Noise Reduction using non linear filters-Geometric Rectification using Bilinear Interpolation-Suppression of in homogeneities using Homomorphic Filtering					
Module:3	Image Analysis and Segmentation	8 hours			
Thresholding - Edge detection- Edge Based Segmentation – Region Based Segmentation-Active Contour Models – Graph Based segmentation - Image Analysis- invariant feature - Image transforms					
Module:4	Mathematical Morphology and Texture Description Image Invariant feature	8 hours			
Skeletons and object marking – Morphological Segmentation – Statistical Texture Description – Co-occurrence matrices – Local Binary Patterns – Syntactic Texture Description Methods - Object Measurement - Counting -Visual inspection tasks regarding textures					
Module:5	Wavelet Transform and Multi-resolution Analysis/ image transforms	5 hours			
Image transforms - Frequency domain transformations - FFT's – Haar Wavelet - Multiresolution analysis - Scale-invariant features					
Module:6	Motion Analysis	6 hours			
Optical Flow – Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - stereo mapping-image fusion					
Module:7	Scene Analysis	4 hours			
Detection of known objects by linear filters - Detection of unknown objects - The Hough transform for the detection of lines - Corner detection - image tagging					

Module:8	Contemporary Issues	2 hours	
			Total Lecture hours: 45 Hours
Text Book(s)			
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4th Edition, Cengage Learning, USA		
2.	Jurgen Beyerer, Fernando Puente Leon, Christian Frese,"Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer		
3.	AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press		
Reference Books			
1.	Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies		09-05-2022	
Approved by Academic Council		No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE417P	Machine Vision Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To enhance the image using various image enhancement methods To segment the image and extract the features To track object from the extracted video frame to support visual inspection process 					
Course Outcome					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> To identify the required operations that helps to segment an object from an enhanced image To apply various techniques to analyze and extract features that helps in visual inspection and classification 					
Indicative Experiments					
1.	Program to display different types of images from different color models	3 hours			
2.	To perform histogram equalization on the image.	3 hours			
3.	Program to perform the edge detection process and extract edges from the input image	5 hours			
4.	Program to perform segmentation, extract and display the segmented region	7 hours			
	Program to analyze and describe the segmented region	3 hours			
5.	Program to detect an object from the input frame	3 hours			
6.	Program to track the object between two frames from image/video	3 hours			
7.	program to demonstrate to understand a scene and generate caption	3 hours			
8.	Program to classify defective object from the correct object	3 hours			
Total Laboratory Hours					30 hours
Text Book(s)					
1.	Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications				
Reference Books					
1.	S.Sridhar, Digital Image Processing, First Edition, Oxford Press				
2.	S. Jayaraman, S.Esakirajan, T.Veerakumar , "Digital Image Processing", TMH First Edition, 2009				
Mode of Evaluation: CAT / Mid-Term Lab/ FAT					
Recommended by Board of Studies			09-05-2022		
Approved by Academic Council			No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE418L	Explainable Artificial Intelligence	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To familiarize concepts related to Explainable Artificial Intelligence (XAI) and interpretable methods, with emphasis on how to build a trustworthy AI system. To understand the performance of a machine learning model and its ability to produce explainable and interpretable predictions. 					
Course Outcomes					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> Understand the methods and terminologies involved in Explainable AI, Differentiate the methods used in XAI and apply suitable XAI Models or approaches for given application. Design and develop XAI use cases for real time applications. Design of test procedures to assess the efficiency of the developed model 					
Module:1	Introduction to Explainable Artificial Intelligence	4 hours			
Fundamentals of XAI - Categorization of XAI - Taxonomy of XAI methods for Machine Learning - Machine Learning Interpretability - Causal Model Induction - Causality learning - XAI techniques and limitations.					
Module:2	Interpretability	5 hours			
Difference between Interpretability and Explainability - Interpretability methods to explain Black-Box Model - Scope of Interpretability - Apply interpretability on Regression, Logistic regression, Generalized Additive Models, Decision Tree - Neural network interpretation - Evaluation of Interpretability					
Module:3	Deep Explanation	4 hours			
Attention Mechanisms - Modular Networks - Feature Identification - Learn to Explain - Feature Visualization - Deep Visualization- gradcam and Activation maps - Sensitivity analysis -					
Module:4	XAI Models	5 hours			
Ante-hoc Explainability (AHE) models - Post-hoc Explainability (PHE) models - Interactive Machine Learning (IML) - Black Box Explanation through Transparent Approximation (BETA) models - Hybrid Models.					
Module:5	XAI Methods	5 hours			
XAI Techniques - Local Interpretable Model-Agnostic Explanations (LIME) - Understanding Mathematical representation of LIME - Shapley Additive exPlanations (SHAP) - Diverse Counterfactual Explanations (DiCE) - Layer wise Relevance Propagation (LRP).					
Module:6	Trust and acceptance	3 hours			
Metrics to evaluate XAI, Trustworthy Explainability Acceptance, Power Quality Disturbance (PQD) classification, Methods for measuring human intelligence. Evaluating AI system.					
Module:7	Building Trustworthy Model with Explainable AI	3 hours			
Medical diagnosis- Making AI Decisions Trustworthy for Physicians and Patients – Sales predictions on the house sale.					
Module:8	Recent Trends	1 hours			
Total Lecture hours:					30 Hours
Text Book(s)					

1.	Molnar, Christoph. "Interpretable machine learning. A Guide for Making Black Box Models Explainable", 2019. https://christophm.github.io/interpretable-ml-book/ .		
2	Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning, Uday Kamath: John Liu, Springer, ISBN 9783030833558		
Reference Books			
1.	Tim Miller Explanation in Artificial Intelligence: Insight from Social Science, https://arxiv.org/abs/1706.07269		
2.	A Guide for making black-box machine learning models https://christophm.github.io/interpretable-ml-book/		
3	Explainable AI: A Review of Machine Learning Interpretability Methods https://www.mdpi.com/1099-4300/23/1/18		
4	Lötsch, J.; Kringel, D.; Ultsch, A. Explainable Artificial Intelligence (XAI) in Biomedicine: Making AI Decisions Trustworthy for Physicians and Patients. <i>BioMedInformatics</i> 2022, 2, 1-17. https://doi.org/10.3390/biomedinformatics2010001		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022

Course code	Course Title	L	T	P	C
BCSE419L	Speech and Language Processing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Be competent with fundamental concepts for natural language processing and automatic speech recognition 2. To understand technologies involved in developing speech and language applications. 3. To demonstrate the use of deep learning for building applications in speech and natural language processing 					
Course Outcomes					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> 1. Describe the importance of different NLP modules in Text processing and fundamentals of speech production 2. Describe ways to represent speech and text 3. Demonstrate the working of sequence models for text 4. Use signal processing techniques to analyze/represent the speech signal 5. Execute trials of speech/language systems 					
Module:1	Introduction to Natural Language Processing	7 hours			
Overview of NLP - Introduction to Levels of NLP - Morphology: Derivational & Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.					
Module:2	Text Preprocessing & Feature Representation	8 hours			
Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fasttext.					
Module:3	Applications of NLP-1	6 hours			
Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models.					
Module:4	Applications of NLP-2	4 hours			
Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.					
Module:5	Introduction to Speech Processing	6 hours			
Fundamentals of speech production – Perception of sound – Vocal tract model - Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis.					
Module:6	Feature Representaion of Speech Signal	4 hours			
Mel Frequency Cepstral Coefficients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.					
Module:7	Automatic Speech and Speaker Recognition	8 hours			
Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model -- CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker recognition model – Alexa/Google assistant based application development.					
Module:8	Contemporary issues	2 hours			
Total Lecture hours:					45 Hours

Text Book(s)			
1.	Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3 rd Edition, Prentice Hall 2022.		
2.	Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.		
Reference Books			
1.	Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.		
2.	Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.		
3.	Ben Gold, Nelson Morgan, Dan Ellis "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley & Sons, 2011.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies		09-05-2022	
Approved by Academic Council		No. 66	Date 16-06-2022

Course code	Course Title	L	T	P	C
BCSE419P	Speech and Language Processing Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Be competent with fundamental concepts for natural language processing and automatic speech recognition 2. To understand technologies involved in developing speech and language applications. 3. To demonstrate the use of deep learning for building applications in speech and natural language processing 					
Course Outcome					
At the end of this course, student will be able to: <ol style="list-style-type: none"> 1. Describe the importance of different NLP modules in text processing and fundamentals of speech production 2. Describe ways to represent speech and text 3. Demonstrate the working of sequence models for text 4. Use signal processing techniques to analyze/represent the speech signal 5. Execute trials of speech/language systems 					
Indicative Experiments					
1.	Installing various packages for text and Speech Processing: NLTK, Spacy, Speech Recognition etc.	3 Hours			
2.	POS Tagging and Parsing using various python packages	2 Hours			
3.	Implementation of BOW, topic models for text representation and classification	2 Hours			
4.	Implementing N-gram language models for next word prediction	2 Hours			
5.	Implementing Word embedding based text classification	2 Hours			
6.	Implementing CNN for sentiment analysis	2 Hours			
7.	Implementing RNN for Named Entity recognition	2 Hours			
8.	Implementing text summarization using deep learning	2 Hours			
9.	Implementing chatbot using deep learning	2 Hours			
10.	Implementing machine translation using encoder-decoder models	2 Hours			
11.	Developing speech recognition system to recognize voice commands	3 Hours			
12.	Developing speech recognition system to recognize continuous speech	3 Hours			
13.	Implementing CNN based speech recognition using mel spectral images	3 Hours			
Total Laboratory Hours					30 hours
Text Book(s)					
1.	Delip Rao, Brian McMahan, "Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning", 2019, 1 st Edition, O'Reilly Media.				
Reference Books					
1.	Mark Liu, "Make Python Talk: Build Apps with Voice Control and Speech Recognition", 2021, 1 st Edition, No Starch Press.				
Mode of Evaluation: CAT / Mid-Term Lab/ FAT					

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

Course Code	Course Title	L	T	P	C	
BCSE427L	Cognitive Robotics	2	0	0	2	
Pre-requisite	NIL	Syllabus Version				
		1.0				
Course Objectives						
<ol style="list-style-type: none"> 1. To understand the main types of cognitive (vision, motor control, language, social skills) robots and their driving requirements (engineering operations, navigation, cooperation) 2. To understand advanced methods for creating efficient and dynamic cognitive robots. 3. To understand the recent literature, and collectively synthesize, clearly explain and evaluate the state of the art in cognitive robotics. 4. To apply one or more core reasoning methods to create a simple agent that is driven by goals or rewards. 						
Course Outcomes						
After the completion of the course, student will be able to:						
<ol style="list-style-type: none"> 1. Understand how our psychology and neuroscience understanding of behavior and intelligence informs the design of robotics models and applications 2. Compare, select and apply different machine learning methods for intelligent behavior in robots. 3. Analyze the methods and software/hardware technologies for robotics research and applications. 4. Discuss the state of the art in cognitive and intelligent robotics models, and how this leads to the design of future robot applications. 						
Module:1		Introduction			2 hours	
Thinking, Cognition, and Intelligence, Defining Intelligence – Embodiment and Its Implications, Synthetic Methodology for Intelligence.						
Module:2		Cybernetic View of Robot Cognition and Perception			4 hours	
Introduction to the Model of Cognition, Visual Perception, Visual Recognition, Machine Learning, and Robot Cognition.						
Module:3		Intelligent System Design, Cognition Development and control			5 hours	
Properties of Complete Agents, Agent Design Principle, Developmental Robot Design, Matching brain and Body Dynamics, Artificial Neural Networks (ANN), Fuzzy Logic, Genetic Algorithms and Other Nature Inspired Methods, Optimal Control using ANN, Introduction to CNN.						
Module:4		Map Building			5 hours	
Introduction, Constructing a 2D World Map, Data Structure for Map Building, Explanation of the Algorithm, An Illustration of Procedure Map Building.						
Module:5		Randomized Path Planning			5 hours	
Introduction, Representation of the Robot's Environment, Review of configuration spaces, Visibility Graphs, Voronoi diagrams, Potential Fields and Cell						

Decomposition, Planning with moving obstacles, Probabilistic Roadmaps, Rapidly exploring random trees, Execution of the Quad tree-Based Path Planner Program.			
Module:6	Simultaneous Localization and Mapping (SLAM)		5 hours
Problem Definition, Mathematical Basis, Examples: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter, Graph-Based Optimization Techniques, Particle Methods Relation of Paradigms.			
Module:7	Robot Programming methods		3 hours
Python Robot Programming Methods-: Go-to-Goal Behavior, Avoid-Obstacles Behavior, Hybrid Automata (Behavior State Machine), Follow-Wall Behavior. A Complete Program for autonomous mobile robot.			
Module:8	Contemporary Issues		1 hours
			Total Lecture hours: 30 hours
Text Book(s)			
1.	Patnaik, Srikanta, "Robot Cognition and Navigation – An Experiment with Mobile Robots", Springer Verlag Berlin and Heidelberg, 2007		
2.	Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge, 2005.		
3	David Vernon, "Artificial Cognitive Systems: A Primer" ,The MIT Press, 1st Edition,2014		
Reference Book(s)			
1.	HoomanSomani, "Cognitive Robotics", CRC Press, 2015		
2.	Jared Kroff, "Cognitive Robotics: Intelligent Robotic Systems", Wilford Press, 2016		
3.	https://www.toptal.com/robotics/programming-a-robot-an-introductory-tutorial		
Recommended by Board of Studies		13-05-2022	
Approved by Academic Council		No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BCSE427P	Cognitive Robotics Lab	0	0	2	1
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand advanced methods for creating efficient and dynamic cognitive robots 2. To apply one or more core reasoning methods to create a simple agent that is driven by goals or rewards 					
Course Outcomes					
<p>After the completion of the course, student will be able to:</p> <ol style="list-style-type: none"> 1. Understand how our psychology and neuroscience understanding of behavior and intelligence informs the design of robotics models and applications 2. Compare, select and apply different machine learning methods for intelligent behavior in robots. 3. Apply the methods and software/hardware technologies for robotics research and applications. 4. Implement the state of the art in cognitive and intelligent robotics models, and how this leads to the design of future robot applications. 					
List of Challenging Experiments (Indicative)					
1	Introduction to the Python language and Python libraries, including NumPy, SciPy and NXT Python • Introduction to numerical arrays and parallel arithmetic • Introduction to numerical data plotting • • Introduction to numerical regression techniques • Installing Raspbian OS on the Raspberry Pi 3	4 hours			
2	Introduction to microcontrollers (32-bit ARM-based devices) in embedded applications used in automobiles and home appliances (such as washing machines, microwave ovens, telephones, and computer system peripherals) • Controlling GPIO pins (e.g., connected to LEDs) on the Raspberry Pi 3 using Python • Controlling motors • Collecting sensor data (such as light-color sensor, touch sensor, infrared proximity sensor and ultrasonic sensor) • Writing and uploading robotic control programs	4 hours			
3	Interfacing data acquisition system hardware with computer to measure and control the robotic system.	4 hours			
4	Robotic motion and autonomous responses • Path following, solving a Rubix cube, book scanning, and other fun problems	4 hours			
5	Machine learning algorithms for neural network pattern recognition	4 hours			
6	Extend the deep learning exercises (e.g. Multi-Layer Perceptron (MLP) and/or Convolutional Neural Network (CNN) exercises for image datasets) to optimize the training for robotics (vision) applications.	6 hours			
7	SLAM in ROS	4 hours			
Total Laboratory Hours					30 hours
Text Book(s)					

1.	Learning Computing with Robots, Deepak Kumar, Institute for Personal Robots in Education, June 2008		
Reference Books			
1.	Programming Cognitive Robots, Hector J. Levesque, 2019		
2.	Learning Robotics Using Python, Lentin Joseph, 2015		
3.	https://www.ieee-ras.org/cognitive-robotics/resources (Research Challenges)		
Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).			
Recommended by Board of Studies		13-05-2022	
Approved by Academic Council		No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C
BCSE428L	Autonomous Drones	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To know the principles of flight and how they apply to robotic drones 2. To know different kinds of airframes and how to assemble a drone. 3. To know the basics of drone design and how to choose the right components. 					
Course Outcomes					
<ol style="list-style-type: none"> 1. Understand the evolution and classification of Drones / Unmanned aerial Vehicle (UAVs) 2. Gain knowledge on UAVs technology side of things (i.e. sensors, platforms, navigation, power source, communication, range, altitude and speed) 3. Illustrate the commercial applications used by various types of drones such as aerial photography, law enforcement surveillance, and border enforcement. 4. Discuss Indian government airspace policy, regulations, and a comparison of other international regulations, and risk factors 5. Realize the emerging technologies being integrated into the drone market including semi-autonomous and autonomous systems for various applications. 					
Module:1	Introduction to Autonomous Drones	4 hours			
History of Drones – Types of drones – Airframe – Batteries – Motors – ESC: Electronic Speed Controller – Propellers.					
Module:2	Design Fundamentals	3 hours			
Flight Controllers – RC Transmitters – FPV Systems – Telemetry – Timing Gates.					
Module:3	Drone Basics	5 hours			
Flight Basics – Preflight Checks – Flight Modes – The Maiden Flight – Roll, Pitch, Throttle & Yaw – Key Skills – Simulators – Manual Mode – GPS Autopilot – Intelligent Flight Modes					
Module:4	Modelling and Control With MATLAB/Simulink Implementation	5 hours			
Quadcopter Project: Quadcopter Physical Characteristics, Vehicle Dynamic, Components, Simulink Modelling.					
Module:5	Stability and control	5 hours			
Static stability, Dynamic stability, static stability and control, Longitudinal control, stick forces, directional stability and control, roll stability and control.					
Module:6	Applications	3 hours			
Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, Conservation					

Module:7	Expanding Drones Abilities	3 hours
Add a camera and FPV, Collect more data with other sensors, Altering Speed and Increasing flight times. Building a Quadcopter		
Module:8	Contemporary Issues	2 hours
Total Lecture hours: 30 Hours		
Text Book(s)		
1.	Adam Juniper, "The Complete Guide to Drones", 2 nd Edition, ilex.	
2.	John Baichtal "Building your own Drones A beginners Guide to Drones, UAVs and ROVs", Que Publishing 2016	
3.	Terry Kilby and Belinda Kilby, Make: Getting Started with Drones, First Edition, Maker Media Inc, San Francisco CA, 2016	
4.	Robert C.Nelson, "Flight Stability and Automatic control", McGraw-Hill.	
5.	https://in.mathworks.com/help/aeroblks/quadcopter-project.html	
Reference Books		
1.	A. R. Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", First Edition, CRC Press, 2020	
Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).		
Recommended by Board of Studies		13-05-2022
Approved by Academic Council		No. 68 Date 19-12-2022

Course Code	Course Title	L	T	P	C
BCSE428P	Autonomous Drones Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To gain insight into the basic elements of commercial-off-the-shelf (COTS) drone systems used in civilian missions 2. To introduce unmanned aerial systems (UAS) including drones and autonomous unmanned aerial vehicles (UAV) with sensors 					
Course Outcomes					
At the end of this course, student will be able to:					
<ol style="list-style-type: none"> 1. Gain knowledge on UAVs technology side of things (i.e. sensors, platforms, navigation, power source, communication, range, altitude and speed) 2. Illustrate the commercial applications used by various types of drones such as aerial photography, law enforcement surveillance, and border enforcement. 					
Indicative Experiments					
1.	Basic building blocks and 3D Design of a Drone				
2.	Making the drone to be stable and fly autonomously with little human intervention				
3.	Design a control system architecture that will hover a quadcopter				
4.	Position Control: To implement a local navigation algorithm through the use of a PID controller.				
5.	Navigation by position: To implement an autopilot by using the GPS sensor, the IMU, and a position-based PID controller. For this exercise, a simulated 3D world has been designed that contains the quadrotor and five beacons arranged in a cross. The objective is to program the drone to follow a predetermined route visiting the five waypoints in a given sequence. It illustrates the algorithms typically included in commercial autopilots such as ArduPilot or PX4.				
6.	Following an object on the ground: To implement the logic that allows a quadrotor to follow a moving object on the ground, using a primary color filter in the images and a vision-based PID controller. The drone keeps its altitude and moves only in a 2D plane.				
7.	Searching for people to rescue within a perimeter: The objective of this exercise is to implement the logic of a global navigation algorithm to sweep a specific area systematically and efficiently, in conjunction with visual face-recognition techniques, to report the location of people for subsequent rescue. The drone behavior is typically implemented as a finite state machine, with several states such as go-to-the-perimeter, explore-inside-the-perimeter, or go-back-home.				
Total Laboratory Hours					30 hours
Text Book(s)					
1.	Terry Kilby and Belinda Kilby Make: Getting Started with Drones, First Edition, Maker Media Inc, San Francisco CA, 2016				
Reference Books					
1.	Mohammad H. Sadraey "Design of Unmanned Aerial Systems" First Edition, John Wiley & Sons, Inc., USA 2020				

2.	A. R. Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", First Edition, CRC Press, 2020		
Mode of assessment: Continuous assessment / FAT / Oral examination and others			
Recommended by Board of Studies		13-05-2022	
Approved by Academic Council	No. 68	Date	19-12-2022

Project/Internship

BCSE399J	Summer Industrial Internship	L	T	P	C
		0	0	0	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.					
Course Outcome:					
1. Demonstrate professional and ethical responsibility.					
2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.					
3. Develop the ability to engage in research and to involve in life-long learning.					
4. Comprehend contemporary issues.					
Module Content					
Four weeks of work at industry site. Supervised by an expert at the industry.					
Mode of Evaluation: Internship Report, Presentation and Project Review					
Recommended by Board of Studies		09-03-2022			
Approved by Academic Council		No. 65	Date	17-03-2022	

BCSE497J	Project - I	L	T	P	C
		0	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.					
Course Outcome:					
<ol style="list-style-type: none"> 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					
<p>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.</p> <p>Can be individual work or a group project, with a maximum of 3 students.</p> <p>In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.</p> <p>Carried out inside or outside the university, in any relevant industry or research institution.</p> <p>Publications in the peer reviewed journals / International Conferences will be an added advantage.</p>					
Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews					
Recommended by Board of Studies		09-03-2022			
Approved by Academic Council		No. 65	Date	17-03-2022	

BCSE498J	Project – II / Internship	L	T	P	C
		0	0	0	5
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.					
Course Outcome:					
<ol style="list-style-type: none"> 1. Formulate specific problem statements for well-defined real life problems with reasonable assumptions and constraints. 2. Perform literature search and / or patent search in the area of interest. 3. Conduct experiments / Design and Analysis / solution iterations and document the results. 4. Perform error analysis / benchmarking / costing. 5. Synthesize the results and arrive at scientific conclusions / products / solution. 6. Document the results in the form of technical report / presentation. 					
Module Content					
<ol style="list-style-type: none"> 1. Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities. 2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations. 3. Can be individual work or a group project, with a maximum of 3 students. 4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project. 5. Carried out inside or outside the university, in any relevant industry or research institution. 6. Publications in the peer reviewed journals / International Conferences will be an added advantage. 					
Mode of Evaluation: : Assessment on the project - project report to be submitted, presentation and project reviews.					
Recommended by Board of Studies		09-03-2022			
Approved by Academic Council		No. 65	Date	17-03-2022	

Open Elective Courses

Course Code	Course Title	L	T	P	C	
BHUM201L	Mass Communication	3	0	0	3	
Pre-requisite	NIL	Syllabus version				
		1.0				
Course Objectives						
<ol style="list-style-type: none"> 1. To understand the basics of mass communication theories and models 2. To analyze the role of different medium of mass communication 3. To develop perspectives on positive and negative aspects of mass communication on society 						
Course Outcomes						
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Explore the basic conceptual knowledge of mass communication. 2. Familiarise the communication models and theories associated with it. 3. Assess the tools of mass communication used for effective communication. 4. Evaluate the impact of mass communication on social institutions. 5. Explain the role of contemporary media towards society. 6. Analyse the impact of mass communication on social problems. 						
Module:1		Mass Communication			6 hours	
Mass Communication: Meaning & definitions, Characteristics, Functions of Mass Communication, Importance, patterns, Techniques of Communication, Formal/informal, verbal / written, downward & upward. Forms of Communication, Barriers of Communication, Communication Process. 7 C's of communication, Factors affecting process of communication.						
Module:2		Communication Models			6 hours	
Linear communication model. Aristotle's communication model. Laswell's communication model. The Shannon-Weaver communication model. Berlo's S-M-C-R communication model. Interactive communication model. The Osgood-Schramm communication model. The Westley and Maclean communication model.						
Module:3		Communication Theories			7 hours	
Theories of Mass Communication: Cognitive Theory, Dissonance Theory, Agenda Setting Theory, Cultivation Theory, Authoritarian Theory, Libertarian Theory, Social Responsibility theory, Soviet communist theory, Magic Bullet theory, Two step flow theory, Uses and Gratification theory. Social Media Integration Theory.						
Module:4		Tool of Mass Communication			6 hours	
Tools of Mass Communication: Newspapers, Magazines, Radio, TV, Films, Internet, mobiles. Advertising, Public Relations & Public Affairs, Traditional & Folk Media, Media and modern society, Media and democracy-Mass Media-Social Media.						
Module:5		Mass Communication and Social Institutions			6 hours	
Impact on Society: Family, Marriage, Culture, Religion, Economy Health, Education and Polity.						
Module:6		Mass Communication and Development			6 hours	
Social Development, Rural and Urban Development, Environmental Protection, Gender and Development, Mass Communication and Globalization.						
Module:7		Mass Communication and Emerging Issues			6 hours	
Pornography – Crime - Juvenile Delinquency - Terrorism – Case Studies - Social media issues - Artificial Intelligence.						
Module:8		Contemporary Issues			2 hours	

Course Code	Course Title	L	T	P	C
BHUM202L	Rural Development	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To make the students to understand the concepts and approaches to rural development 2. To sensitize students about the role of state and various institutions 3. To assess, interpret and evaluate the various policies and programmes					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Understand the elementary concepts of rural development. 2. Outline the historical perspectives of rural development. 3. Critically analyse the issues and challenges in the rural society, business and economy. 4. Interpret the role and responsibilities of rural institutions and governance. 5. Apply rural development Planning and management. 6. Design, develop and implement rural centric policies and programmes.					
Module:1	Rural Development	4 hours			
Definition, Concept, Nature, Elements - Determinants of rural development - Need for rural development in India and components of rural development. Scope of rural development – approaches. Significance of rural development in Indian context.					
Module:2	Historical Perspectives of Rural Development	6 hours			
History of rural development in India. Pre-colonial and Post-Colonial rural development. Land reform - Green revolution - WTO regimes. MDGs – SDGs - Sustainable rural development.					
Module:3	Rural Business	4 hours			
Rural small business management - process of Management - meaning organizing - Leading, Co-ordinating, and controlling, Training Programmes for entrepreneurship development, Entrepreneurial motivation and motives for entrepreneurship, Guidelines for entrepreneurship programme.					
Module:4	Rural Development Institutions	6 hours			
Cooperative Institutions: Types and Working of Rural Cooperatives - Community Based Organizations: Watershed Committees - Village Forest Committees - Role of CBOs in Rural Development - Rural Banking and Credit: Types and sources of rural credit- Training Institutions NIRD & PR, NABARD, RRB, CAPART, FTCs, KVKs.					
Module:5	Rural Governance	5 hours			
Rural Governance: Panchayat raj - Meaning - Origin – Objectives – PRI's the Gram Panchayats and Power and Functions - Decentralized Governance and Women Empowerment, SHG, and Community Organization. Impact of Decentralized Governance on Rural Development.					
Module:6	Issues and Challenges for Rural Development	8 hours			
Education and Rural Development – Formal and Non-formal education- Educational facilities in rural areas - Rural Health care - Primary health care – Development of health care services in rural India-Rural Housing: Shelter as a basic requirement - Types of rural houses – Housing as social security – Dimensions of rural housing problems - Sources of Drinking Water – National water Policy, Water Rights: Excess and underutilization of water. Access to					

sanitation: Sanitation and environment sanitation. Technology and Innovation in Rural Development. Involvement of youth in Rural Development.			
Module:7	Rural Development Programs and Policies		10 hours
Rural Development during the Five-year plan period. Major RD Programs in India - CDP, IRDP, MGNREGS, PMAY (IAY), NRLM, TRYSEM - Success and Failures. Rural Development Policies: Need for Rural Development policies - Rural Development Legislations and Policies in India - National Forest Policy - National Water Policy - Land Reforms Policy - Agricultural Price Policy - Rural Credit Policy - National Agricultural Policy - National Policy in Cooperatives - National Policy for Farmers.			
Module:8	Contemporary Issues		2 hours
Total Lecture Hours			45 hours
Text Book(s)			
1.	Tahir Hussain Mary Tahir and Riya Tahir (2020), Fundamentals of Rural Development, Dreamtec Press.		
2.	Abdul Azeez NP and S. M. Jawed Akhtar (2016), Rural Development in India: Policies and Programmes, Kalpaz Publications.		
3.	Katar Singh, Anil Shishodia (2019), Rural Development Principles, Policies and Management, 4 th Edition, SAGE Publications.		
Reference Books			
1.	Krishna Prasada Rao and Suresh Vadranam (2020), Dynamics of sustainable Rural Development: Issues and trends, Raj Publications.		
2.	Sujit Kumar Paul (2015), Rural Development: Concept and Recent Approaches, Concept Publishing Company.		
3.	Willem Van Eekelen (2020), Rural Development in Practice Evolving Challenges and Opportunities, Routledge Publisher.		
4.	Journal of Rural Development, NIRDPR, Hyderabad.		
5.	Journal of Economic and Political Weekly.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM203L	Introduction to Psychology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To describe the nature of human behaviour and mental functions 2. To provide knowledge of the concepts of the psychological processes 3. To apply the psychological principles for understanding human behavior					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe the basic concepts of Psychology. 2. Understand the knowledge of the processes of sensation and perception. 3. Acquire an in-depth knowledge of learning, memory, forgetting and decision making. 4. Analyze the importance of motivation and emotions. 5. Apply the theoretical foundations to describe human personality and intelligence. 6. Develop and implement the resilience strategies to promote mental health.					
Module:1	Foundations of Psychology	6 hours			
Nature of psychology - Neurobiological approach - Behavioural approach - Cognitive approach - Psychoanalytic approach - Humanistic approach - The broad province of contemporary psychology - Methods of psychology.					
Module:2	Sensation and Perception	6 hours			
General characteristics of sensation: Absolute thresholds - Difference thresholds - Object perception and perceptual constancies - Organization and perception - Movement perception-Depth perception - Visual coding and pattern recognition - Extra sensory perception.					
Module:3	Learning, Memory and Forgetting	6 hours			
Classical conditioning - Operant conditioning - Multiple response learning - Cognitive learning - Application of learning theories in organizational setting - Kinds of remembering - Retrieval processes - Nature of forgetting - Improving memory.					
Module:4	Motivation and Emotion	6 hours			
Physiological bases of motivation: Hunger - Obesity - Thirst - Theories of motivation - Physiological responses in emotion - Theories of emotion - Emotional expression.					
Module:5	Personality and Intelligence	6 hours			
Social learning approach - Rogers' approach - Self-esteem - Self-regulation - Self-presentation - Assessment of personality - Guilford's model of intelligence - Gardner's theory of multiple intelligence - Test of personality and intelligence related to placement context - Genetic basis and extremes of intelligence - Emotional intelligence.					
Module:6	Conflict and Adjustment	6 hours			
Understanding conflict - Frustration - Reaction to frustration - Defense Mechanisms - Adjustment - Coping with mal-adjustment.					
Module:7	Mental Health	7 hours			
Abnormal behaviour - Kinds of stressors - Coping with stress - Anxiety disorders - Depressive disorder - Factors affecting mental health - Enhancing mental health.					
Module:8	Contemporary Issues	2 hours			

		Total Lecture Hours	45 hours
Text Book(s)			
1.	Hilgard, E. R., Atkinson, R. C., & Atkinson, R. L., (2017), Introduction to Psychology, 16 th Edition, Oxford and IBH.		
Reference Books			
1.	Feldman, S. R., (2021), Understanding Psychology, 15 th Edition, McGraw Hill Education.		
2.	Myers, D.G., (2018), Psychology, 12 th Edition, Worth Publishers.		
3.	Plotnik, R., & Kouyoumdjian, H., (2018), Introduction to Psychology, 10 th Edition, Cengage		
4.	Weiten W. Dunn D. & Hammer E. Y. (2017), Psychology Applied to Modern Life: Adjustment in the 21st Century, 12 th Edition, Cengage Learning.		
5.	Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J., (2014), Introduction to Psychology, 7 th Edition, McGraw Hill Education.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM204L	Industrial Psychology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To introduce the nature, scope and applications of the industrial psychology 2. To Acquire knowledge of the employment selection and appraisal process considering workplace wellbeing 3. To be able to take role of employees and managers					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe the utility and research methods used in the Industrial Psychology. 2. Acquire practical knowledge of training and performance evaluation. 3. Understand workplace assessment tools and techniques. 4. Enhance leadership skills and team building. 5. Appraise the issues of equity and inclusion at work place. 6. Analyse and address stress and well-being related issues.					
Module:1	Introduction to Industrial Psychology	8 hours			
Industrial Psychology-definition – Major Fields - Brief History - Employment of Industrial Psychologists - Research Methods – Importance of Research -Process - Statistics, Job Analysis & Job Evaluation.					
Module:2	Evaluating the Quality of Performance Measures	7 hours			
Total Quality Management – Importance - Identifying Criteria & Validating Tests and Measures, Screening Methods - Intensive Methods.					
Module:3	Employees Performance and Evaluation	5 hours			
Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.					
Module:4	Organisational Fairness and Diversity Management	6 hours			
Employee Motivation, Psychological contracting - Satisfaction and Commitment, Diversity, Fairness and Inclusion -Work place Harassment and Vishakha Guidelines.					
Module:5	Leadership and Organisational Development	6 hours			
Leadership – Styles and Skills, Organizational Climate and Culture, Organizational Development – Factors contributing to organizational development, Current work paradigm.					
Module:6	Group Behaviour and Team	6 hours			
Group Behaviour: Group dynamic – work dynamic, Teams in Organizations, conflict management – Negotiation and persuasion - The Organization of Work Behaviour.					
Module:7	Stress and Well-being	5 hours			
Understanding Stress: Types, Sources of stress and demands of life and work, Managing Burnout, Building Resilience and Enhancing well-being at work.					
Module:8	Contemporary Issues	2 hours			
Total Lecture Hours					45 hours
Text Book(s)					
1.	Aamodt M. (2016), Industrial/Organizational Psychology: An Applied Approach, 8 th Edition, Wadsworth Publishing Co.				
Reference Books					

1.	Frank J. Landy & Jeffrey M. Conte (2016), Work in the 21 st Century: An Introduction to Industrial and Organizational Psychology, 5 th Edition, John Wiley & Sons Inc
2.	Paul E. Levy (2017), Industrial/Organizational Psychology: Understanding the Workplace, 5th Edition, Worth Publishers.
3.	Satoris S. Culbertson & Paul M. Muchinsky (2022), Psychology Applied to Work, 13 th Edition, Hypergraphic Pr
4.	Ronald E. Riggio (2017), Introduction to Industrial and Organizational Psychology, 6 th Edition, Pearson.
Mode of Evaluation: CAT, Quiz, Assignment and FAT.	
Recommended by Board of Studies	22-02-2023
Approved by Academic Council	No. 69 Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM205L	Development Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To provide students with essential tools and concepts of development economics 2. To equip students to critically evaluate different economic development models 3. To provide students with an understanding of what helps development succeed					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe the central themes and issues of economic development. 2. Differentiate between economic growth and development, major theories and their measurement. 3. Illustrate the significance of agriculture in developing countries, along with poverty and population related issues. 4. Assess the functions of international trade and the importance of foreign aid. 5. Analyse empirical evidence in the pattern of economic development. 6. Develop an understanding of the ongoing sustainable development agenda and its relevance.					
Module:1	Development Indicators and Issues	7 hours			
The concept of development - Indicators and Issues - Seven dimensions of development - Income, income growth and the Convergence Club - Poverty and hunger - Inequality and inequity - Vulnerability to Poverty - Basic needs: Human Development - Sustainability in the use of natural resources - Quality of life.					
Module:2	Impact of Development Policies and Programs	6 hours			
Objectives and overview of impact evaluation - methods of impact evaluation - Experimental design - Randomized Controlled Trials (RCTs) - Matching method to construct control groups: propensity score matching - Difference-in-difference method - Regression discontinuity designs - Event analysis and event - severity analysis - Instrumental variable estimation - Qualitative Methods.					
Module:3	Inequality, Inequity, Poverty and Vulnerability Analysis	6 hours			
Describing and measuring inequality - Decomposing inequality - Pro-poor growth and the growth incidence curve - The growth-inequality-poverty development triangle - Equity and development - inclusive growth - Characterize welfare: choice of an indicator of wellbeing - Poverty profile and aggregate indicators - Vulnerability - Other aspects of poverty - Correlates of poverty – poverty maps - behavioral poverty traps - Reducing poverty.					
Module:4	International Trade and Industrialisation Strategies	5 hours			
Trade openness - Gains from trade - Absolute, comparative and competitive advantage - Trade policy and indicators of protection - Tariffs and subsidies - Trade and the environment – Trade and food security - WTO and Multilateralism - Exchange trade Policies - regimes.					
Module:5	Economic Growth and Human Capital	7 hours			
Growth puzzle - Generic modelling of income growth - Harrod-Domar model - Solow model - Endogenous growth model - Education and Health - Education and Growth - Determinants of levels of Schooling - Estimating the returns to Education - Impact of Health on development.					
Module:6	Agriculture, Labour, Migration and Population	5 hours			

The state of world agriculture - Determinants of agricultural growth - food security in developing countries - Role of subsidies – European Union common agricultural policy - The economics of farm households - Farm household behaviour models - Responses to market signals - Labour and employment - Rural-urban migration - Demography - concepts - Some data for world Population - Cause of Population growth - Population Policy.			
Module:7 Sustainable Development and Environment		7 hours	
Sustainable development goals - Links between development, Resource conservation, and environmental sustainability - negative externalities - Public goods - Economics of Common Property Rights (CPR) - Discounting: Private Vs Social and Exponential Vs Hyperbolic - the sustainability objective - Dilemmas in environment - development relation - Introducing new markets: payments for environmental services.			
Module:8 Contemporary Issues		2 hours	
		Total Lecture Hours	45 hours
Text Book (s)			
1.	Alain de Janvry and Elisabeth Sadoulet (2021), Development Economics: Theory and Practice. Second Edition, Routledge.		
2.	H.L. Ahuja (2016), Development Economics - A Critical Study of Economic Growth, Development and Environment, S. Chand Publishers, New Delhi.		
Reference Books			
1.	A.P. Thirlwall and Penelope Pacheco - Lopez (2017), Development Economics: Theory and Evidence. Tenth Edition, Springer Nature Limited.		
2.	J. Edward Taylor and Travis J. Lybbert (2015), Essentials of Development Economics. Second Edition, University of California Press, California, USA.		
3.	Gerard Roland (2014), Development Economics, Routledge, USA.		
4.	Claudia Sunna and Davide Gualerzi (2016), Development Economics in the Twenty-First Century, Routledge.		
5.	Robert J.Barro, Xavier Sala I Martein (2003), Economic Growth, MIT Press, Cambridge, London.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No.69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM206L	International Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand trade related concepts and their applications in international trade 2. To understand the importance and role of foreign capital and foreign exchange for the economic development of the nations 3. To understand the nature of trade related issues and its solutions 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Comprehend the concepts of international economics through the nature of trade issues and the importance of international cooperation. 2. Assess the importance of international trade and its contribution to economic development and growth. 3. Ascertain the basics of international trade theories and the role of factor movement at the global level. 4. Examine the essence of foreign capital flow, foreign exchange reserve and the method of exchange rate determination. 5. Review trade policies for trade promotion and trade restriction. 6. Analyse the importance and impact of balance of trade and balance of payment in the national economy. 					
Module:1 Trade and Economy					4 hours
Introduction to International Economics – Subject matter - Internal trade and International Trade – Current International Economic problems and challenges – Categories of Economies - Global Economic Integration – New Economic Policy.					
Module:2 International Trade and Economic Development					5 hours
Introduction – Importance of trade and development – Terms of trade and economic development – trade problems and economic development – Foreign debt and economic development – Export instability and economic development.					
Module:3 Theories of Trade					4 hours
Comparative cost theory – Hicksian theory of trade - Factor endowment theory – International factor movement - gains from trade.					
Module:4 Trade Policies and Regional Co-operation					6 hours
Trade promotion: export promotion, Export subsidies, and Custom union – Export Oriented Units (EOU) – Special Economic Zones (SEZ) - Trade restriction: Tariff and Quota – Effects of Tariff and Quota - Import substitution – Dumping – World Trade Organization (WTO) - Regional economic co-operation (ASEAN, NAFTA, EU, and SAARC).					
Module:5 Capital Flow					9 hours
Foreign capital – Foreign Direct Investment (FDI) - FDI policy in India - FDI Cap-reforms – initiatives - Foreign Investment Promotion Board (FIPB) and Foreign Portfolio Investment (FPI) – FDI in retailing – world investment reports, IMF reports - International Financial Institutions – (World Bank, UNCTAD, International Monetary Fund, Asian Development Bank) – Financial crisis.					
Module:6 Foreign Exchange					9 hours

Foreign exchange market: Meaning, functions – risks - IMF classification of exchange rate – IMF AREAER Report - Rate of exchange: Determination – Effects – Fixed, Flexible and Floating exchange rate - exchange rate models – Foreign exchange reserve - exchange rate risk (case studies of Indian IT industries) - risk management – Currency Crises - Currency Wars.			
Module:7	Balance of Payment	6 hours	
Balance of trade – meaning - favorable and unfavorable - Balance of payment – meaning – favorable and unfavorable – current account and capital account – Disequilibrium in balance of payment – measures to correct disequilibrium.			
Module:8	Contemporary Issues	2 hours	
		Total Lecture Hours	45 hours
Text Book(s)			
1.	Paul R. Krugman, Maurice Obstfeld and Marc J. Melitz (2017), International Economics.11 th Edition, Pearson Education.		
2.	Francis Cherunilam (2020), International Economics. 6 th Edition, Tata MC Graw Hill Companies, New Delhi.		
Reference Books			
1.	Dominick Salvatore (2021), International Economics. 13 th Edition, John. Wiley and Sons, Inc.		
2.	Hendrik Van Den Berg (2016), International Economics. 3 rd Edition, Taylor & Francis.		
3.	James Rickards (2012), Currency Wars: The Making of the Next Global Crisis, Penguin Books.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM207L	Engineering Economics	3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the basic concepts of economics in engineering decision making, theories and tools of economics in engineering applications 2. To analyze cost and revenue data and carry out economic analysis to justify or reject alternatives and projects based on an economic perception 3. To analyze the risk and project uncertainty and to provide guidance to use the appropriate approach to handle the project uncertainty 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Comprehend the basic principles of engineering economics. 2. Evaluate the methods of cost estimation and forecast the present and future values of cashflows. 3. Identify project appraisal techniques and evaluate the key factor of the project which defines the viability of a project proposal. 4. Determine the depreciation and understand the tax impact while calculating depreciation. 5. Identifying, analyse and manage various types of risk. 6. Make decisions on investing funds in the most appropriate and efficient projects. 					
Module:1	Overview of Engineering Economics	4 hours			
The Principles of Engineering Economics – Engineering Economics and the Design Process –Engineering Economic Analysis.					
Module:2	Cost Concepts and Cost Estimation Techniques	6 hours			
Cost Concepts - Cost terminology - The General Economic Environment - Cost-Driven Optimisation. Cost Estimation Techniques – An Integrated Approach - Selected Estimating Techniques (Models) and Parametric Cost Estimating.					
Module:3	The Time Value of Money	8 hours			
Simple Interest - Compound Interest - The concept of Equivalence. Cash flows – Relating present and future equivalent values of single Cash Flows - Relating a uniform series (Annuity) to its present and future equivalent values – Deferred Annuities – Equivalence calculations involving multiple interest formulas – uniform (Arithmetic) Gradient of cash flow – Geometric sequences of cash flow – Interest rates that varies with time - Nominal and effective interest rate – compounding more often than once per year – continuous compounding and discrete cash flow.					
Module:4	Project Estimation and Evaluation Techniques	8 hours			
Determining the minimum attractive rate of interest (MARR) – The present worth method – The future worth method - The annual worth method - The internal rate of return method - The external rate of return method and payback (payout) period method. Evaluation of Alternatives – comparison and selection among alternatives - Techniques of Evaluation. Cost-Benefit Analysis – Perspective and terminology for analysing public projects and evaluating independent projects.					
Module:5	Depreciation and Income Taxes	6 hours			
Depreciation concepts and terminology - The classical depreciation methods – The modified accelerated cost recovery system – Income taxes – The effective corporate income rate – Gain (loss) on the disposal of an asset – General procedure for making After-tax economic analysis and Economic value added.					

Module:6	Project Risk Analysis	5 hours
Breakeven analysis – Sensitivity analysis – Multiple factor sensitivity analysis. Probabilistic risk analysis – Sources of uncertainty – Distribution of random variables – Evaluation of projects – Discrete random variables and Continuous random variables - Evaluation of risk and Uncertainty by Monte Carlo Simulation.		
Module:7	The Capital Budgeting Process and Decision Making	6 hours
Debt Capital – Equity capital – The weighted average cost of capital (WACC) – Project selection – Budgeting of Capital Investments and Management Perspective – Leasing decision and Capital allocation. Multi-attributes – Choices of attributes, Selection of a measurement scale, and Dimensionality of the problem – Compensatory and Non-compensatory models.		
Module:8	Contemporary Issues	2 hours
Total Lecture Hours		45 hours
Text Book (s)		
1.	Sullivan G William, Elin M Wicks and C. Patrick Koelling (2018), Engineering Economy. Pearson Education, 17 th Edition.	
Reference Books		
1.	Blank, Leland and Anthony Tarquin (2017), Engineering Economy. Tata Mc Graw Hill, 8 th Edition.	
2.	Chan S.Park (2019), Fundamentals of Engineering Economics. Pearsons Education, 4 th Edition.	
Mode of Evaluation: CAT, Quiz, Assignment and FAT.		
Recommended by Board of Studies		23-02-2023
Approved by Academic Council	No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM208L	Economics of Strategy	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To create awareness about the importance of strategic thinking among students 2. To understand the need for being competitive in all aspects of business 3. To familiarize the students with modern industrial organization with business strategy perspective					
Course Outcomes					
Upon successful completion of the course students will be able to					
1. Describe and apply elasticity of demand. 2. Apply the Economies of scale and scope concepts. 3. Interpret and apply the vertical integration concepts. 4. Explain and apply diversification. 5. Analyze and explain the market structures. 6. Critically evaluate entry and exit decisions.					
Module:1	Economic Concepts For Strategy	7 hours			
Demand, Elasticity and Revenue, Total Revenue and Marginal Revenue, Costs and Cost Functions - Fixed and Variable Costs, Theory of the firm, Game Theory - Normal and Extensive Games, Economic Costs and Profitability.					
Module:2	Production and Cost Behavior	6 hours			
Economies and Diseconomies of Scale and Economies of Scope – Sources, Indivisibilities, and the Spreading of Fixed Costs, The Learning Curve, Learning and Organization					
Module:3	The Economics of Transaction Costs	6 hours			
The Vertical Boundaries of Firm, Make Vs Buy Decisions, Contracts, Transactions Cost, Asset Specificity, Rents and Quasi-Rents, The Holdup Problem.					
Module:4	Diversification	6 hours			
Diversification - Reasons for Diversification, Costs of Diversification, Performance of Diversified Firms, Mergers and Acquisition- Benefits.					
Module:5	Market Structure	6 hours			
Market Structure and Competition, Measuring Market Structure, Monopoly, Monopolistic and Oligopoly Market Structures - Cournot and Bertrand Models, Market Structure and Performance					
Module:6	Industry Analysis	6 hours			
Five - Forces Analysis - Application of Five - Forces, Entry and Exit Decisions, Barriers to Entry, Entry - Detering Strategies, Exit- Promoting Strategies.					
Module:7	Strategic Positioning	6 hours			
Competitive Advantage and Value Creation - Value Creation Vs Value Redistribution, Cost and Benefit Advantage, Broad Coverage versus Focus Strategy.					
Module:8	Contemporary Issues	2 hours			
		Total Lecture Hours			45 hours
Text Book(s)					
1.	David Dranove, David Besanko, Mark Shanley and Scott Schaeffer (2017), Economics of Strategy. Wiley, 7 th Edition.				

Reference Books			
1.	Paul Belleflamme and Martin Peitz (2015), Industrial Organization: Markets and Strategies. Cambridge University Press, 2 nd Edition.		
2.	Don E Waldman and Elizabeth J Jensen (2019) Industrial Organization: Theory and Practice. Routledge, 5 th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM209L	Game Theory	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To provide game theory fundamentals so as to apply the same in their professional life 2. To make the students understand the strategic interactions between players using game theory 3. To provide tools of game theory to apply in different decision making situations					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe and apply knowledge of strategic games with perfect information. 2. Identify Nash equilibrium in games. 3. Describe mixed strategy games. 4. Analyze extensive games with perfect information. 5. Describe extensive games with imperfect information. 6. Apply bargaining in Game theory setting.					
Module:1 Games with Perfect Information					5 hours
Strategic Games and Examples. Nash Equilibrium, Strict and Nonstrict Nash Equilibria, Best Response Functions, Dominated Actions - Strict and Weak Domination, Symmetric Games.					
Module:2 Nash Equilibrium					6 hours
Cournot's Model of Oligopoly - Bertrand's Model of Oligopoly, Electoral Competition, Median Voter Theorem and Auctions.					
Module:3 Mixed Strategy Equilibrium					5 hours
Randomization and Expected Payoffs, Mixed Strategy Nash Equilibrium and Properties, Dominated Actions – Strict and Weak Domination.					
Module:4 Extensive Games with Perfect Information					7 hours
Strategies and Outcomes, Nash Equilibrium, Subgame Perfect Equilibrium, Backward Induction, The Ultimatum game, The Holdup game and Stackelberg's Model of duopoly, Properties of Subgame perfect equilibrium.					
Module:5 Extensive Games with Imperfect Information					6 hours
Strategies and Nash Equilibrium, Beliefs and Sequential equilibrium, Sequential Rationality, Signaling Games, Separating and Pooling Equilibrium.					
Module:6 Repeated Games					7 hours
Finitely and Infinitely Repeated Prisoner's dilemma, Grim Trigger and Tit-for-tat Strategies, Nash Equilibria of General Infinitely Repeated Games, Finitely Repeated Games.					
Module:7 Bargaining					7 hours
Bargaining as an Extensive Game, Nash's axiomatic Model, Bargaining Solution, Pareto Efficiency and Symmetry, Nash Bargaining Solution.					
Module:8 Contemporary Issues					2 hours
Total Lecture Hours					45 hours
Text Book (s)					
1.	Avinash Dixit, Susan Skeath and David McAdams (2020), Games of Strategy. W.W.Nortonand Co, Fifth Edition.				

2.	Bernhard Von Stengel (2021), Game Theory Basics. Cambridge University Press, 1 st Edition.		
Reference Books			
1.	Drew Fudenberg and Jean Tirole (1991), Game Theory. MIT Press, 1 st Edition.		
2.	Osborne, Martin J (2012), An Introduction to Game Theory. Oxford University Press, 1 st Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM210E	Econometrics	2	0	2	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the basic concepts of econometrics 2. To familiarize the students with econometrics methodology 3. To use appropriate econometrics tools based on data sets 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Analyse economic data based on a broad knowledge of the linear regression model. 2. Apply the multiple regression model and test hypothesis. 3. Examine the use of dummy variables in regression model. 4. Explain the violations of OLS assumptions, such as multicollinearity, heteroscedasticity, and auto correlation. 5. Analyse and assess empirical results and econometric findings. 6. Design, develop and execute various time series models. 					
Module:1	Inferential Statistics	3 hours			
Normal distribution, chi-square, t - and F- distributions - Estimation of parameters - Testing of hypotheses - Defining statistical hypotheses - Distributions of test statistics - Testing hypotheses related to population parameters - Type-I and Type-II errors; Power of a test - Tests for comparing parameters from two samples.					
Module:2	The Nature and Scope of Econometrics	3 hours			
Introduction to Econometrics – Methodology of Econometrics – Types of Data: Parametric and Non-Parametric test and Sources of Data – Population Regression Function and Sample Regression Function – Significance of error term.					
Module:3	Simple Linear Regression Model: Two Variable Case	3 hours			
Estimation of model by method of ordinary least squares - Properties of estimators – Gauss Markov Theorem (BLUE) - Goodness of Fit - Testing of Hypothesis - Scaling and units of measurement - Confidence Intervals - Forecasting.					
Module:4	Multiple Regression Analysis	5 hours			
Estimation of parameters - Properties of OLS estimators - Goodness of fit- R^2 and Adjusted R^2 – Partial regression coefficients - Testing Hypotheses: Individual and Joint - Functional Forms of Regression Models.					
Module:5	Dummy Variables in Regression Models	4 hours			
Exogenous Dummy Variable - Formulating and interpreting coefficients on dummy explanatory variables, interactions involving dummy variables and the use of dummy variables in seasonal analysis, piece wise regression analysis, the dummy variable alternative to chow test.					
Module:6	Violation of Classical Assumptions	4 hours			
Multicollinearity – autocorrelation – heteroscedasticity – problems – causes – consequences remedial measures – model specification and diagnostic testing.					
Module:7	Time Series Analysis and Forecasting Models	6 hours			

Stationarity Vs. Non - Stationarity – Unit root Stochastic Process – Tests of Stationarity - The Unit Root Test - Transforming Non-stationary Time Series – Cointegration and Error Correction Mechanism (ECM) - ARIMA model – The Box Jenkins Methodology – Vector Auto regression (VAR) Estimation.			
Module:8 Contemporary Issues		2 hours	
		Total Lecture Hours	
		30 hours	
Text Book(s)			
1.	Damodar. N. Gujarati and Sangeetha (2021), Basic Econometrics. 6 th Edition, Tata McGraw-Hill.		
2.	Christopher Dougherty (2016), Introduction to Econometrics. 5 th Edition, Oxford University Press.		
Reference Books			
1.	Jeffrey M. Wooldridge (2019), Introductory Econometrics: A Modern Approach, 7 th Edition, Cengage Learning.		
2.	G.S. Maddala and Kajal Lahiri (2012), Introduction to Econometrics, 3 rd Edition, Pearson.		
3.	Greene, W. (2018), Econometric Analysis, 8th Edition, Pearson.		
4.	Chris Brooks (2014), Introductory Econometrics for Finance. 3 rd Edition, Cambridge University Press.		
Indicative Experiments			Hours
1.	Statistical Inferences		2 hours
2.	The Classical Linear Regression Model		4 hours
3.	Multiple Regression Analysis		4 hours
4.	Functional Forms of Regression Models		4 hours
5.	Dummy (Binary) Variables		4 hours
6.	Testing for Violation of Classical Assumptions		4 hours
7.	Tests of specification errors (Ramsay Test)		2 hours
8.	Time Series Modelling		6 hours
Total Laboratory Hours			30 hours
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM211L	Behavioral Economics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To impart knowledge on current ideas and concepts regarding decision making in Economics, Particularly from a behavioral science perspective. 2. The course will explore key departures and the consequences of behavior of firms, households and other economics entities 3. To provide an overview of how behavioral principles have been applied to economic problems. 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Identify and evaluate evidence for systematic departures of economic behavior from the traditional economic models. 2. Predictions of the neoclassical model, and psychological explanations for these anomalies. 3. Incorporate psychologically motivated assumptions into economic models, and interpret the implications of these assumptions. 4. Explain how these models change the predictions for equilibrium behavior and welfare analysis, and assess the implications for optimal policy. 5. Compare the predictions of neoclassical and behavioral models, and evaluate the best method for approaching a given topic. 6. Apply Behavioral principles in economic problems. 					
Module:1	Introduction	6 hours			
The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications gains and losses, money illusion, charitable donation.					
Module:2	Basics of Choice Theory	6 hours			
Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis consumption and addiction, environmental protection, retail therapy; applications pricing, valuation, public goods, choice anomalies.					
Module:3	Beliefs, Heuristics and Biases	6 hours			
Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self-projection; inconsistent and biased beliefs; probability estimation; trading applications trade in counterfeit goods, financial trading behavior, trade in memorabilia.					
Module:4	Choice under Uncertainty	6 hours			
Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications ownership and trade, income and consumption, performance in sports.					

Module:5	Intertemporal Choice	6 hours	
Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis mobile calls, credit cards, organization of government; applications consumption and savings, clubs and membership, consumption planning.			
Module:6	Game and Strategy Behavior	6 hours	
Review of game theory and Nash equilibrium strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signaling, learning; applications competitive sports, bargaining and negotiation, monopoly and market entry.			
Module:7	Social Preference	7 hours	
Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion; policy analysis norms and markets, labor markets, market clearing, public goods; applications logic and knowledge, voluntary contribution, compensation design.			
Module:8	Contemporary Issues	2 hours	
		Total Lecture hours:	45 hours
Text Book(s)			
1.	N.Wilkinson and M.Klaes (2017), "An Introduction to Behavioral Economics", 3 rd Edition, Red Globe Press.		
Reference Books			
1.	Bazerman, Max and Don Moore (2012), Judgment in Managerial Decision Making, 8 th Edition, John Wiley & Sons.		
2.	Kahneman, Daniel (2011), Thinking, Fast and Slow, New York: Farrar, Straus and Giroux.		
Mode of Evaluation: CAT /Quiz / Assignment / FAT.			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM212L	Mathematics for Economic Analysis	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To provide basic mathematical tools and techniques to solve the problems that arise from Economics 2. To develop skills in Mathematical Modelling 3. To demonstrate the use of Mathematics in understanding theoretical Economics 					
Course Outcomes					
Upon successful completion of the course students will be able to					
<ol style="list-style-type: none"> 1. Demonstrate the use of tools of differentiation in solving the economic problems. 2. Apply mathematical techniques to economic theory. 3. Describe economic problems in mathematical terms. 4. Implement methods from calculus to find the optimal location and value (maximum/minimum) of a mathematical function. 5. Explain the constrained optimization techniques in economic models and apply them to economic problems. 6. Apply the optimization techniques to economic problems. 					
Module:1	Economic Models and Functions	6 hours			
Equations and Identities, The Real Number System, The Concept of Sets, Functions – Types. Graphs of Functions, Types of Functions; Linear, Quadratic, Polynomial, Power, Exponential and Logarithmic functions – Limits and continuity. Economic Applications - Demand, Cost and Revenue functions.					
Module:2	Unconstrained Optimization	5 hours			
Slopes of Curves, Simple Rules of Differentiation, Second and Higher order derivatives, Maxima and Minima, Convex and Concave functions. Economic Applications – Marginal Revenue, Marginal Propensity to Consume.					
Module:3	Derivatives and Optimization	5 hours			
The Chain Rule, Partial Elasticities, Homogeneous and Homothetic functions and Systems of Equations. Economic Applications – Macroeconomic Models.					
Module:4	Multi Variable Optimization	7 hours			
Functions of Several Variables, Geometric representation of functions of several variables, Partial derivatives, Higher order partial derivatives. Economic Applications - Marginal Product of Labour and Capital.					
Module:5	Constrained Optimization	6 hours			
The Lagrange Multiplier method, Economic Interpretations of Lagrange Multipliers, Linear Programming Problems - Kuhn-Tucker Method, Kuhn-Tucker Sufficiency Theorem, Arrow - Enthoven Sufficiency Theorem. Economic Applications – Utility Maximization with Constraints.					
Module:6	Integration, Differential and Difference Equations	6 hours			
Definite and Indefinite Integrals and Economic Applications, First order and Second order Difference equations, First order and second order differential equations. Economic Applications- Income Distribution.					
Module:7	Matrix and Vector Algebra	8 hours			
Systems of Linear Equations – Matrices and Matrix Operations – Matrix					

Multiplication – The Transpose – Vectors – Determinants and Inverse of a Matrix – The Leontief Model. Linear Programming – Graphical Approach – The Duality Theorem – Matrix Formulation.			
Module:8	Contemporary Issues		2 hours
		Total Lecture Hours	45 hours
Text Books			
1.	Knut Sydsaeter, Peter Hammond, Arne Strom and Andres Carvajal (2021), Essential Mathematics for Economic Analysis. Pearson, Sixth Edition.		
Reference Books			
1.	Chiang, Alpha C and Kevin Wainwright (2017), Fundamental Methods of Mathematical Economics. McGraw Hill Education, 4 th Edition.		
2.	Simon C P and Lawrence Blume (2018), Mathematics for Economists, Viva Norton Student Edition.		
3.	Dowling, Edward T (2011), Shaum's Outline Series on Introduction to Mathematical Economics. McGraw Hill, 3 rd Edition.		
Mode of Evaluation : CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM213L	Corporate Social Responsibility	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the need and importance of Corporate Social Responsibility and Ethics 2. To familiarise with CSR Legislations and Responsibilities 3. To identify the role of NGOs in CSR 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Describe the concepts of Corporate Social Responsibility. 2. Explain and Clarify the Legal provisions of Corporate Social Responsibility. 3. Identify the role of different stakeholders of CSR and effective implementation. 4. Analyse CSR Strategy and its implementation. 5. Carry out CSR need and impact study. 6. Design, develop and implement CSR strategy and policies. 					
Module:1	Corporate Social Responsibility	6 hours			
Definition, evolution, essentials of CSR, and arguments for CSR. The driving forces of CSR: inequality within countries and inequality among countries, sustainability, globalization, and communication- mobile and social media. Brands with attitude.					
Module:2	Stakeholder Theory	5 hours			
Definition. Stakeholder categorization: organizational and economic and societal stakeholders. Evolving issues. Model of stakeholder management, stakeholder engagement. Case Study – Capitalism; The rise of Socialism.					
Module:3	CSR Behavioural Perspective	5 hours			
Markets: Shareholders as market makers. Profit: economic value and social value. Profit optimization, production value and consumption value, social progress, the next billion, case study – Unilever.					
Module:4	CSR Strategy & Implementation	7 hours			
Vision, mission, strategy and tactics. Strategic analysis - Resource perspective and industry perspective. Integrating CSR, strategy formulation and CSR implementation. Strategic CSR is not an option – Not philanthropy, not caring capitalism and not sharing value. Strategic CSR is business. Case study - Starbucks.					
Module:5	CSR Legal Provisions	6 hours			
Clause 135 of Companies Act 2013. Schedule VII in Section 135 of Companies Act (2013), Companies (Corporate Social Responsibility) Rules 2014. CSR Policy Amendment Rules 2021 and 2022. CSR Committee, CSR Policy, Roles and Responsibilities of Board of Directors.					
Module:6	Compliance and Accountability	7 hours			
Voluntary Vs mandatory, Self-interest; behavioural economics; nudges. Accountability – defining CSR- measuring CSR. CSR reporting - standardizing CSR, certifying CSR and labelling CSR. Pricing CSR, Life cycle pricing. Case study – Socially responsible investing. Impact investing.					
Module:7	Sustainable Development and Business	7 hours			

UN Sustainable Development Goals, Sustainability in practice – climate change, resilience and natural capital. Waste: E-waste and plastic. Beyond sustainability. Sustainable value creation – values, morals and business ethics. Conscious capitalism and Value based business.			
Module:8	Contemporary Issues		2 hours
		Total Lecture Hours	45 hours
Text Book(s)			
1.	Chandler. D. (2022), Strategic Corporate Responsibility: Sustainable Value Creation, 6 th Edition, North America: Sage Publication Inc.		
2.	Kadokia, R.S. (2022), Corporate Social Responsibility: Law and Practice. Delhi: Taxman.		
Reference Books			
1.	Mitra. N. and Schmidpeter, R. (2017), Corporate Social Responsibility in India: Cases and Development After the Legal Mandate. Springer Link.		
2.	Confederation of Indian Industry (2013), Handbook on Corporate Social Responsibility in India. Delhi: PricewaterhouseCoopers Private Limited (PwCPL).		
3.	Kotler.P. & Lee, N. R. (2005), Corporate Social Responsibility: Doing the Most Good for Your Company and Cause. New Jersey: John Wiley & Sons.		
4.	Hohnen. P (2007), Corporate Social Responsibility: An implementation guide for business, Potts. J (Ed). Winnipeg, Manitoba, Canada: International Institute for Sustainable Development(IISD's).		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM214L	Political Science	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To describe the salient features of Indian politics 2. To understand political phenomena, and to explore their ethical and normative dimensions 3. To identify and reflect on the major issues confronting politics 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Develop basic understanding of the Constitution. 2. Examine the working of the political system and institutions in India. 3. Understand different political theories and ideologies. 4. Critically analyze the issues and concerns of political life surrounding them. 5. Analyse the challenges for contemporary India. 6. Provide policy level solutions for the issue in world politics. 					
Module:1	Indian Constitution at Work	5 hours			
Nation and State - Salient Features of the Constitution of India - Regimes - Fundamental Rights.					
Module:2	The Bases of Politics	6 hours			
Politics - Political Science - Political Theory - Political ideologies - Liberalism - Conservatism - Marxism - Nationalism - Totalitarianism.					
Module:3	Political Attitudes	5 hours			
Political culture - Subculture - Political Socialization - Public Opinion - Opinion Polls.					
Module:4	Political Interactions	6 hours			
Political Communication - the Mass Media and Politics - Social Media - Media and Government - Interest Groups.					
Module:5	Parties – Elections	7 hours			
Parties - Parties in Democracies - Classification – Party systems - Elections – People Vote - Electoral System - Electoral Realignment - Democracy - Changing Positions.					
Module:6	Political Institutions	8 hours			
Legislature - the origin of Parliament system - modern day politics. Executive and Bureaucracies - Presidents and Prime ministers - Executive Leadership - Cabinets - issues and challenges. Judiciaries - Types of Law - the Court - the Bench and the Bar - Common Law vs Code Law – role of Courts - Indian Judicial System.					
Module:7	Political System Rule	6 hours			
Political Economy - Welfare of the state - the costs of Welfare - Poverty - the role of big governments - Violence and Revolution - International Relations - Power and National Interest - War and Peace - Foreign Policy.					
Module:8	Contemporary Issues	2 hours			
					Total Lecture Hours
					45 hours
Text Book(s)					

1.	Michael G. Roskin, Robert L. Cord, James A. Medeiros and Walter S. Jones (2019), Political Science: An Introduction, 14 th Edition, Pearson Education.		
Reference Books			
1.	Basu, Durga Das (2022), Introduction to the Constitution of India, 26 th Edition, Nagpur: Lexis Nexis Butterworths Wadhwa.		
2.	M Laxmikanth (2021), Indian Polity, 6th Edition, McGraw Hill Education (India) Private Limited, Noida.		
3.	O.P. Gauba (2019), An Introduction to Political Theory, 7th Edition, Mayur Paperbacks.		
4.	Robert Garner, Peter Ferdinand and Stephanie Lawson (2023), Introduction to Politics, 5 th Edition, OUP Oxford.		
5.	Peter Ferdinand, Robert Garner and Stephanie Lawson (2018), Politics, Oxford University Press.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM215L	International Relations	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand India's bilateral relationships and its role in global economic, security and political regimes 2. To analyse the issues and developments pertaining to India's foreign policy 3. To update the knowledge on contemporary issues and challenges at the global level 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Trace the historical development of India's foreign policy. 2. Describe social, economic and political institutions (regional and global). 3. Critically evaluate the role of India as emerging super power. 4. Examine Sustainable Developmental goals of contemporary Indian society and the world. 5. Identify the opportunities and challenges between India and rest of the world. 6. Provide policy level solutions for the major challenges faced by India in the 21st century. 					
Module:1	India's International Relations: A Historical Perspective	7 hours			
A Historical Perspective of diplomatic relations - Genesis of India's Foreign Policy – Objectives and Principles - Determinants - Internal and External Dimension - Non-Alignment: Concepts, Policy and Relevance - Evolution of India's Foreign Policy - Neo-Colonialism.					
Module:2	India and the Global Economic and Political Scenario	5 hours			
India and the United Nations: Security Council Reforms - India and World Trade Organization (WTO) - World Bank - IMF - G7 - G20.					
Module:3	Emerging India	5 hours			
Globalization- SWOT-Asian Century- India's Role in the World Today-Strategic Challenges.					
Module:4	India's Foreign Policy towards Neighboring Countries	5 hours			
Pakistan - Afghanistan - Sri Lanka - Bangladesh - Nepal - Bhutan - Maldives.					
Module:5	India's Policy towards Major Powers	6 hours			
USA - Russia - China - Japan - UK.					
Module:6	India's Multilateral Engagement	9 hours			
Association of South East Asian Nations (ASEAN) - South Asian Association for Regional Cooperation (SAARC) - East Asia Summit (EAS) - European Union (EU) - The African Union (AU) - BRICS - Shanghai Cooperation Organization - The Indian Ocean Rim Association (IORA) - The Asia-Pacific Economic Cooperation (APEC) - The North Atlantic Treaty Organization (NATO).					
Module:7	India's Domestic and External Challenges	6 hours			
Poverty – Education – Health - Terrorism - Climate Change - Energy and Food Security.					
Module:8	Contemporary Issues	2 hours			
		Total Lecture Hours		45 hours	
Text Book(s)					

1.	Peu Ghosh (2020), International Relations, PHI Learning; 5 th Edition.		
Reference Books			
1.	Deepanshu Singh (2021), International Relations -Interests & Challenges, Disha Publication.		
2.	Aparna Pande (2020), From Chanakya to Modi: The Evolution of India's Foreign Policy New Delhi: Harper.		
3.	Alyssa Ayres (2018), Our Time Has Come: How India is Making Its Place in the World, Oxford University Press.		
4.	Arvind Gupta and Anil Wadhwa (2020), India's Foreign Policy: Surviving in a Turbulent World, SAGE Publications Pvt Ltd.		
5.	Adluri Subramanyam Raju and R. Srinivasan (ed.) (2023), The Routledge Handbook of South Asia: Region, Security and Connectivity, Routledge India.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM216L	Indian Culture and Heritage	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To enthuse the students to know more about India's rich traditions and culture 2. To inspire the students to appreciate and respect the History and Society through the Ages 3. To familiarize students on heritage sites and its history and importance 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Illustrate the meaning of culture and heritage and the factors which contributed to themaking of our culture. 2. Examine the glory of Indian history. 3. Trace the evolution of Indian society over centuries. 4. Identify the development of our heritage and its features. 5. Explain the significance, conditions and development of ancient Indian science and technology. 6. Critically analyse the modernization of Indian culture from the past to the present and the future. 					
Module:1	Indian Culture	5 hours			
Concept and meaning of Culture - Culture and Civilization - Culture and Heritage - Importance of Culture in Human life - Indian Culture - Characteristics of Indian Culture - Unity and Diversity - Aspects of Indian Culture - Cultural Identities - Significance of Geography on Indian Culture - Cultural influences.					
Module:2	History, Society and Culture through the Ages	9 hours			
Indus Valley Civilisation - Invasions and its impact on Indian culture - Ashoka the great - Legacy of Mauryans - Socio cultural development of Deccan and South India - Classical age of Gupta - Life of people under Delhi sultanate - Cultural development during Mughals - India in the 18 th Century: Economy, Society and Culture - Origin and Evolution of Nationalist Movement.					
Module:3	Indian Languages and Literature	4 hours			
Evolution of script and languages in India: Harappan Script and Brahmi Script - Role of Sanskrit: Vedas, Upanishads, Epics and Puranas - Buddhist and Jain literature in Pali and Prakrit – Evolution of regional Languages and literature: Sangam literature, Urdu and Hindi - Role of Christian missionaries in the Indian languages and literature.					
Module:4	Religion and Philosophy	6 hours			
Vedic religion - Hinduism and branches - Jainism – Buddhism - Islam and Sufism - Sikhism - Bhakti movement - religious and social reform movements.					
Module:5	Arts and Architecture	9 hours			
Origin and Evolution of Paintings in India - Concept of Performing Arts - Indian classical music: Ancient and Modern Indian Music and Folk Music - Dances of India: Various Dance forms - Indian Sculpture - Art schools in ancient India - Architecture: Meaning, Form and Context, The Temple, Medieval Architecture of India and Colonial Architecture – World Heritage Sites.					
Module:6	Science and Technology	6 hours			

Course Code	Course Title	L	T	P	C
BHUM217L	Contemporary India	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the process of making the Constitution and the Integration and Reorganization of Indian States 2. To acquaint the students with the political developments in India after Independence 3. To comprehend the socio-economic changes and progress in India 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Understand the reconstructive events of post-independence India. 2. Examine the socio-economic transformation and political realignments in India. 3. Describe the Political developments since 1991. 4. Analyse the factors responsible for Socio – Economic issues. 5. Critically assess the opportunities and challenges in the globalized environment. 6. Review the progress of recent developments in India towards policy development. 					
Module:1	Making of the Republic - The Constituent Assembly	6 hours			
The Legacy of Colonialism and National Movement - Framing of Indian Constitution - Constituent Assembly - Draft Committee Report - declaration of Indian Constitution - Features of Indian Constitution.					
Module:2	Challenges of Nation Building (1947 – 1964)	6 hours			
India on the eve of Independence - Partition of India - Integration of Princely States - Internal and External policies of Nehru - Integration and Reorganization of Indian States - Socio- Economic Reforms - Planning Commission – Five year planning.					
Module:3	Political, Social and Economic Developments (1964 – 1991)	5 hours			
Political Developments after Nehru Era - Green Revolution - White Revolution – Blue Revolution - Abolition of Privy Purses and Titles - Nationalization of Banks - The Emergency - Janata Government; Return of Congress to power.					
Module:4	Political, Social and Economic Reforms since 1991	8 hours			
Political Developments - relations with neighboring countries - Liberalization, Privatization and Globalization - important economic achievements of Vajpayee - Economic growth under Manmohan Singh - Mahatma Gandhi National Rural Employment Guarantee Act - Economic Reforms and Policy Implementation under Modi - Make in India - Digital India - Atmanirbhar Bharat – Citizenship Amendment Act (CAA) - Confidence-building Measures in Kashmir – Post COVID-19 reality.					
Module:5	Emerging Trends	6 hours			
An Emerging Global Power - ISRO and Its Achievements - India and Its Digitalization - Indian Smart Cities - Science, Technology and Education - Healthcare - IT - Service Industry – Governance - Concept of Society 5.0.					
Module:6	Socio-Cultural and Economic Issues	6 hours			
Communalism and Separatist Movements - Unemployment and Income inequalities – Inflation - Child Labour - Poverty - Gender issues - Women safety.					

Module:7	Empowerment Programs	6 hours
Entrepreneurship Programs - A brief mention of ongoing welfare schemes of the Central and State Governments for women, aged, youth - Women Empowerment and Policy of Reservation.		
Module:8	Contemporary Issues	2 hours
Total Lecture Hours		45 hours
Text Book(s)		
1.	Bipan Chandra (2017), India Since Independence, Imprint: India Penguin.	
2.	Deepak Singh (2022), India at 75 - History of Post-Independence India, Disha Publication.	
Reference Books		
1.	Chinmaya Saxena, Smiti Saxena (2021), India Post Independence, Notion Press.	
2.	Basu, Durga Das (2021), Introduction to the Constitution of India, 5 th Edition, Nagpur: Lexis Nexis Butterworths Wadhwa.	
3.	Ramachandra Guha (2017), India After Gandhi: The History of the World's Largest Democracy. New York: Ecco (Harper Collins).	
4.	Neera Chandhoke and Praveen Priyadarshi (2009), Contemporary India: Economy, Society, Politics, Pearson Education India; First edition	
5.	Sanjaya Baru (2022), Journey of a Nation: 75 years of Indian Economy, Rupa Publications India.	
6.	L,O-Paul Dana and Naman Sharma and Satya Ranjan Acharya (eds.) (2021), Organising Entrepreneurship and MSMEs across India, World Scientific India.	
7.	https://www.ibef.org/	
Mode of Evaluation: CAT, Quiz, Assignment and FAT.		
Recommended by Board of Studies		22-02-2023
Approved by Academic Council	No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM218L	Financial Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To develop through understanding of the role of the financial manager 2. To learn financial decision making relates to Working Capital, Investment, Capital structure and Dividend. 3. To attain application level knowledge in financial decision making. 					
Course Outcomes					
<p>Upon successful completion of the Course the students will be able to</p> <ol style="list-style-type: none"> 1. Understand role and functions of a Financial Manager 2. Assess the linkages between the economic environment and corporate. 3. Apply Working Capital Management techniques 4. Use various capital budgeting tools and techniques 5. Critically evaluate and implement different financial decisions. 6. Demonstrate professional level financial managerial skills. 					
Module:1	Financial Management – An Overview	4 hours			
Finance and Related Disciplines; Scope of Financial Management; Objectives of Financial Management; Primary Objective of Corporate Management; Agency Problem; Organization of Finance Function; and Emerging Role of Finance Managers in India - Economic Environment and Businesses.					
Module:2	Risk and Return of Portfolio	5 hours			
Time Value of Money, Conceptual Framework of Risk and Return: Type of Risks; Risk and Return of a Single Asset; Risk and Return of Portfolio; Portfolio Selection; and Capital Asset Pricing Model (CAPM)					
Module:3	Capital Budgeting Decision	7 hours			
Capital budgeting process - Estimation of relevant cash flows – Payback Period method - Accounting Rate of Return - Net Present Value - Net Terminal Value - Internal Rate of Return - Profitability Index - Capital Budgeting Under Risk –Certainty Equivalent Approach and Risk Adjusted Discount Rate.					
Module:4	Financing Decision	7 hours			
Cost of Capital and Financing Decision - Estimation of Components of Cost of Capital: Equity Capital - Retained Earnings - Debt and Preference Capital –Weighted Average Cost of Capital and Marginal Cost of Capital - Sources of Long-Term Financing – Capital Structure - Operating and Financial Leverage - Determinants of Capital Structure.					
Module:5	Working Capital Management	7 hours			
Meaning and Nature of Working Capital - Determination of Working Capital Requirement - A Brief Overview of Cash Management, Inventory Management and Receivables Management.					
Module:6	Dividend Decision	4 hours			
Meaning – Types – Dividend Decision Policy – Factors Affecting Dividend Decisions - Dividend Decisions Theories.					
Module:7	Business Valuations	9 hours			
Nature and Purpose of the Valuation of Business and Financial Assets - Models for					

the Valuation of Shares - Valuation of Debt and Other Financial Assets - Efficient Market Hypothesis (EMH) and Practical Considerations in the Valuation of Shares.			
Module:8	Contemporary Issues		2 hours
Total Lecture hours			45 hours
Text Book(s)			
1.	I.M. Pandey, (2021) Financial Management. Pearson New Delhi.		
2.	Eugene. Brigham, Joel. Houston (2021), Fundamentals of Financial management, South & Western Cengage Learning India (PVT) Ltd.		
Reference Books			
1.	Prasanna Chandra, (2022), Financial Management, Theory and Practice, Tata McGraw Hill Publishing Company, New Delhi.		
2.	M Y Khan and P K Jain, (2018), Financial Management: Text, Problems and Cases 8th Edition Tata McGraw Hill Publishing Company, New Delhi.		
3.	James.C. Van Horne, (2015), Fundamentals of Financial Management, Pearson ,UK		
Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies		06-03-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM219L	Principles of Accounting	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To understand the Accounting fundamental concepts and principles. 2. To know the accounting Process and preparation of Financial Statements. 3. To analyse the financial statements for business decision making.					
Course Outcomes					
Upon successful completion of the Course the students will be able to 1. Acquire knowledge on double entry system of book keeping. 2. Prepare the Financial Statements 3. Develop understanding on Global and Indian Accounting Standards. 4. Apply different depreciation methods for capital assets. 5. Analyse, interpret and use accounting data in managerial decision making. 6. Acquire knowledge on Accounting Information System					
Module:1	Fundamentals of Accounting	6 Hours			
Fundamentals of Accounting – Meaning – Scope, Objects and limitations; Financial Accounting – Role of Financial Accounting – Differences – Financial Accounting - Management Accounting – Accounting concepts & convention - Bank Reconciliation Statement					
Module:2	Accounting Framework	5 Hours			
Capital and Revenue items - Double Entry System - Introduction to Journal - Ledger and Procedure for Recording and Posting - Introduction to Trial Balance					
Module:3	Accounting Standards	5 Hours			
IFRS - GAAP – Ind AS - Specific Standards - AS 1 : Disclosure of Accounting Policies - AS 2 : Valuation of Inventories - AS 3 : Cash Flow Statements - AS 10 : Property, Plant and Equipment - AS 11 : The Effects of Changes in Foreign Exchange Rates - AS 12 : Accounting for Government Grants - AS 13 : Accounting for Investments - AS 16 : Borrowing Costs					
Module:4	Financial Statements and Analysis	9 Hours			
Financial Statements - Meaning and Components of Financial Statements - Preparation of Final Accounts - Profit and Loss Account - Balance Sheet – Problems with Simple Adjustments. Comparative Financial Statement – Common Size Financial Statements and Trend Analysis – Key Ratios					
Module:5	Depreciation	6 Hours			
Depreciation – Concepts – Causes – Methods of Deprecation – Problems on Straight Line Method and Written Down Value Method.					
Module:6	Accounts from Incomplete Records	6 Hours			
Single Entry System – Features - Advantages – Disadvantages - Single Entry Versus Double Entry- Statement of Affairs – Meaning – Profit Calculation.					
Module:7	Accounting Information System	6Hours			
Application of Computers in Accounting- Data analytics in Accounting – Frauds and Errors – Controls. Revenue Cycle – Expenditure Cycle – Production Cycle- Payroll Accounting- Introduction to ERP, Accounting Softwares and Core Banking					
Module: 8	Contemporary Issues	2 Hours			
Total Lecture hours:					45 hours

Text Book(s)			
1.	R.L. Gupta and V. K Gupta, (2019) Principles and Practice of Accountancy, Sultan Chand and Sons		
2.	S.P. Jain, K.L. Narang, Simmi Agrawal and Monika Sehgal (2018), Financial Accounting, Volume 1, 21st Edition, Kalyani Publishers, New Delhi		
Reference Books			
1.	M.C. Shukla, T.S. Grewal and S.C. Gupta, (2022), Advanced Accounts Volume 1, 19th Edition, S. Chand Publishing, New Delhi		
2.	S.N. Maheshwari, CA S.K. Maheshwari and S.K. Maheshwari, (2018), Advanced Accountancy, Volume 1, 11th Edition, Vikas Publishing House Ltd., New Delhi		
3.	T. Horngren Charles, L. Sundern Gary, A. Elliott John, R. Philbrick Danna, (2017), Introduction to Financial Accounting, Pearson Education, India		
Mode of Evaluation: CAT / Assignment / Quiz/ Final Assessment Test			
Recommended by Board of Studies		06-03-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM220L	Financial Markets and Institutions	3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives					
1. To understand the structure, operations and different instruments of capital markets 2. To explain the role and challenges of financial intermediation 3. To acquire knowledge on the regulatory framework of the financial system					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Explain the regulator's role in a country's Financial System. 2. Articulate the structure of Indian capital market operations. 3. Appreciate the operation of the capital market. 4. Comprehend the Money market operations. 5. Assimilate the role of depositories and stock broking services. 6. Explain various financial services offered by financial institutions.					
Module:1	An Overview of Financial Environment	7 hours			
The nature and role of financial system- Financial structure – Different financial functions - Role of financial Markets and Institutions - Recent developments. Indian financial system – History and developments. Globalization and financial sector changes. Reforms in the financial system.					
Module:2	Financial Institutions	6 hours			
Overview of Financial Institutions - Regulatory and non - regulatory institutions - Banking and nonbanking institutions – Role and functions.					
Module:3	Regulatory Framework	6 hours			
Financial system regulators: Reserve Bank of India (RBI) – Securities and Exchange Board of India (SEBI) – Pension Fund Regulatory and Development Authority (PFRDA) - Insurance Regulatory and Development Authority (IRDA). Role and functions – Acts and regulations.					
Module:4	Primary Market	5 hours			
New issues - Primary market operation - Intermediaries – lead managers - underwriting- bankers to Issue - listing mechanism – listing regulations. Registrar and share transfer agents.					
Module:5	Secondary Market	7 hours			
Stock exchanges - intermediaries and stock broking services – custodial services – depository System - clearing and settlement systems. Role of technology in financial markets operations.					
Module:6	Money Market	5 hours			
Instruments - Intermediaries – importance and applications.					
Module:7	Financial Services	7 hours			
Fee based Financial services: Merchant banking - Mergers and Acquisitions – Credit Syndication - Credit Rating. Fund based Financial services: Leasing – Hire Purchasing- Mutual Funds - Bills Discounting – Factoring and Forfeiting –Housing finance – Venture Capital – Insurance.					
Module:8	Contemporary Issues	2 hours			

	Total Lecture Hours		45 hours
Text Book (s)			
1.	Bharti V. Pathak (2018), Indian Financial System, Pearson India, 5 th Edition.		
2.	Anthony Saunders, Marcia Millon Cornett and Anshul Jain (2021), Financial Markets and Institutions, McGraw Hill, 7 th Edition.		
Reference Books			
1.	L.M.Bhole and Jitendra Mahakud (2017), Financial Institutions and Markets. Structure, Growth and Innovations, McGraw Hill Education, 6 th Edition.		
2.	Mishkin, Frederic S, Stanley G Eakins, Tulsi Jayakumar and R.K.Pattnaik (2017), Financial Markets and Institutions, Pearson Education, 8 th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM221L	Economics of Money, Banking and Financial Markets	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To create awareness about Financial Markets 2. To make students understand the nuances of Financial Economics 3. To create awareness about the working of Banks and Financial Institutions					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe financial markets and institutions. 2. Explain the functions of money 3. Define and apply interest rate dynamics 4. Critically evaluate monetary policy and its tools 5. Interpret exchange rate changes and its impact 6. Articulate the interconnected dynamics of the financial system.					
Module:1	Financial System and Economic Indicators	7 hours			
Financial System – Financial Markets - Banking and Financial Institutions - Regulatory Framework. Global and National Macroeconomic Indicators – Economic Growth, Money Supply, Inflation and Interest Rates. Business Cycles. Role of Commodity Markets. Monetary Policy and its uses.					
Module:2	Money Supply, Liquidity and Credit	6 hours			
Money – Meaning and Functions - Money Supply - Types – Liquidity Theory – RBI’s Monetary and Liquidity Aggregates - Factors influencing Supply and Demand for Money. Credit Multiplier – Determinants of Credit.					
Module:3	Interest Rates	6 hours			
Understanding Interest Rates and Return. Real and Nominal Interest Rates. Changes in interest rates. Term Structure of Interest Rates. Behavior of Interest Rates - Asset Demand – Demand in Bond and Money Markets – Equilibrium Interest Rates – Shifts in Equilibrium Rates.					
Module:4	Central Banking and Monetary Policy	5 hours			
Central Bank – Role and Functions. Central Bank’s Balance Sheet and the Control of Monetary Base. Monetary Policy – Goals and Tools. Monetary Transmission Mechanism – Channels. Reserve Bank of India – Objectives, Organization, Functions and Role. Financial Stability - Regulation and Enforcement – Debt Management - Currency Management.					
Module:5	The Foreign Exchange Market	7 hours			
Foreign Exchange Market – Foreign Exchange Rates – Determination – Changes in the Exchange Rates. Law of One Price – Purchasing Power Parity Theory. Exchange Rates in the Short run and Long run. Big Mac Index. Currency War.					
Module:6	The Keynesian IS-LM Model	5 hours			
Aggregate Demand – Keynesian View, Shifts in Aggregate Demand and Aggregate Supply - Determination of Aggregate Output, Investment and the Role of the Government. The ISLM Model – Equilibrium in the Goods Market and Money Market. Monetary and Fiscal Policy in ISLM Model.					
Module:7	Financial Crises and Learning	7 hours			

Great Depression in the US 1929 - South Asian Financial Crises - 1997-98. Financial Crisis in Mexico 1994-95 and Argentina - 2001-02. Subprime Financial Crisis - 2007-08. Banking Crises. Factors causing financial Crises – Agency Problem – Housing Price Bubbles – Financial Innovations.			
Module:8	Contemporary Issues		2 hours
		Total Lecture Hours	45 hours
Text Book(s)			
1.	Frederic S Mishkin (2021), The Economics of Money, Banking and Financial Markets, Pearson Education Limited, 13 th Edition.		
Reference Books			
1.	N. Gregory Mankiw (2022), Principles of Macroeconomics, Cengage India, 9 th Edition.		
2.	O. Blanchard (2020), Macroeconomics, Pearson Education, 7 th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM222L	Security Analysis and Portfolio Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To create awareness about functions and structure of financial markets and institutions 2. To make students understand the nuances of investment decision making 3. To achieve investment advisory skills					
Course Outcomes					
Upon successful completion of the course students will be able to 1. Describe the linkages between Macroeconomic environment and financial markets. 2. Explain theoretical foundations of financial markets. 3. Demonstrate skills in financial statement analysis. 4. Apply financial security analysis. 5. Execute portfolio construction and evaluation techniques. 6. Demonstrate professional investment advisory skills.					
Module:1 Macroeconomics and Financial Market					6 hours
Financial Markets and the Economy- Economic Growth, Business Cycles, Inflation, Interest Rates, Commodity Prices. Monetary and Fiscal Policy. Global Economic Indicators. Financial Market - Instruments – Institutions - Regulatory Framework. Trading: Trading mechanics – Types of Orders – Margins.					
Module:2 Investment Theories					7 hours
Risk and Return – Mean, Variance, Covariance and Standard Deviation. Efficient Market Hypotheses- Random Walk – Modern Portfolio Theory – Dow Theory. Mean – Variance Portfolio Theory - Beta – Capital Asset Pricing Model (CAPM). Security Market Line (SML) Efficient Frontier. Portfolio Models. Index Models – Single and Multi -Index Models. Fama- French Model.					
Module:3 Financial Statement Analysis					6 hours
Financial Statements – Standalone Vs Consolidated – Analysis of Balance Sheet, Profit and Loss and Cash flow Statement. Ratio Analysis – Investment Related Ratios (Return, Operating and Profitability Ratios). Common size and Comparative size Statement Analysis.					
Module:4 Fundamental and Technical Analysis					5 hours
Economy – Industry - Company Analysis - Top down approach-Value investing principles - Short term vs Long term investing - Qualitative and Quantitative factors. Valuation models. Technical Analysis - Chart Types – Candle Chart, Bar Chart, Line Chart – Chart Patterns – Candle Patterns. Technical Indicators – Oscillators – Rule Based Trading Strategies.					
Module:5 Equity Valuation					7 hours
Cost of capital – Weighted Average Cost of Capital (WACC) - Growth estimation - cash flow estimation – Discounted Cash Flow (DCF) models. Stock Valuation: Stock Valuation models - Dividend Discount Models, Price-Earnings Ratio, Free Cash flow - Valuation Approaches.					
Module:6 Fixed Income Securities					5 hours
Bonds - Corporate and Government securities - Treasury Securities - Types. Bond - Yield,					

Maturity and Bond valuation - duration and modified duration - Bond Portfolio Strategies.			
Module:7 Portfolio Management			7 hours
Diversification and Portfolio Risk, Combination of risky assets – Portfolio possibilities curve. Portfolio Management Process - tools and techniques, Sharpe Ratio, Jensen Alpha and Treynor Index. Coffee Can Investing. Mutual Funds and Alternate Investments - Mutual Funds – Classification – Mutual Fund Investments – Systematic Investment Plan (SIP) - Hedge Funds - Real Estate Investment Trusts (REITs).			
Module:8 Contemporary Issues			2 hours
Total Lecture Hours			45 hours
Text Book(s)			
1.	Zvi Bodie, Alex Kane, Alan J. Marcus and Pitabas Mohanty (2019), Investments, McGrawHill, 11 th Edition.		
2.	Prasanna Chandra (2021), Investment Analysis and Portfolio Management, McGraw Hill, 6 th Edition.		
Reference Books			
1.	Frank Reilly and Keith C Brown (2019), Investment Analysis and Portfolio Management, Cengage, 11 th Edition.		
2.	Charles P Jones (2016), Investments: Principles and Concepts. Wiley Finance, 12 th Edition. Edwin J Elton, Martin J Gruber, Stephen J Brown and		
3.	William N.Goetzmann (2015), Modern Portfolio Theory and Investment Analysis. John Wiley, 9 th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM223L	Options, Futures and other Derivatives	3	0	0	3
Pre-requisite	NIL	Syllabus version			
Course Objectives	1.0				
<p>1. To identify the basic principles of Derivatives Market</p> <p>2. To define the nature of risk and identify hedging strategies</p> <p>3. To describe the principles of risk management and the role of the risk manager</p>					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <p>1. Examine the role of Risk Manager in the Financial Planning Process.</p> <p>2. Analyze and evaluate various risk exposures.</p> <p>3. Compare and contrast the different types of derivatives.</p> <p>4. Identify the different types of options.</p> <p>5. Critically evaluate Option Pricing Mechanism.</p> <p>6. Explain the concept of commodity derivatives.</p>					
Module:1	Financial Risks – An Overview	7 hours			
Financial Risk - Types - Market Risk - Credit Risk - Liquidity Risks - Operational Risk - Commodity Price Risk - Trading Risk - Portfolio Risk. Global Financial Crises and RiskManagement – Hedging - Tools and Techniques.					
Module:2	Derivatives	6 hours			
Derivatives – definition - classification. Risk - risk management. Futures Vs. forwards, Over the Counter (OTC) Vs. exchange traded contracts. Futures and options on stocks, indices, commodities, exchange rates etc., understanding quotes.					
Module:3	Futures and Forwards	6 hours			
Futures: Specification-spot, forward and future relationship convergence – delivery and settlement. Margi-margin call. Hedging strategies using futures. Determination of forward and future prices.					
Module:4	Options	7 hours			
Options: Mechanics of option market - option properties – Put, Call, American and European options. Put - Call parity - underlying asset. Option pricing model: Black-Scholes option pricing model assumptions - theoretical Vs market price – volatility - historical and implied volatility- volatility estimation - volatility smile. Option Greeks: Delta - delta hedging – theta – Gamma - Vega-Rho - relationship between them.					
Module:5	Option Trading Strategies	5 hours			
Single option strategies - Multiple option strategies – Neutral and Volatility based strategies.					
Module:6	Credit Derivatives	5 hours			
Credit derivatives: Credit risk - credit default swap – Asset backed Securities – collateralized securities. Swaps: LIBOR – interest rate swaps - currency swaps- total return swaps – other types.					
Module:7	Commodity Derivatives	7 hours			
Commodity derivatives: Commodity market – commodity price risk – futures and options on commodities – hedging using commodity derivatives.					
Module:8	Contemporary Issues	2 hours			
Total Lecture Hours					45 hours
Text Book(s)					

1. Hull, John.C and Shankarshan Basu (2022), Options, Futures and other Derivatives, Pearson, 11 th Edition			
2. Don M Chance, Robert Brooks and Sanjay Dhamija (2019), An Introduction to Derivatives and Risk Management, Cengage India, 10 th Edition.			
Reference Books			
1. John Hull (2012), Risk Management and Financial Institutions, Wiley.			
2. Robert A. Strong (2016), Derivatives An Introduction Second Edition, South-Western.			
Mode of Evaluation: CAT, Quiz, Assignment and FAT			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council	No. 69	Date	16-03-2023

Course Code	Course Title	L	T	P	C
BHUM224L	Fixed Income Securities	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To make the students comprehend the specific features of the Indian and Global Fixed Incomesecurities markets 2. To make the students learn and use the term structure theories to form fixed income portfolio techniques and to use the appropriate immunization strategies to manage the fixed income portfolio 3. To make the students understand Government securities market 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Comprehend the bond market and players in the bond market. 2. Value the bonds under changing interest rate market scenario. 3. Apply the term structure theory in forecasting the future interest rates. 4. Grasp the price sensitivity of bonds to changing interest rate and apply quantitativeimmunization strategy to mitigate the risk. 5. Construct the bond portfolio to accommodate the changing interest rates. 6. Explain corporate debt markets. 					
Module:1 Instruments and Characteristics					7 hours
Fixed Income Securities - Bond and Money Markets – Instruments- Bond Features and Types – Risk Associated with Bonds. Pricing of Bonds - Review of Time value of Money – Fixed and Floating Rate Securities. Nominal Vs Real Interest Rates Coupon Rate and Current Yield, Zero Coupon Rate – Supply and Demand of Bonds – Changes in Equilibrium Interest Rates.					
Module:2 Volatility and Term Structure of Interest Rates					6 hours
Term Structure of Interest Rates – Classical Theory of Term Structure. Yield Curve, Zero Coupon Bond Yield Curve. Bond Price Volatility – Price Sensitivity – Immunization – Measurement of Duration, Modified Duration- Convexity Measurement, Factors influencing yield. Term Structure of Interest Rate, Spread, Corporate Debt Instruments.					
Module:3 Fixed Income Portfolio Management					6 hours
Active and Passive Bond Portfolio Construction – Management Strategies. Indexing – Bond Indices. Setting Portfolio Objectives, Interpreting Portfolio Parameters and PerformanceMeasurement.					
Module:4 Risk and Risk Management					5 hours
Interest Rate Risk- Impact on Bonds – Risk Management – Tools and Techniques. Swaps and Futures, Credit Derivatives – Credit Default Swaps, Plain Vanilla Options and Exotic derivatives.					
Module:5 Securitization					7 hours
Mortgage backed securities – Collateral Mortgage Obligations – Asset backed securities – Collateral Debt Obligation.					
Module:6 Indian Government - Securities Market					5 hours
Government Security (G-Sec) – Participants - How they are issued – Auction- Auction Type -Open Market Operation – Repo and Reverse Repo - Liquidity Adjustment Facility. Treasury Bills. Yield Calculation.					
Module:7 Corporate Debt Markets					7 hours

Primary and Secondary Markets- Corporate Debt Instruments – Types – Bond with embedded Options- Sinking Funds – Convertible Bonds- Warrants. Commercial Papers – Preference Shares – High Yield Bonds. Credit Analysis - Credit Rating - Methodology.			
Module:8		Contemporary Issues	
		2 hours	
		Total Lecture Hours	
		45 hours	
Text Book(s)			
1.	Frank J. Fabozzi (2012), Bond Markets, Analysis and Strategies, Pearson India, 9 th Edition.		
2.	Moorad Choudhry, Masekoldrisch (2012), Fixed Income Market: Instruments, Application, Mathematics. Wiley Finance Series, 2 nd Edition.		
Reference Books			
1.	Fabozzi, F.J (2017), The Handbook of Fixed Income Securities, McGraw Hill Education, 8 th Edition.		
2.	Choudhry (2010), Fixed Income Securities and Derivatives Handbook, Wiley, 2 nd Edition.		
3.	Suresh Sundaresan (2009), Fixed Income Markets and their Derivatives, Academic Press Inc, 3 rd Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM225L	Personal Finance	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To explain the aspects of financial planning like savings, investment, taxation, insurance & retirement planning and to develop necessary skills to become a successful financial planner 2. To impart knowledge on various investment instruments 3. To make the students understand the personal finance planning process with its elements 					
Course Outcomes					
<p>Upon successful completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Describe outline the meaning and relevance of financial planning. 2. Identify the need for career planning and financial services. 3. Examine the concept of personal tax planning 4. Explain the concept of investment planning and its methods. 5. Analyze insurance planning and its relevance. 6. Demonstrate personal financial advisory skills. 					
Module:1	Personal Finance Foundations	7 hours			
The financial planning process – setting goals-achieving goals. Time value of money and opportunity cost concepts. Economic Way of Thinking. Career Planning and Financial Planning - Career choice – opportunities – long term career development. Money management – personal financial records – asset and liability – budgeting.					
Module:2	Macroeconomic Environment	6 hours			
Economic growth – Household Savings – Circular Flow of Income - Business Cycles - Inflation – Interest rates - Banking and financial markets.					
Module:3	Tax Planning	6 hours			
Tax Planning - Income tax – Tax Slabs - Gross Income and Taxable Income – Eligible Deductions – HRA Calculations – HRA Exemptions - Tax Deducted at Source (TDS). Tax on property, wealth and earnings. Tax filing – PAN and TAN – Tax planning strategies. Capital Gains – Short Term and Long Term Capital Gains and Taxes.					
Module:4	Credit Planning	5 hours			
Credit Planning - Types of Credit – Home, Auto and Personal loans. Mortgage Loans – Reverse Mortgage Loans - Consumer Credit - Credit Cards - Purchasing decisions - Credit Score (CIBIL).					
Module:5	Insurance Planning	7 hours			
Need for Protection Planning - Risks of Mortality - Life Insurance - Term Insurance - Whole Life Insurance – Endowment Policy - Money Back Policy - Children Policies - Annuity Plans – Unit Linked Insurance Policies (ULIP). Health insurance - Cashless Facility - Exclusions-Add – ons. Motor Insurance – Liability Only Policy – Package Policy - Coverage and Exclusions. Travel Insurance - Property and General insurance - Insurance and Tax planning.					
Module:6	Investment Management	5 hours			

Investment plan - Process and Objectives - Risk and Return - Portfolio Risk and Return - Diversification. Factors influencing investment – asset allocation - source of information. Investing in stocks – short term vs long term – stock evaluation and analysis. Mutual funds and Systematic Investment Plans (SIP). Fixed income securities - real estate investments - Precious metals – alternate investments - Commodities - Various Savings Schemes.			
Module:7	Retirement Planning	7 hours	
Controlling Financial Future: Retirement planning – Financial analysis - Planning for retirement income. Pension Schemes - Estate planning – Will – Trust - Estates.			
Module:8	Contemporary Issues	2 hours	
		Total Lecture Hours	45 hours
Text Book(s)			
1.	Kapoor, J.R, Les R Dlabay, Robert J Hughes and M.M.Hart (2020), Personal Finance, McGraw Hill, Twelfth Edition.		
2.	Gitman, Joehnk, and Billingsley (2015), Personal Financial Planning, Cengage Learning, Thirteenth Edition.		
Reference Books			
1.	Thomas Garman and Raymond Fogue (2014), Personal Finance, South Western College, Publishing, 12 th Edition.		
2.	Arthur J. Keown (2019), Personal Finance, Pearson, 8 th Edition.		
3.	Jeff Madura (2020), Personal Finance, Pearson, 7 th Edition.		
Mode of Evaluation: CAT, Quiz, Assignment and FAT.			
Recommended by Board of Studies		23-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM226L	Corporate Finance	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To provide foundational knowledge of corporate finance. 2. To analyse and interpret major corporate issues and challenges. 3. To advance strategic financial decision-making skills 					
Course Outcomes					
<p>Upon successful completion of the Course the students will be able to</p> <ol style="list-style-type: none"> 1. Understand the foundational theories and concepts of corporate finance 2. Analyze capital budgeting process and techniques 3. Estimate cost of capital with due consideration of risk and returns. 4. Evaluate long term financing decisions 5. Develop strategic understanding of Mergers, Acquisition and Corporate Restructuring 6. Demonstrate application orientation skills in valuation 					
Module:1	Corporate Finance: Introduction	6 hours			
Scope and Objectives of Corporate Finance - Overview of Financial Management Process - Financial Goals and Constraints - Role of Financial Manager - Tools of Corporate Finance -Understanding of Financial Statements and Cash Flows - Corporate Financing Decision – Corporate Taxes					
Module:2	Net Present Value and Investment rules	6 hours			
Time Value of Money - Present and Future Value of Single Payments - Capital Budgeting Tools and Techniques and Decisions					
Module:3	Cost of Capital, Risk and Return	7 hours			
Concepts of Risk and Return – Diversifiable and Non - Diversifiable Risk – Risk Return Trade off- Cost of Capital - Cost of Debt Capital - Cost of Equity Capital - Cost of Preference Capital- Weightage Average Cost of Capital- Capital Asset Pricing Model (CAPM) - Security Market Line (SML).					
Module:4	Long Term Financing	5 hours			
Early Stage Financing – Venture Capital - IPO – FPO - Rights Issue. Equity – Common and Preferred Stock; Debt – Bank Loans- Bonds – International Bonds - Capital Dilution – Leasing - Types of Leasing.					
Module:5	Mergers, Acquisition and Corporate Restructuring	6 hours			
Merger and Acquisition in India, Forms of Merger, Concept of Acquisition, Difference between Merger and Acquisition, Strategic Rationales for M&A, Steps in M&A Process, Due Diligence, Regulatory Framework for M&A - Corporate Restructuring.					
Module:6	Valuation: Principles and Practice	8 hours			
Concept of Valuation - Equity Valuation – Valuation Models - Dividend Discount Model - Discounted Cash Flow Model - Residual Income Model – Asset - based Model.					
Module:7	International Corporate Finance	5 hours			
Foreign Exchange Markets - Exchange Rates – Exchange Rate Risk – Interest Rate – Interest Rate Risk – International Capital Budgeting – Political Risk – Risk Management Tools.					

Module:8	Contemporary Issues	2 hours	
		Total hours:	45 hours
Text Book(s)			
1.	Aswath Damodaran (2020) Corporate Finance: Theory and Practice John Wiley & Sons.		
2.	Ross, S. A., Westerfield, R., Jordan, B. D., & Biktimirov, E. N. (2021) Fundamentals of Corporate finance. McGraw-Hill		
Reference Books			
1.	Brealey Myer (2013) Principles of Corporate Finance McGraw-Hill Education.		
2	Vernimmen, P., Quiry, P., & Le Fur, Y. (2022). Corporate finance: theory and practice. John Wiley & Sons.		
3	Jonathan Berk, Peter DeMarzo, Jarrad Harford, Fundamentals of Corporate Finance (2019, 3 rd Edition), Pearson, India.		
Mode of Evaluation: CAT / Assignments / Quiz/ Final Assessment Test			
Recommended by Board of Studies		06-03-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM227L	Financial Statement Analysis	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To Provide framework for Financial Statement Analysis 2. To develop a thorough understanding of tools and techniques of Financial Statements 3. To understand the application of tools and techniques in the Financial Statement Analysis. 					
Course Outcomes					
Upon successful completion of the Course the students will be able to					
<ol style="list-style-type: none"> 1. Understand role and purpose of Financial Statement Analysis 2. Apply various tool and techniques to analyze Financial statements 3. Carry out effective Cash Flow Analysis 4. Estimation of Enterprise value 5. Forecast Company's Financial Statements 6. Evaluate Company's Performance using Credit Analysis 					
Module:1	Framework for Financial Statement	5 hours			
Nature and Objectives of Financial Statements - Uses and Limitations of Financial Statements -Types of Financial Statements - Balance Sheet, Income Statement, Cash Flow Statement - Stakeholders of Financial Statements - Financial Reporting - Role of Auditor					
Module:2	Tools and Techniques of Financial Statement Analysis	5 hours			
Ratio Analysis - Profitability ratio, Liquidity ratio, Short - Term and Long - Term Solvency Ratios - Operating and Financial Leverages- EPS and other Ratios used in Valuation – P/E and PB ratio- Dividend Payout Ratio- Application of Ratios to Prepare the Balance Sheet					
Module:3	Cash Flow Analysis and Estimation	6 hours			
Cash Flow Statement - Financing, Investing, and Operating Activities As per AS 3 - Preparation of the Cash Flow Statement - Earnings before Interest and Taxes (EBIT), - EBITDA and Total Enterprise Value					
Module:4	Inter Corporate Transactions	6 hours			
Corporate Investment Category- Minority Passive and Minority Active Investments. Joint Ventures – Controlling Interest Investments – Pooling of Interest – Impact of Pooling – Consolidated Financial Statements – Goodwill- Goodwill Impairment-Specil Purpose of Entity -Securitization of Assets.					
Module:5	Forecasting Financial Statements	7 hours			
A Typical One -Year Projection - Sensitivity Analysis with Projected Financial Statements - Projecting Financial Flexibility - Pro Forma Financial Statements - Multiyear Projections					
Module:6	Credit Analysis	7 hours			
Meaning of Credit Risk – Importance and Limitations-7 C' of Credit Worthiness					

Analysis- Credit Rating Process - Combination Ratios - Ratios Relating to Credit Risk			
Module:7	Equity Analysis	7 hours	
The Dividend Discount Model - The Price-Earnings Ratio - The Du Pont Formula - Valuation Through Restructuring Potential			
Module:8	Contemporary Issues	2 hours	
Total Lecture hours			45 hours
Text Book(s)			
1.	Martin S. Fridson (Author), Fernando Alvarez (2022), Financial Statement Analysis: A Practitioner's Guide, Wiley Finance		
2.	Gerald I. White, Ashwinpaul C. Sondhi, and Haim D. Fried.3e The Analysis and Use of Financial Statements, Wiley Publication		
3.	P. C. Tulsian, CA Bharat Tulsian, Tushar Tulsian (2022), Analysis of Financial Statements, Tcom Prints		
Reference Books			
1.	K. R. Subramanyam, (2020), Financial statement analysis, Published by McGraw-Hill Education, New York.		
2.	Sandeep Goel (2014), Financial statement analysis, Publisher: Routledge Taylor & Francis Group.		
3.	Robinson, Greuning, Henry, and Broihahn (2009) International Financial Statement Analysis. Published by John Wiley & Sons, Inc., Hoboken, New Jersey.		
Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies		06-03-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM228L	Cost and Management Accounting	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To familiarize the students with the basic management and cost accounting concepts 2. To develop an understanding of the decision choices in business. 3. To gain the application of budgeting techniques in management decision making. 					
Course Outcomes					
Upon successful completion of the Course the students will be able to					
<ol style="list-style-type: none"> 1. Gain a working knowledge of the principles of cost and Management accounting 2. Express the place and role of cost sheet in Organization 3. Prepare Material, Labour, Overheads cost and activity based costing to control them effectively 4. Apply the skills of Marginal costing techniques in managerial decision making 5. Assess the performance and control cost by analyzing the variance 6. Prepare Cash flow and different functional budgets 					
Module:1	Overview of Cost and Management Accounting	4 hours			
Meaning - Cost & Management Accounting – Accounting Information on Managerial Decisions - Differences between Management Accounting and Cost Accounting					
Module:2	Cost - Sheet	4 hours			
Meaning, Elements of Cost- Preparation of Cost sheet, Basics of Tender and Quotations					
Module:3	Materials, Labour, and Overhead Cost	8 hours			
Materials, Labour, Overhead: Purchase Procedure- MRP (Materials Requirement Planning), EOQ (Economic Ordering Quantity); Methods of Labor Remuneration; Overhead Absorption- Activity Based Costing					
Module:4	Marginal Costing	8 hours			
Introduction- Significance of P/V ratio, BEP (Break-even Point), MOS (Margin of safety) - Make or Buy Decisions, Accepting Order, Product Mix Decision, Shutdown					
Module:5	Standard Costing	7 hours			
Meaning, Characteristics, Objectives, Differences between Estimated Costing and Standard Costing, Budgeting, and Standard Costing Differences - Variance Analysis - Material Cost Variance only					
Module:6	Cash Flow	5 hours			
Preparation of Cash Flow – Investment Activities – Operating Activities – Financing Activities					
Module:7	Budgeting	7 hours			
Meaning, Nature, Functions of Budgeting, Process of Budget Control- Zero Based Budgeting, Preparation of Budget- Flexible Budget, Production Budget, Purchase Budget					
Module:8	Contemporary Issues	2 hours			

Total Lecture hours		45 hours	
Text Book(s)			
1.	Colin Drury, 11 th Edition (2020) Management and Cost Accounting, Cengage Learning Publication.		
2.	Jain, S.P. and K.L. Narang, (2019) Cost and Management Accounting, Kalyani Publishers.		
Reference Books			
1.	C.A. Chhawchharia, C.A. Yash 4 th Edition, (2022), Cost & Management Accounting, Taxmann Books Publications.		
2.	CA. P C Tulsian (2022) Cost & Management Accounting, S.Chand Publications		
3.	M. N. Arora 11 th Edition (2021), A Textbook of Cost and Management Accounting, S. Chand Publications.		
4.	Khan, M.Y. and P.K. Jain,(2013), Management Accounting, Tata McGraw Hill, Publishing, New Delhi		
5.	S.N. Maheshwari, (2013), Management Accounting, S. Chand Publications, New Delhi.		
Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies		06-03-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Course Code	Course Title	L	T	P	C
BHUM229L	Mind, Embodiment and Technology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. The course will help the science and technology students to speculate on the notion of humanness that has been configured and reconfigured by the technological developments initiated in the domain of artificial intelligence, and robotics. 2. The course will help learners to speculate on the philosophical issues related to concepts such as human, transhuman, and posthuman. 3. This course aims to establish a dialogue between scientists, engineers, and society with an aim to help the students understand the possible positive consequences and paranoia generated by technological interventions. 					
Course Outcomes:					
<ol style="list-style-type: none"> 1. Students will be aware of the ethical and bioethical issues related to technological developments. 2. Students will be able to gauge the positive possibilities and paranoia related to technological developments and interventions. 					
Module:1	Mind-Body Dualism	4 hours			
The Organic Body- The Prosthetic and Entangled Bodies-The Dualist Theories of Mind and Body					
Module:2	Mind, Body, and Technology	4 hours			
Humanism- Transhumanism- Posthumanism- Synthetic Beings- Antihumanism- Digital Resurrection-Digital Legacies					
Module:3	Medical Enhancement and Posthumanism	4 hours			
Therapy, Enhancement, and Improvement- Bioelectronic and Implantation Devices- Queer Body and Technological Interventions					
Module:4	Emotive Technologies	4 hours			
Caring through Technology- Emotions, My Mobile, and My Identity- Creativity, Motivation, and Technology					
Module:5	Posthumanism and Morality	4 hours			
Posthuman Ethics- Artificial Life- Evolving Species					
Module:6	Technology and Popular Culture	4 hours			
American Dystopian Science Fiction- Westworld (TV Series)- Altered Carbon (Netflix)- Love, Death+Robots (Animated Series, Netflix)- Biohackers (Netflix Webseries)					
Module:7	Novels and Short Stories	4 hours			
Excerpts from Mary Shelley's Frankenstein (1818)- Excerpts from Nancy Kress's Beggars in Spain (1993)- Hanif Kureishi's "The Body" (2002)- Greg Egan "The Extra" (2015)					
Module:8	Contemporary Issues	2 hours			

	Total Lecture hours:		30 hours
Text Book(s)			
1.	Cary, Woolfe. (2010). <i>What is Posthumanism?</i> Minneapolis and London: University of Minnesota Press.		
Reference Books			
1.	Damasio, A. (2023). <i>Feeling and Knowing Making Minds Conscious</i> . Little, Brown Book Group.		
2.	Clark, A. (2019). <i>Surfing Uncertainty: Prediction, Action, and the Embodied Mind</i> . Oxford University Press.		
3.	Jonathan, Westphal. (2016). <i>The Mind-Body Problem</i> . Cambridge and Massachusetts: The MIT Press.		
4.	Peter, Mahon. (2017). <i>Posthumanism: A Guide for the Perplexed</i> . London: Bloomsbury Academic.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies		10-03-2023	
Approved by Academic Council		No. 70	Date 24-06-2023

Course Code	Course Title	L	T	P	C
BHUM230L	Health Humanities in Biotechnological Era	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. To sensitize the students about the complex entanglement between biomedicine, technology, and disability narratives. 2. To inform the students about the politics of health management, and the shame and stigma associated with the discourse of illness 3. To sensitize students about the possible consequences of biotechnological intervention in human lives. 					
Course Outcomes:					
The students will be able to: <ol style="list-style-type: none"> 1. Understand the intricate relationships between the body, illness, health management, and biopolitics. 2. Understand how socially constructed phenomena such as shame, stigma, and prejudices inform our understanding of body, health, and wellbeing. 					
Module:1	Body, Biomedicine, and Biopolitics	4 hours			
Medical Gaze- Gender Medicine- Biomedicalization- Biopolitics- Citizenship- Illness, Disease, and Sickness- Dualism					
Module:2	Disability Studies	4 hours			
Madness and Civilization- Assistive Technology and the Prosthetic Self- Neurocognitive Disorders- Neurodiversity Movement- Chronic Pain- Ageing- Decadent Bodies					
Module:3	Mental Health and Illness	4 hours			
Depression and Life Narratives- Narrative of a Psychopath- Living with Individual Diagnosed with Bipolar Disorder- Stories of Alzheimer Disease- Stories of Post-Traumatic Stress Disorder- Addiction and Substance Abuse					
Module:4	Doctor's Narrative	4 hours			
The Uncertain World of Medicine- Gender, Space, and Medical Profession- Occupational Hazard in Medical Profession- Stress, Trauma, and the Evolution of Machinic Self					
Module:5	Living with Dying	4 hours			
Family Illness Narratives of Chronic Illness and Trauma					
Module:6	Global Health	4 hours			
Infection and Inequalities: The Pandemic Era- Occupational Hazards- Chronic Diseases and the Pharmaceutical Industry- Insomnia					
Module:7	Bioethical Imperatives	4 hours			
Euthanasia: Death and Dying- Artificial Reproductive Technology (ART) and Surrogacy- Organ Transplantation- Brain Death					
Module:8	Contemporary Issues	2 hours			

	Total Lecture hours:		30 hours
Text Book(s)			
1.	Bleakley, Alan. (2015). Medical Humanities and Medical Education. London and New York: Routledge.		
Reference Books			
1.	Calo, Thomas R, Nathan S. Carlin, and Ronald A. Carson. (2015). Medical Humanities: An Introduction. Cambridge: Cambridge University Press.		
2.	Chadwick, R. F., & Schüklenk Udo. (2021). This is Bioethics: An introduction. Wiley Blackwell.		
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies		10-03-2023	
Approved by Academic Council		No. 70	Date 24-06-2023

		Total Lecture hours:	45 hours
Text Book(s)			
1.	Abhay Chawla (2021), Introduction to Mass Communication, Pearson Publishers.		
2.	Ralph E. Hanson (2016), Mass Communication: Living in a Media World, Sage Publications.		
Reference Books			
1.	Keval J. Kumar (2020), Mass Communication in India, 5 th Edition, Jaico Publishing House.		
2.	Terhi Rantanen (2019), Globalization and the Media (4-vol. set) Routledge.		
3.	Prabakar. N (2017), Mass Media and Contemporary Social Issues, Common Wealth Publishers.		
4.	Stanley J Baran (2013), Mass Communication Theory: Foundations, Ferment, and FutureWadsworth Publishing Co Inc.		
5.	Joseph Turow (2022), Media Today: Mass Communication in a Converging World, Routledge.		
6.	D. S. Mehta (2006), Mass Communication and Journalism In India, Allied Publishers.		
Mode of Evaluation: CAT / Quiz / Assignment / FAT			
Recommended by Board of Studies		22-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023

Bridge Course

BENG101N	Effective English Communication			L	T	P	C
				0	0	4	2
Pre-requisite	Nil			Syllabus Version			
				1.0			
Course Objectives:							
1. To hone LSRW skills for effective communication							
2. To enhance communication skills for future career aspirations							
3. To gain critical communication skills in writing and public speaking							
Course Outcomes:							
1. Write effective sentences using appropriate grammar and vocabulary							
2. Express clearly in everyday conversations with lucid pronunciation							
3. Analyse the given listening inputs for effective comprehension							
4. Apply different reading strategies to various texts and use them appropriately							
Indicative Experiments							
1.	Fundamentals of Grammar: Parts of Speech, Articles, Tenses, Sentence Structure, Types of Sentences, Subject-Verb Agreement Activity: Exercises and worksheets						
2.	Speaking for Self-Expression: Formal Self-Introduction, Expressing Oneself Activity: Self-Introduction, Just a Minute (JAM)						
3.	Basic Listening: Listening to Simple Conversations, Short Speeches/Stories Activity: Gap fill exercises						
4.	Reading Skills: Reading Strategies, Skimming and Scanning Activity: Cloze reading, Reading comprehension, Reading newspaper articles						
5.	Drafting Paragraphs: Keywords Development, Writing Paragraphs using Connectives Activity: Picture and poster interpretation						
6.	Vocabulary Enrichment: Synonyms and Antonyms, Prefixes and Suffixes, Word Formation, One Word Substitution, Frequently used Idioms and Phrases, Homophones and Homonyms Activity: Crossword puzzles and worksheets						
7.	Listening for Pronunciation: Introduction to Phonemes, Listening to Native Speakers, Listening to Various Accents Activity: Listening and imitating, Spell Bee						
8.	Interactive Speaking: Everyday Conversations, Team Interactions, Simulations Activity: Situational role plays						
9.	Email and Letter Writing: Types and Format of Emails and Letters Activity: Official e-mails and letters, personal letters						
10.	Reading for Comprehension: Short Stories by Indian Writers Activity: Summarising, loud reading						
Total Laboratory Hours						60 hours	
Mode of Evaluation: Continuous assessment / FAT / Written assignments / Quiz/ Oral examination / Group activity							
Recommended by Board of Studies				28.06.2021			
Approved by Academic Council				No. 63	Date	23.09.2021	

Non Graded Credit Requirement

BCHY102N	Environmental Sciences	L	T	P	C
		0	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
The course is aimed at students to					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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, 15 th Edition, Cengagelearning. 2. Benny Joseph, (2012), Environmental Science and Engineering, 5 th 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, 4 th 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, 17 th Edition, Brooks/Cole, USA.		
Recommended by Board of Studies	14-02-2022	
Approved by Academic Council	No. 65	Date 17-03-2022

BCSE101N	Introduction to Engineering			L	T	P	C
				0	0	0	1
Pre-requisite	Nil			Syllabus version			
				1.0			
Course Objective:							
<ul style="list-style-type: none"> • 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:							
<ul style="list-style-type: none"> • 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							
<ol style="list-style-type: none"> 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 <p>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.</p>							
Mode of Evaluation: Evaluation of the submitted report and interaction with the students							
Recommended by Board of Studies				02.07.2021			
Approved by Academic Council				No. 63	Date	23.09.2021	

BHUM101N	Ethics and Values	L	T	P	C
		0	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 1. Students will be able to: 2. Follow sound morals and ethical values scrupulously to prove as good citizens. 3. Understand various social problems and learn to act ethically. 4. Understand the concept of addiction and how it will affect the physical and mental health. 5. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects. 6. Identify the main typologies, characteristics, activities, actors and forms of cybercrime. 					
Module:1 Being Good and Responsible					
Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society.					
Module:2 Social Issues 1					
Harassment – Types - Prevention of harassment, Violence and Terrorism.					
Module:3 Social Issues 2					
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices.					
Module:4 Addiction and Health					
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases.					
Module:5 Drug Abuse					
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.					
Module:6 Personal and Professional Ethics					
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism.					
Module:7 Abuse of Technologies					
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites.					
Total Lecture Hours:					60 hours
Text Books :					
1.	R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2019, 2nd Revised Edition, Excel Books, New Delhi.				
2.	Hartmann, N., "Moral Values" , 2017, United Kingdom: Taylor & Francis.				
Reference Books :					
1.	Rachels, James & Stuart Rachels, "The Elements of Moral Philosophy", 9th edition, 2019, New York: McGraw-Hill Education.				

2.	Blackburn, S. "Ethics: A Very Short Introduction", 2001, Oxford University Press.
3.	Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts", 2016, Writers Choice, New Delhi, India.
4	Ministry of Social Justice and Empowerment, "Magnitude of Substance Use in India", 2019, Government of India.
5.	Ministry of Home Affairs, "Accidental Deaths and Suicides in India", 2019, Government of India.
6.	Ministry of Home Affairs, "A Handbook for Adolescents/ Students on Cyber Safety", 2018, Government of India.
Mode of Evaluation: Poster making, Quiz and Term End - Quiz	
Recommended by Board of Studies	27-10-2021
Approved by Academic Council	No. 64 Date 16-12-2021

BSSC101N	Essence of Traditional Knowledge	L	T	P	C
		0	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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:					
<ol style="list-style-type: none"> 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