SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY BHOPAL

Scheme & Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

School of Advanced Computing

(For Batch 2020-21 Onwards)

Program Educational Objectives (PEOs)

PEO-1: Graduates shall have the ability to apply knowledge across the disciplines and in emerging areas of Computer Science and Engineering for higher studies, research, employability, product development and handle the realistic problems.

PEO-2: Graduates shall have good communication skills, possess ethical conduct, sense of responsibility to serve the society and protect the environment.

PEO-3: Graduates shall possess academic excellence with high ethical values, soft skills, managerial skills, leadership qualities, knowledge of contemporary issues and understand the need for lifelong learning for a successful professional career.

PEO-4: To imbibe in graduates the team-spirit and problem-solving skills so they can lead organizations they join in or initiate their own ventures.

PEO-5: To disseminate the ability to analyze the requirements, understand the technical specifications and design the innovative solutions by applying the principles of computing.

Program Outcomes (POs):

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Curriculum Components

Components	**Credits**
Program Core (21 Courses)	**86**
Program Electives (Discipline Specific Electives) (11 Courses)	**37**
Generic Electives (04 Courses)	**8**
Ability & Skill Development (Ability Enhancement Courses) (03 Courses)	**6**
Ability & Skill Development (Skill Enhancement Courses) (04 Courses)	**8**
Project Based Learning (PBL)/MOOCs (08 courses)	**20**
Project (03 Courses)	**32**
Yoga &Meditation* (06 Courses)	**-**
Green Credit* (06 Courses)	**-**
Total	**197**

Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

First Semester																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B101	Environmental Studies and Disaster Management	2	-	-	2	3	30	05	05	10	50	100				100
UC20B102	Communication Skills	2	-	-	2	3	30	05	05	10	50	100				100
MA20B103	Engineering Maths-I	4	-	-	4	3	30	05	05	10	50	100				100
PY20B104	Engineering Physics	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
EE20B202	Basic Electrical and Electronics Engineering	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B106	Programming Practice – I	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
Table-I	DSE – I	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
PB20B101	Project Based Learning-I	-	-	4	2	2	-						50^	50	100	100
IY20B101	Yoga & Meditation –I*	-	-	2	-	-	-						50^			50
GC20B101	Green Credit-I*	-	-	2	-	-	-						50^			50
		Total			**24**											**1000**

*Mandatory, Non-Credit Course

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Second Semester																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B202	Entrepreneurship Development	2	-	-	2	3	30	05	05	10	50	100				100
ME20B105	Engineering Drawing	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
ME20B203	Basic Mechanical and Civil Engineering	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
MA20B204	Engineering Maths-II	4	-	-	4	3	30	05	05	10	50	100				100
CS20B205	Programming Practice - II	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
ME20B206	Workshop Practice	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
Table-I	DSE – II	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE - III	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
PB20B201	Project Based Learning-II	-	-	4	2	2	-						50^	50	100	100
IY20B201	Yoga & Mediation-II*	-	-	2	-	-	-						50^	-		50
GC20B201	Green Credit-II*	-	-	2	-	-	-						50^	-		50
		Total			**27**											**1100**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Third Semester																
CourseCode	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B302	Quantitative Aptitude-I	2	-	-	2	3	30	05	05	10	50	100				100
CS20B301	Operating System	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B302	Data Structure and Algorithms	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B303	Java Programming	2	2	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE-IV	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE-V	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
Table-II	Generic Elective-I	2	-	-	2	3	30	05	05	10	50	100				100
PB20B301	Project Based Learning-III	-	-	4	2	2	-						50^	50	100	100
IY20B301	Yoga & Mediation-III*	-	-	2	-	-	-						50^			50
GC20B301	Green Credit-III*	-	-	2	-	-	-						50^			50
		Total			**24**											**1150**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Fourth Semester																
CourseCode	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B402	Quantitative Aptitude-II	2	-	-	2	3	30	05	05	10	50	100				100
CS20B401	Object Oriented Analysis and Design	2	2	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B402	Data Communication	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B403	Database Management System	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B404	Computer Organization and Architecture	2	2	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE-VI	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-II	Generic Elective – II	2	-	-	2	3	30	05	05	10	50	100				100
PB20B401	Project Based Learning-IV	-	-	4	2	2	-						50^	50	100	100
IY20B401	Yoga & Mediation-IV*	-	-	2	-	-	-						50^			50
GC20B401	Green Credit-IV*	-	-	2	-	-	-						50^			50
		Total			**26**											**1150**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Fifth Semester																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B501	Introduction to Management and Leadership	2	-	-	2	3	30	05	05	10	50	100				100
CS20B501	Computer Networks	2	2	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B502	Theory of Computation	3	2	-	4	3	30	05	05	10	50	100				100
CS20B503	Analysis and Design of Algorithms	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
CS20B504	Microprocessor and Microcontroller	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE –VII	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-II	Generic Elective – III	2	-	-	2	3	30	05	05	10	50	100				100
PB20B501	Project Based Learning-V	-	-	4	2	2	-						50^	50	100	100
IY20B501	Yoga & Mediation-V*	-	-	2	-	-	-						50^			50
GC20B501	Green Credit-V*	-	-	2	-	-	-						50^			50
		Total			**26**											**1100**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Sixth Semester																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
UC20B601	Social and Professional Ethics	2	-	-	2	3	30	05	05	10	50	100				100
CS20B601	Software Engineering	2	2	2	4	3	30	05	05	10	50	100	20	30	50	150
AI20B601	Data Mining and Warehousing	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE – VIII	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE – IX	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
Table-II	Generic Elective – IV	2	-	-	2	3	30	05	05	10	50	100				100
PB20B601	Project Based Learning-VI	-	-	4	2	2	-						50^	50	100	100
IY20B601	Yoga & Mediation-VI*	-	-	2	-	-	-						50^			50
GC20B601	Green Credit-VI*	-	-	2	-	-	-						50^			50
		Total			**20**											**1000**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Seventh Semester																
Course Code	**Course Title**	**Contact Hours Per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
CS20B708	TCP/IP and Web Technology	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE – X	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
Table-I	DSE – XI	2	-	2	3	3	30	05	05	10	50	100	20	30	50	150
AI20B701	Summer Internship Project	-	-	8	4	-							50^	50	100	100
AI20B702	Minor Project	-	-	16	8	-							100^	100	200	200
		Total			**22**											**750**

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Bachelor of Technology (Hons) CSE –Artificial Intelligence (2020-21)

Eighth Semester																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ESE Duration (Hours)**	**Theory**						**Practical**			**GT**
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Tot**	**CE**	**ESE**	**Tot**	
MO20B801	MOOC-1	-	-	8	4								50	50	100	100
MO20B802	MOOC-2	-	-	8	4								50	50	100	100
AI20B801	Major Project	-	-	40	20								250^	250	500	500
		Total			**28**											**700**

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Distribution of credits across all components

SEM	Prog. Core	Discipline Specific Electives (DSE)	Generic Electives (GE)	Ability & Skill Development		Project Based Learning (PBL) / MOOCs	Project	Yoga & Meditation*	Green Credit*	Total Credit
				Ability Enhancement Courses	Skill Enhancement Courses					
I.	14	4	-	2	2	2	-	-	-	**24**
II.	16	7	-	2	-	2	-	-	-	**27**
III.	12	6	2	2	-	2	-	-	-	**24**
IV.	16	4	2	-	2	2	-	-	-	**26**
V.	16	4	2	-	3	2	-	-	-	**26**
VI.	8	6	2	-	2	2	-	-	-	**20**
VII.	4	6	-	-	-	-	12	-	-	**22**
VIII.	-	-	-	-	-	8	20	-	-	**28**
Total	**86**	**37**	**8**	**6**	**8**	**20**	**32**	**-**	**-**	**197**

*Mandatory Non-Credit Course

Table-I

List of Discipline Specific Electives (DSE)

DSE-I		
SN	**Course Code**	**Course Name**
1.	**CS20B107**	Design Thinking
2.	**CS20B108**	Introduction to Computational Thinking
3.	**CS20B109**	Introduction to Digital Technology
DSE-II, III		
SN	**Course Code**	**Course Name**
1.	**CS20B207**	Introduction to Artificial Intelligence and Data Science
2.	**CS20B208**	C# Programming
SN	**Course Code**	**Course Name**
1.	**CS20B209**	Analog and Digital Communication
2.	**CS20B210**	Data Analysis Uusing Python
DSE-IV, V		
SN	**Course Code**	**Course Name**
1.	**AI20B304**	Probabilistic Modeling and Reasoning
2.	**AI20B305**	Information Theory and Coding
SN	**Course Code**	**Course Name**
1.	**AI20B306**	Linear Algebra
2.	**AI20B307**	Computer Graphics and Multimedia
DSE-VI		
SN	**Course Code**	**Course Name**
1.	**AI20B405**	Machine Learning and Pattern Recognition
2.	**AI20B406**	Big Data and Analytics
DSE-VII		
SN	**Course Code**	**Course Name**
1.	**AI20B501**	Neural Networks and Deep Learning
2.	**AI20B502**	Biometrics
DSE-VIII, IX		
SN	**Course Code**	**Course Name**
1.	**AI20B602**	Data Science Tools and Techniques
2.	**AI20B603**	Digital Image Processing
3.	**AI20B604**	Biomedical Image and Signal Processing

SN	Course Code	Course Name
1.	**AI20B605**	Principle and Design of IoT Systems
2.	**AI 20B606**	Natural Language Processing
3.	**CY20B607**	Block Chain & Distributed Ledgers
4.	**AI20B607**	Computer Vision
DSE-X, XI		
SN	**Course Code**	**Course Name**
1.	**AI20B703**	Data Analytics & Visualization
2.	**AI20B704**	Cloud Computing
3.	**AI 20B705**	Cognitive Modeling
SN	**Course Code**	**Course Name**
1.	**AI20B706**	Self-Driving Cars
2.	**AI 20B707**	Dev Ops-Build, Test, Deployment Automation
3.	**AI 20B708**	Virtual and Augmented Reality
4.	**AI 20B709**	Bioinformatics

Table-II

List of Generic Electives

Students of all Undergraduate programs are required to study one generic elective in each of the semesters from 3rd to 6th. They may choose any one of the following courses **(excluding the courses offered by the parent departments, if not stated otherwise).**

Generic Electives for III Semester

SN	Code	Nomenclature of the Course	Offering School
1.	GE20B301	Introductory Biology	School of Sciences
2.	GE20B302	Basic Analytical Chemistry	School of Sciences
3.	GE20B303	Basic Instrumentation Skills	School of Sciences
4.	GE20B304	Elementary Number Theory	School of Sciences
5.	GE20B305	Production Technology for Vegetable and Spices	School of Agriculture
6.	GE20B306	General Studies – I	School of Arts, Humanities and Social Sciences
7.	GE20B307	Basics of Acting	School of Performing Arts
8.	GE20B308	C++ Programming	School of Engineering and Technology
9.	GE20B309	Photography	School of Journalism and Mass Communication
10.	GE20B310	Introduction to Retail Chain System	School of Commerce

Generic Electives for IV Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B401	Genetics and Society	School of Sciences
2.	GE20B402	Green Chemistry and Green Methods in Chemistry	School of Sciences
3.	GE20B403	Electrical circuit Network Skills	School of Sciences
4.	GE20B404	Introduction to statistical methods and Probability	School of Sciences
5.	GE20B405	Farming System & Sustainable Agriculture	School of Agriculture
6.	GE20B406	General Studies – II	School of Arts, Humanities and Social Sciences
7.	GE20B407	Bollywood's Signature Moves	School of Performing Arts
8.	GE20B408	R Programming	School of Engineering and Technology

9.	GE20B409	Typography	School of Design
10.	GE20B410	Building Leadership &Fellowship Skills	School of Commerce

Generic Electives for V Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B501	Biotechnology	School of Sciences
2.	GE20B502	Pharmaceutical Chemistry	School of Sciences
3.	GE20B503	Digital, Analog and Instrumentation	School of Sciences
4.	GE20B504	Applications of Mathematic in Finance and Insurance	School of Sciences
5.	GE20B505	Crop Improvement-I	School of Agriculture
6.	GE20B506	Civil Services Aptitude Test – I	School of Arts, Humanities and Social Sciences
7.	GE20B507	Mime	School of Performing Arts
8.	GE20B508	Web designing	School of Engineering and Technology
9.	GE20B509	Fine Arts	School of Design
10.	GE20B510	Resolving Conflicts and Negotiation Skills	School of Commerce

Generic Electives for VI Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B601	Bioinformatics and Systems Biology	School of Sciences
2.	GE20B602	Pesticide Chemistry	School of Sciences
3.	GE20B603	Elements of Modern Physics	School of Sciences
4.	GE20B604	Mathematical Modeling	School of Sciences
5.	GE20B605	Post-Harvest Management and Value Additionof Fruits and Vegetables	School of Agriculture
6.	GE20B606	Civil Services Aptitude Test – II	School of Arts, Humanities and Social Sciences
7.	GE20B607	Body Movement (Expressing through Body nuances)	School of Performing Arts
8.	GE20B608	Python programming	School of Engineering and Technology
9.	GE20B609	Digital learning-Adobe cloud	School of Design
10.	GE20B610	Introduction to IFRS	School of Commerce

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

I Semester

School of Advanced Computing

COURSE CODE	ENVIRONMENT STUDIES & DISASTER MANAGEMENT	Total Lecture: 30
UC20B101		(LTP=2-0-0=2)

Course Objectives:

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
- Capacity to integrate knowledge and to analyses, evaluate and manage the different public health aspects of disaster events at a local and global levels.
- Capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.

UNIT	CONTENTS	HOURS
I	**Introduction to Environment:** Definition, Components of Environment, Relationship between different components, Man-Environment relationship, Impact of Technology on the environment, Environmental Degradation, Sustainable Development, Environmental Education.	5
II	**Ecology & Ecosystems:** Introduction: Ecology- Objectives and Classification, Concepts of an ecosystem- structure & function of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers, Energy flow in the ecosystem - Ecological succession, Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and its types, Bio-Geo- Chemical Cycles - Hydrological Cycle, Carbon cycle, Oxygen Cycle, Nitrogen Cycle, Sulfur Cycle.	7
III	**Environmental Pollution:** Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like SPM, SO2, NOX , Natural & Anthropogenic Sources, Effects of common air pollutants, Air Pollution Episodes, Sound and Noise measurements, Sources of Noise Pollution, Ambient noise levels, Effects of noise pollution, Noise pollution control measures, Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants, Eutrophication, Water Pollution Episodes, Global Warming and Green Houses Effect, Acid Rain, Depletion of Ozone Layer.	7
IV	**Energy Resources:** Renewable & Nonrenewable Resources: Renewable Resources, Nonrenewable Resources, Indian Scenario, Conventional Energy Sources & its problems, non-conventional energy sources-Advantages and its Limitations	**4**
V	**Disaster Management:** Natural Disasters and its types, Accidental Disasters, Impact of Disasters on Trade and International Trade, Introduction, Natural disasters , Earthquakes, Hurricanes, Tornadoes, Floods, Drought, Tsunami, Volcanoes, Cyclones and Storms, Forest Fires, Severe Heat Waves, Landslides and Avalanches, Epidemics and Insect Infestations, Technological and Social Disasters Types of Technological Hazards, Social Disasters, Political and Crowd Disasters, War and Terrorism, Components of Disaster Management, Government's Role in Disaster Management through Control of Information, Actors in Disaster Management, Organizing Relief measures at National and Local Level, Psychological Issues, Carrying Out Rehabilitation Work, Government Response in Disaster	**7**

Course Outcome as per Bloom's Taxonomy	
At the end of the course the students will be able to:	
CO1	**Understand**[2] the importance of Environment.
CO2	**Understand**[2] the knowledge of Ecology & Ecosystems.
CO3	**Analyze**[3] to impart basic knowledge about Environment Pollution & theirs Remedies.
CO4	**Understand**[2] about Energy Resources.
CO5	**Understand**[2] about Disaster Management.
Text Books	• Dr. N. S. Varandani (2013): **Basics of Environmental Studies** Books India Publications. • Mukesh Dhunna (2011): **Disaster Management,** Delhi Publication: Vayu Education of India. • Benny Joseph (2017): **Environmental Studies**: McGraw Hills Education,
Reference Books	• R. Rajagopalan (2015): **Environmental Studies**: Oxford University, Press Publication. • Richard T Wright & Bernard J Nebel (2002): **Environmental Science**: Prentice Hall India Publication. • Daniel B. Botkin & Edward A Keller (2014): **Environmental Science**: Wiley Publications.

COURSE CODE	ENVIRONMENT STUDIES & DISASTER MANAGEMENT	Total Lecture: 30
UC20B102		**2– 0– 0-2**
Course Objectives:	The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. Along with the above mentioned, care has been taken to enhance the grammatical skills of the students with sufficient practical purposes. The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books. The students are advised to arrange the prescribed texts well before beginning the classes. The course provides good introduction and understanding about the following: • The concept and understanding of different types of Communication • Introduce different tools of communication that are useful in various techniques of problems solving. • The Grammatical knowledge of Language learning with the enhancement of word power. To introduce the tricks and methods of official and Technical writing.	
Pre-requisites:	Nil	
UNIT	**CONTENT**	**HOURS**
I	**Introduction:** Theory of Communication, Types and Modes of Communication, Effective Communication, Barriers of Communication, Strategies to overcome the Barriers	**3**
II	**Professional Skills:** Social skills - Small talks and leading the Conversation, conducting Debate and Discussions, Public Speaking,Public Speech, Presentation skills and Meeting etiquettes, Business Communication, GD and Interview Skills, Critical Conversations	**3**
III	**Cross Cultural Communication:** Contextual Conversation, do's and don'ts of Cross Cultural Communication, Verbal and Non Verbal Communication, Bias and Prejudice, Body Language.	**3**
IV	**Internet Etiquettes:** Email writing, Social Media Articles/Blogs, Notes, Memos, Reports & Proposal Writing, Writing Letters, Formal & Informal. Self profiling - Making Job Resume/CV, Elevator Pitch (3 minutes self- introduction during interviews), Twitter/ Facebook bio.	**3**
V	Critical Thinking:Where the Mind is without Fear: Rabindranath Tagore The Portrait of a Lady: Khushwant Singh On the Rule of the Road: AG Gardiner Cherry Tree: Ruskin Bond Close Reading, Comprehension, Analysis and Interpretation, Paraphrasing and Summary	**3**

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to:	
CO 1	Students will **apply**[3]correct usage of English grammar in writing and speaking.
CO 2	Students will **analyze**[4] and improve their speaking ability in English both in terms of fluency and comprehensibility
CO 3	Students will **evaluate**[5] themselves by giving oral presentations and will receive feedback on their performances.
CO 4	Students will **develop**[3] their reading speed and comprehension of academic articles
CO 5	Students will **compare**[5] their reading fluency skills.
Text Books:	• EASTWOOD, J. **Oxford practice grammar**1999 - Oxford University Press – Oxford • MURPHY, R. **English grammar in use**2012 - Cambridge University Press - Cambridge • **Fluency in English** - Part II, Oxford University Press, 2006. • **Language, Literature and Creativity**, Orient Black s • wan, 2013.
Reference Books:	• **Warriner's English Grammar and Composition**: Complete Course - John E. Warriner, Harcourt, Brace, Jovanovich (1973) • ALEXANDER, L. G. **Longman English grammar practice**1999 - Longman - New York • BEAUMONT, D. AND GRANGER, C. **The Heinemann English grammar**1992 - Heinemann – Oxford

COURSE CODE	ENGINEERING MATHS- I	Total Lecture: 60
MA20B103		(LTP=4-0-0=4)

Course Objectives:

The objective is to provide essential knowledge of basic tools of Matrix Algebra, Differential Calculus, Integral Calculus, Vector Calculus and Vector spaces.

The course provides good introduction and understanding about the following:

- Working with matrices and using it as tool in solving the system of equations, learning to find eigen values and eigenvectors of a matrix and use it for diagonalization of a matrix.
- The concept and use of differential calculus in tracing of curves in different coordinate systems, partial differentiation, Homogeneous functions and its use in Euler's theorem and minimization/ maximization of the function.
- The concept of higher order integration and its application in finding length, area and volume.
- The concept of vector differentiation and integration.
- The concept of Vector Spaces, Sub spaces, Basis of a vector space and Linear Transformations.

UNIT	CONTENTS	HOURS
I.	Rank of a matrix, Inverse of the matrix, solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal and Unitary matrices and their elementary properties. Eigen values and Eigen vectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	**12**
II.	Expansion of functions of one variable using Taylor's and Maclaurin's theorem,, Partial differentiation, homogeneous functions, Euler's theorem and its extension up to second order, Differentiation of composite functions, Taylor's series expansion of function of two or more variable, Maxima and Minima of function of two or more variables, Lagrange method of undetermined multipliers.	**12**
III.	Brief review of curve tracing (Cartesian, polar and parametric), area of curve, length of curve, volume and surface area of the surface formed by revolution of curve about an axis, beta and gamma functions and their applications in real integration, Double, triple integrals, change of order of integration, area and volume of the surfaces using multiple integrals.	12
IV.	Vector differentiation, gradient, directional derivative, divergence & curl of vector point function, Line Integral, Surface Integral, Gauss Divergence Theorem, Stokes theorem & Green's Theorem.	12
V.	Vector Space, Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space, Linear Transformations	12

Course Outcome as per Bloom's Taxonomy

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

CO1	Utilize3 matrices as tool in solving linear systems and determine if a given matrix is diagonalizable.
CO2	Apply3differential calculus in tracing of curves, series expansion of functions, solving maximization/ minimization problems.
CO3	Utilize3 concepts of integral calculus in finding area and volume over higher dimensional domain
CO4	Evaluate5 integrals of functions or vector-related quantities over curves, surfaces, and domains in

	two- and three-dimensional space.
CO5	Define1 vector spaces, sub spaces, basis of a vector space and Linear Transformations.
Text Books	• Grewal. B. S. (2017): Higher Engineering Mathematics, 43rd Edition, Delhi: Khanna Publishers. • Das H K (2019): Advanced Engineering Mathematics, 22nd Edition, Bhopal Madhya Pradesh: S. Chand. • Hill Tim (2018): Essential Permutations & Combinations. A Self-teaching Guide, Questing Vol. Press.
Reference Books	• Kreyszig E (2011): Advanced Engineering Mathematics, 9th edition, U. K: John Wiley and Sons, Inc. • Poole D (2005): Linear Algebra: A Modern Introduction, 2nd Edition: Brooks/Cole. • B. V. Ramana (2010): Higher Engineering Mathematics, 11th Reprint, New Delhi: Tata McGraw Hill.

COURSE CODE	ENGINEERING PHYSICS	Total Lecture: 45 Practical: 15
PY20B104		(LTP=3-0-2=4)

Course Objectives:

The main objective of the course is to introduce the student to various branches of physics which plays a significant role in the understanding and development of modern day technology.

The course provides good introduction and understanding about the following**:**

The origin of quantum mechanics**,** dual nature of matter**,** Wave function and its interpretation**,** Schrodinger wave equation and application.

The electric and magnetic field for a given charge and current distribution**,** Maxwell equation and its significance.

The wave nature of light including Hygen's principle**,** interference**,** diffraction and resolving power of grating and prism.

The spontaneous and stimulated emission and how the concept of stimulated emission explains the production of laser beam. Principle of propagation of light in optical fiber.

The semiconductor (p and n type)**,** the theory for semiconductor's energy level**,** various semiconductor devices and basic of digital electronic.

UNIT	CONTENTS	HOURS
I.	**Quantum Mechanics for Engineers** Introduction to Quantum mechanics**,** Davisson Germer experiment**,** Wave nature of Particles**,** Time-dependent and time independent Schrodinger equation for wave function**,** Born interpretation**,** probability current**,** Expectation values**,** Free-particle wave function and wave- packets**,** Uncertainty principle and its experimental verification**,** Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box	**10**
II.	Electrodynamics Coulomb's law in vector form, Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential, Boundary conditions of electric field and electrostatic potential, energy of a charge distribution and its expression in terms of electric field, Gauss Divergence theorem, Stokes' theorem; Continuity equation, Maxwell equation and its significance	8
III.	Wave Optics Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Fresnel's biprism, Thin film interference, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit, double slit and circular aperture Diffraction gratings, Rayleigh criterion for limit of resolution and its application to vision, Resolving power of grating and prism.	10
IV.	Laser and Fiber optics Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, Component of laser, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), Properties of laser beams, applications of lasers in science, engineering and medicine, Introduction to fibre, total internal reflection, acceptance angle and cone, Numerical aperture, V-number, Types fibre, fibre losses, Attenuation constant, Types of dispersion, Intermodal dispersion in graded index fibre. Fibre optics communications system	8
V.	Semiconductor and Digital Electronics Band theory of metals, Fermi level, Intrinsic and extrinsic semiconductor, Hall Effect, Fabrication of PN junction diodes, V-I characteristics of PN junction, Zener diode, Tunnel diode, Solar Cell, Basic concepts of Transistor, Logic gates and number system (binary, hexadecimal, and octadecimal), Flip Flop Circuits	9

	List of Experiments: 1. To determine the resistivity of a semiconductor as a function of temperature and to estimate its band gap using four-probe method. 2. Radius of curvature of plano convex lens using Newton's rings. 3. To study the single slit diffraction by laser light. 4. Determination of wavelength different colour of light using diffraction grating. 5. To determine the value of Planck's constant by measuring radiation in a fixed spectral range. 6. To determine the wavelength of sodium light by Newton's Ring. 7. V-I Characteristics of PN Junction. 8. V-I Characteristics of Zener diode. 9. V-I Characteristics of Solar cell 10. Determine the frequency of AC mains 11. Determine the height of Tower using Sextant	

Course Outcome as per Bloom's Taxonomy	
At the end of the course the students will be able to:	
CO 1	Define1 interference and diffractions of light in different conditions.
CO 2	Apply3 the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to a matter wave system.
CO 3	Differentiate3 the solids on the basis of band theory and to calculate conductivity of semiconductors
CO 4	Describe1 the basic laser physics, working of lasers, holography and principle of propagation of light in optical fiber.
CO 5	Conclude5 the importance of Band theory of solid in determining the properties of metals; understand the concept of logic gates and number system.
Text Books	Gaur R. K and S. L. Gupta (2012): Engineering Physics, New Delhi: Dhanpat Rai Publications. Khan Md. M. & Panigrahi, S. : Principle of Physics, Vol. I & Vol. II, Cambridge Univ. Press.
Reference Books	Maharana L. , Panda Prafullaku, Dash Sarat Ku. , Ojha Babita (2019): Lectures on Engineering Physics, New Delhi NCR: Pearson. Bhattacharrya D. K. and Tondon Poom (2015): Engineering Physics lucknow uttarpradesh, Oxford University Press.

COURSE CODE	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Total Lecture: 45 Practical: 15
EE20B202		(LTP=3-0-2=4)

Course Objectives:

- Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices
- Students will gain knowledge regarding the various laws and principles associated with electrical systems.
- Students will gain knowledge regarding Fundamentals of Electrical Machines
- Student will gain knowledge. Evolution and Impact of Electronics in industries and in society
- Student will gain knowledge on electronic systems. & field of electrical & electronics engineering.

UNIT	CONTENTS	HOURS
I.	**D. C. Circuits:** Basic Laws**:** Ohm's law**,** Kirchhoff's voltage and current laws**,** Nodes-Branches and loops**,,** Mesh analysis and Nodal analysis**,** Series elements and Voltage Division**,** Parallel elements and Current Division**,** Star-Delta transformation**,** Independent sources and Dependent sources**,** source transformation. Superposition theorem**,** Thevinin's theorem **Basic electrical parameter measuring Instruments** Voltmeters & ammeter**,** wattmeter**,** energy meter**,**	**10**
II.	**AC Fundamentals-I:** Reviews of Complex Algebra**,** Sinusoids**,** phasors**,** Phasor Relations of circuit elements**,** Impedance and admittance**,** Impedance Combinations**,** Series and Parallel combination of Inductors and capacitor.	**10**
III.	**AC Fundamental-II:** RMS and average values**,** Form factors**,** Steady state Analysis of series**,** Parallel and Series Parallel combination of R**,** L**,** C with Sinusoidal excitation**,** Instantaneous power**,** Real power**,** Reactive power and Apparent power**,** concept of Power factor**,** Frequency.	**9**
IV.	**Fundamentals of Electrical Machines:** Construction**,** Principle**,** Operation and Application of –(i) Single phase Transformer (ii) Single phase Induction motor (iii) DC Motor.	**8**
V.	**Evolution and Impact of Electronics in industries and in society,** Familiarization with Resistors**,** Capacitors**,** Inductors**,** PN Junction diode**:** Structure**,** Principle of operation**,** various types of Diode**,** Bipolar junction transistors (BJT)**,** Half wave and full wave rectifiers**,** Basics of CRO (analog & digital):	**8**
	List of Experiments: • To verify Kirchhoff's Voltage. • To verify Kirchhoff's Current laws. • To verify Thevenin's theorem • To verify superposition theorem	

	• To study star and delta connection for a 3-Φ AC circuit. • To measure the active and reactive power in single phase ac circuit. • To obtain the transient response and measure the time constant of a series RL and RC circuit for a pulse waveform. • To study and verify the various digital logic gates • To study of various electronic devices • To study PN Junction Diode characteristics. • Verification of truth table for various gates**,** Flip-Flops. • Verification of De Morgan's theorems. • Study of V-I Characteristics of Diodes. • To study and plot VI characteristics of semiconductor diodes	

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Understand**[2] the basic properties of electrical elements**,** and solve DC circuit analysis problems. DC network theorems.
CO 2	**Understand**[2] the fundamental behavior of AC circuits and solve AC circuit problems**. Apply** the knowledge gained to explain the behavior of the circuit at series & parallel resonance of circuit & the effect of resonance.
CO 3	**Remembering**[1] to impart basic knowledge of electrical quantities such as current**,** voltage**,** power**,** energy and frequency
CO 4	**Understand**[2] the concepts of fundamentals of Electrical Machines
CO 5	**Understand**[2] the concepts of Electronics in industries and in society**,** transformers and their applications**,** Semiconductors Devices**,** Rectifiers.
Text Books	• Gupta J. B : **Basic Electrical & Electronics Engineering,** New Delhi : Tata McGraw Hill • Theraja B. L. & Theraja A. K. : **Textbook of Electronics Device & Circuit** - Vol. IV**,**New Delhi: S. Chand Publication. • Kothari D. P. & Nagrath, I. J: **Basic Electrical Engineering**, New Delhi: Tata McGraw Hill, latest edition.
Reference Books	• D. P. Kothari & I. J. Nagrath: **Basic Electrical Engineering**, New Delhi: Tata McGraw Hill**,** latest Edition. • Singh S. N. (2013): **Basic Electrical Engineering,** U. S. A. : PHI • Rajendra Prasad(2014): **Fundamentals of Electrical Engineering,** U. S. A: Prentice Hall • Sukhija**,** M. S. , Nagsarkar T. K. (2012): **Basic Electrical and electronics Engineering**, : U. P. : Oxford University press

COURSE CODE	PROGRAMMING PRACTICE –I	Practical: 30
CS20B106		(LTP=0-0-4=2)

Course Objectives:

- Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
- Demonstrate an understanding of computer programming language concepts.
- Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.

UNIT	CONTENTS	HOURS
I.	Basics of Computer Hardware and Software Basics of Computer Architecture: processor, Memory, Input & Output devices Application Software & System software: Compilers, interpreters, High level and low level languages Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (bubble sort, linear search - algorithms and pseudocode)	7
II.	Program Basics Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. (Simple programs covering control flow)	6
III.	Arrays and strings Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) Linear search program, bubble sort program, simple programs covering arrays and strings	5
IV.	Working with functions Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, simple programs using functions	6
V.	Pointers and Files Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer, array access using pointers, pass by reference effect File Operations: open, close, read, write, append Sequential access and random access to files: In built file handling functions (rewind(), fseek(), ftell(), feof(), fread(), fwrite()), simple programs covering pointers and files.	6
	List of Experiments: 1. Write a program to print sample string like “hello world” with different format. 2. Write a program to print different data types in ‘c’ and their ranges. 3. Write a program to printing a variable of different data types. 4. Write a program to demonstrate arithmetic operators. 5. Write a program to demonstrate logical operators. 6. Write a program to read radius value from the keyboard and calculate the area of circle and print the result both floating and exponential notation. 7. Write a program to calculate simple interest.	

	8. Write a program to convert temperature**. (**Fahrenheit-centigrade and vice-versa. 9. Write a program to demonstrate relational operators. 10. Write a program to check equivalence of two number's using conditional operator. 11. Write a program to demonstrate pre-increment and post-increment. 12. Write a program to demonstrate pre- decrement and post- decrement. 13. Write a program for computing volume of cylinder**,** sphere and cone assume that dimensions are integer's use type casting where ever necessary. 14. Write a program to read marks of a student in six subjects and print whether pass or fail. 15. Write a program to calculate roots of quadratic equation. 16. Write a program to perform arithmetic operation's using switch case. 17. Program on 1D and 2D arrays. 18. Program on function. 19. Program on string function. 20. Program on pointers.	

Course Outcome as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] the computer programming language concepts.
CO 2	**Define**[1] data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures.
CO 3	**Define**[1] union and enumeration user defined data types.
CO 4	**Design**[6] Computer programs**,** analyzes**,** and interprets the concept of pointers**,** declarations**,** initialization**,** operations on pointers and their usage.
CO 5	**Develop**[6] confidence for self education and ability for life-long learning needed for Computer language
Text Books	• Balagurusamy E. (2006): **Programming in ANSI C,** 15th Edition**,**Noida: Mcgraw Hill. • Kamthane**,** Asok N (2011): **Programming in C,** 2nd Edition**,** Delhi: Pearson. • Gottfried B. S. (1996): **Programming with C,** Schaum Series**,** 2nd Edtion**,** Noida: Tata McGrawHill.
Reference Books	• Goel Anita and Mittal Ajay (2016**)**: **Computer fundamentals and Programming in C,** Delhi: Pearson publication • Kernighan Brian W. and Ritchie Dennis M (2015): **C Programming Language,** Delhi: Pearson • Rajaraman V (2019): **Computer Basics and Programming in C**: PHI

DISCIPLINE SPECIFIC ELECTIVE-I

COURSE CODE	DESIGN THINKING	Total Lecture: 45 Practical: 15
CS20B107		(LTP=3-0-2=4)

- To familiarize students with design thinking concepts and principles
- To ensure students can practices the methods, processes and tools of design thinking.
- To ensure students can apply the design thinking approach and have ability to model real world situations.
- To enable students to analyse primary and secondary research in the introduction to design thinking and develop ideas.
- To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, hindsight and insight generation.

UNIT	CONTENTS	HOURS
I.	**ENTERPRISE DESIGN THINKING – HISTORY, OVERVIEW** Introduction to Design Thinking, Understand what came before Design Thinking, Design making: Design making: concepts and prototyping; Design breaking; Identifying and using design principles; Identify who did what to bring it about, Learn how it built upon previous approaches, Need of design thinking; An approach to design thinking, Design thinking Process, Enterprise Design Thinking, Understand the principles, loop, and keys. Determine what is most important.	10
II.	**ENTERPRISE DESIGN THINKING – 7 KEY HABITS, THE LOOP, USER RESEARCH** 7 key habits of effective design thinkers, Iteration: understand the importance; Learn how to observe, reflect, & make. An Overview on Loop: - Its principles and keys. Determine what is most important. User Research Its Importance, Empathy through listening.	10
III.	**THE LOOP – MAKE, USER FEEDBACK** Understand how Make fits into the Loop, learn how to leverage Observe information, Learn Ideation, Storyboarding, & Prototyping. Understand user feedback and the Loop, Learn the different types of user feedback, learn how to carry out getting feedback.	9
IV.	**DEVELOPING IDEAS & GENERATING INNOVATIONS** Create Thinking, Generating Design Ideas, Lateral Thinking, Analogies, Brainstorming, Mind mapping, National Group Technique, Synectic's, Development of work, Analytical Thinking, Group Activities Recommended; What is design innovation? A mindset for innovation, and asking "what if?"asking "what wows?"and "what works?"	8
V.	**Reverse Engineering** Introduction - Forward Engineering Design, Design Thought and Process, Design Steps; Reverse Engineering Leads to New Understanding about Products; Schematic Drawings and Analysis; Reverse Engineering in Computer Applications; Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step - Case Study. **List of Lab Experiments**	8

	1) Enterprise Design Thinking - Listening 2) Enterprise Design Thinking – HMW 3) Enterprise Design Thinking - User Research 4) Enterprise Design Thinking – Reflect 5) Enterprise Design Thinking – Ideation 6) Enterprise Design Thinking – Storyboarding 7) Enterprise Design Thinking – 6 Thinking Hat 8) Enterprise Design Thinking – Prototyping 9) Enterprise Design Thinking – User Feedback 10) Enterprise Design Thinking – Playbacks	

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Examine**[3] Design Thinking concepts and principles
CO 2	**Understand**[2] and apply enterprise Design thinking
CO 3	**Experiment**[5] the methods**,** processes**,** and tools of Design Thinking
CO 4	**Apply**[3] the Design Thinking approach and model to real world situations
CO 5	**Apply**[3] and Understand Reverse and Forward Engineering
Text Books:	• Yayici Emrah (2017): **Design Thinking Methodology.** • Ling Daniel (2016): **Complete Design Thinking Guide.**
Reference Books:	• West David**,** Rikner Rebecca (2017): **Design Thinking: The Key to Enterprise Agility, Innovation, and Sustainability**: Author's press international. • Raja Vinesh and Fernandes Kiran J. (2008): **Reverse Engineering: An Industrial Perspective,** London: Springer.

DISCIPLINE SPECIFIC ELECTIVE-I		
COURSE CODE	**INTRODUCTION TO COMPUTATIONAL THINKING**	**Total Lecture: 45** **Practical: 15**
CS20B108		**(LTP=3-0-2=4)**

Course Objectives:

The aim of this course is hence to take students with no prior experience of thinking in a computational manner to a point where they can derive simple algorithms and code the programs to solve some basic problems in their domain of studies. In addition, the course will include topics to appreciate the internal operations of a processor, and raise awareness of the socio-ethical issues arising from the pervasiveness of computing technology.

UNIT	CONTENTS	HOURS
I.	Computer Networking: Introduction, Goals, ISO-OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Introduction to Internet, World Wide Web, E- commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti- Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking,, Logic bombs, Hacking Spamming, Cyber Defamation, pharming Security measures Firewall, Computer Ethics & Good Practices, Introduction of Cyber Laws about Internet Fraud, Good Computer Security Habits,	**10**
II.	CT concept – Abstraction, Decomposition, Pattern recognition, Algorithm, Limit of computing, Analysis of Algorithm Complexity, Space and time Complexity, code optimization.	**10**
III.	Human intelligence and artificial intelligence, introduction, Need of AI and its application. Introduction to Internet of thing, characteristics, benefits, hardware and its application. Introduction of Data science and its application. Cloud computing: definition, characteristics, service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public, private, community and hybrid clouds), Pros and Cons of cloud computing. Edge and Fog Computing, Quantum Computers. Introduction of Big Data and Hadoop.	**9**
IV.	Data base Management System: Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages	**8**
V.	Computer: Definition, Classification, Organization i. e. CPU, register, Bus architecture, Instruction set, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer Application in E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and Climatology, Computer Gaming, Multimedia and Animation etc. Operating System: Definition, Function, Types, Management of File, Process & Memory. Introduction to MS word, MS PowerPoint, MS Excel	**8**

	List of Experiment: 1. Study and practice of Internal & External DOS commands. 2. Study and Practice of MS windows –Folder related operations**,** My-Computer**,** window explorer**,** Control Panel**,** 3. Creation and editing of Text files using MS-word. 4. Creation and operating of spreadsheet using MS-Excel. 5. Creation and editing power-point slides using MS-power point. 6. Study of the features of firewall in providing network security and to set Firewall Security in windows. 7. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool. 8. Connect the computers in Local Area Network. 9. Case Study of Google App Engine. 10. Case Study of Different internetworking devices.	

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Explain**[4] the internal operation of a basic processor**,** how a program is executed by a computer and computing trends.
CO 2	**Express**[2] basic programs based on the programming language used in the course.
CO 3	Formulate a problem and **express**[2] its solution in such a way that a computer can effectively carry it out. (i. e. equip you with CT skills)
CO 4	**Apply**[3] the CT concepts on case studies/problem-based scenarios through hands-on practice of the CT process.
CO 5	**Associate**[2] knowledge of Microsoft office suit and have hands on it.
Text Books	• Forouzan Behrouz A. (2007): **Data communication & networking,** fourth edition**,** Noida: MC Graw-Hill • Korth Henry F (1997): **Data base system concept,** 6th edition**,** Noida: McGraw-Hill Education. .
Reference Books	• Malhotra T D (2020): **New trends in computer,** 1st edition**,** Delhi: Evergreen Publications.

DISCIPLINE SPECIFIC ELECTIVE-I		
COURSE CODE	**INTRODUCTION TO DIGITAL TECHNOLOGY**	**Total Lecture: 45** **Practical: 15**
CS20B109		**(LTP=3-0-2=4)**

Course Objectives:

This course is designed for students to understand, communicate, and adapt to a digital world as it impacts their personal life, society, and the business world. Various forms of technologies will be highlighted to expose students to the emerging technologies impacting the digital world. Professional communication skills and practices, problem-solving, ethical and legal issues, and the impact of effective presentation skills are taught in this course as a foundational knowledge to prepare students to be career ready. The knowledge and skills taught in this course build upon each other to form a comprehensive introduction to digital world.

UNIT	CONTENTS	HOURS
I.	Introduction to Internet, WWW and Web Browsers: Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software's, Search Engines; Understanding URL; Domain name; IP Address; Using E-governance website	**10**
II.	Search Engine, The Mission of Search Engines, Types of SE, Need of SE, How search engines works, Major functions of a search engine, Popular Search Engines, Click Tracking: How Users Click on Results, Natural Versus Paid, Understanding Search Engine Results, Algorithm-Based Ranking Systems: Crawling, Indexing, and Ranking, Determining Searcher Intent and Delivering Relevant, Fresh Content, Analyzing Ranking Factors, Web Traffic, Different types of keywords, Google trends & insights, Steps in Search Engine.	**10**
III.	Introduction and Types of websites, Components of web site, Websites vs. Portals, Domain rank, Architecture of Website, Website Designing Basics, Essentials of good website designing, Usability and User Experience in Website, Domain, Importance of Domain Names and Value, URL renaming/re-writing, Hosting, Hosting Selection, Difference between dynamic & static website, Creating Robots file & sitemaps, Google webmaster tools.	**9**
IV.	Introduction to Social Media, merits & Demerits of Social Media, Social Media Marketing, Social Media Strategy and Planning, Social Media Measurement, Content Strategy, Social Media Sites, Face book Account Creation, Face book Page Creation, Business Promotion, About Instagram- Live, Reels, LinkedIn, Twitter, Social Media management and measurement tools, a social media audit tools.	**8**
V.	Introduction –Content, Art of Writing, Type of Contents, Promotion of contents, What is Blogging, Promotion of Blogs, Submission of Blogs, Different platforms for Blogs (BlogSpot, word press, Type Pad), Advantage of Blogs, Career as a Blogger, Popular Blogs, Blog vs. Article. How to Create and Manage an Account on different Platforms, How to Get audience, Social Sharing & Comments, How to Optimize Submissions,	**8**

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Explain**[2], research, and present findings on positions and career paths in technology and the impact of technology on chosen career area.
CO 2	**Understand**[2] effective professional communication skills (oral, written, and digital) and practices that

	enable positive customer relationships.
CO 3	**Identify** and **utilize**[3] appropriate technology.
CO 4	**Understand**[2]**,** communicate**,** and adapt to a digital world.
CO 5	**Explain**[2] the basic components of computer networks.
Text Books	• ISRD Group (2011): **Internet Technology & Web Design,** New Delhi, TMH Education. • Jan Zimmerman (2017): **Social Media Marketing ALL IN ONE For Dummies,** 4th Edition**,** Noida: Wiley. • Tannenbaum Andrew S (2012): **Computer Network,** 5th Edition**,**UK: Pearson Education.
Reference Books	• McDonald Jason (2020): Social media Marketing Workbook**,** 1st Edition: Independent Published.

COURSECODE	PROJECT BASED LEARNING-I	Total Lecture: 30 Practical: 30
PB20B101		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction

	2. Review of literature 3. Methodology 4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student**,** a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	**YOGA AND MEDITATION-I**	**Practical: 15**
IY20B101		**(LTP=0-0-2=0)**
	CONTENTS	**HOURS**
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical**,** mental and spiritual faculties so that the students can become healthier**,** saner and more integrated members of the society and of the nation	**15**

COURSE CODE	GREEN CREDIT-I	Practical: 15
GC20B101		(LTP=0-0-2=0)
	CONTENTS	**HOURS**
Course Objectives:	Green Credit helps in self-discipline and self-control**,** leading to immense amount of awareness**,** concentration and higher level of consciousness. Main objective are**:** • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	**15**

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

II Semester

School of Advanced Computing

COURSE CODE	ENTREPRENEURSHIP DEVELOPMENT	Total Lecture: 30
UC20B202		(LTP=2-0-0=2)

Course Objectives:

Develop understanding and confidence in students to venture into entrepreneurship by giving them baseline understanding of the various aspects impacting decision making on various frontiers as faced by an enterprise

UNIT	CONTENTS	HOURS
I.	Introduction: Entrepreneur – meaning, evolution, importance, qualities, nature, types, traits. Entrepreneurship development - its importance, role of Entrepreneurship. Entrepreneurial environment, culture and stages in entrepreneurial process, changing dimensions in entrepreneurship – Digital entrepreneurship. Entrepreneur Vs. Intrapreneur, Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager; Role of Entrepreneur in Indian economy and developing economies with reference to Self-Employment Development Entrepreneurial Culture	7
II.	Starting A New Venture: Generating business idea – sources of new ideas, methods of generating ideas, opportunity recognition. Choice of the organization: Sole Proprietorship, partnerships, Joint Stock Co. , Co-Operatives Family Business – meaning, characteristics, importance, types and models. Growing and evolving family business – Complexity of family enterprise – Diversity of successions; Different Dreams and challenges. Feasibility study – market feasibility, technical/operational feasibility, financial feasibility, environmental scanning, competitor and industry analysis. Drawing business plan - preparing project report, presenting business plan to investors.	7
III.	Financing and Managing New Venture: Financing and Managing the new venture, Source of capital, Record Keeping, financial controls, Marketing and sales control. Internet advertising Features and evaluation of joint ventures. Basic Government Procedures to be complied with; Policies governing SMEs – Steps in setting up a small unit. Type of business- Large Scale/ MSME; Judging Funding requirements of the business; New Generation Funding sources- Venture Capital Funding, SME Funding, Angel Investors etc	5
IV.	Institutional support and government initiatives for Entrepreneurs': Role of Directorate of Industries, Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Industrial Development Corporation (IDC), State Financial Corporation's (IFCs), Commercial Banks, Small Scale Industries Development Corporations (SSIDCs), Khadi and Village Industries Commission (KVIC), Industries Service Institute (SISI), NABARD, National Small Industries corporation (NSIC), Small Industries Development, Bank of India (SIDBI) and other relevant institutions / organizations. Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants.	6
V.	New Venture Expansion and Exit Strategies: Joint Ventures, Acquisitions, mergers, franchising, public issues, right issues, bonus issues and stock issues. Exit Strategies, Reasons for exiting and long and short term preparation, CSR, Dimensions of CSR	5

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**	
CO 1	**Develop**[3] managerial qualities and competencies of an entrepreneur.
CO 2	**Acquaint**[2] himself with the challenges of starting a new venture and the process of setting up a business.
CO 3	**Build**[3] essential skills and creativity needed to build teams and work in and with them.
CO 4	**Know**[1] the essential procedure and funding avenues for setting up a new business.
CO 5	**Learn**[1] the various government initiatives and accordingly plan for his business.
Text Books	• Varshainey G. K. (2019): **Fundamental of Entrepreneurship,** Bangalore**:** Sahitya Bhawan Publications. • Bharti**,** A. N. **,** Tripathi Pramodh Kumar (2021-22): **Fundamental of Entrepreneurship** Agra**,** U. P. : Rajeev Sahitya Bhawan Publication**,** SBPD Publication. • H. Nandan (2013**)**: **Fundamental of Entrepreneurship,** New Delhi**,** Delhi**,** Third Edition: PHI Learning. • K. Nagarajan. (2017): **Project Management,** Second Edition**,** New Delhi: New Age International**,**
Reference Books	• Peters Hisrich (2017): **Entrepreneurship,** Tenth Edition**,** Noida: Mc Graw Hills. • Berger Brigitt **(**1991**)**: **The Culture of Entrepreneurship,** Chennai: ICS Pt. • Steven Brandt (1997): **Entrepreneuring: 10 Commandments for Building a Growth Company (Build Your Business Guides),** Third Edition**,** Singapore: Archipelago Pub. • Gurmit Narula (2002): **The Entrepreneurial Connection**, Noida: Tata McGraw Hills.

COURSE CODE	ENGINEERING DRAWING	Total Lecture: 45 Practical: 15
ME20B105		(LTP=3-0-2=4)

Course Objectives:

This course is design to develop understanding of Engineering Drawing to undergraduate students. It covers various areas of engineering drawing. Principle program outcomes of the course are listed below**:**

- To prepare you to design a system**,** component**,** or process to meet desired needs within realistic constraints such as economic**,** environmental**,** social**,** political**,** ethical**,** health and safety**,** manufacturability**,** and sustainability
- To prepare you to communicate effectively
- To prepare you to use the techniques**,** skills**,** and modern engineering tools necessary for engineering practice.

UNIT	CONTENTS	HOURS
I.	Introduction to Engineering Drawing Principles of Engineering Graphics and their significance**,** usage of Drawing instruments**,** Conic sections ellipse**,** parabola**,** Hyperbola (General method only); Cycloid**,** Epicycloid**,** Hypocycloid and Involute; Scales – Plain**,** Diagonal**,** Vernier Scales and scale of chords.	**10**
II.	Orthographic Projections**,** Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes	**10**
III.	Projections of Regular Solids those inclined to both the Planes**,** Sections and Sectional Views of Right Angular Solids covering**,** Prism**,** Cylinder**,** Pyramid**,** Cone**,** Development of surfaces of Right Regular Solids - Prism**,** Pyramid**,** Cylinder and Cone.	**9**
IV.	Isometric Projections**,** Principles of Isometric projection – Isometric Scale**,** Isometric Views**,** Conventions; Isometric Views of lines**,** Planes**,** Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa**,** Conventions.	**8**
V.	Overview of Computer Graphics covering**,** listing the computer technologies that impact on graphical communication**,** Demonstrating knowledge of the theory of CAD software**,** Auto Cad [such as**:** The Menu System**,** Toolbars (Standard**,** Object Properties**,** Draw**,** Modify and Dimension)**,** Drawing Area (Background**,** Crosshairs**,** Coordinate System)**,** Dialog boxes and windows**,** Shortcut menus (Button Bars)**,** The Command Line (where applicable)**,** The Status Bar**,** Different methods of zoom as used in CAD**,** Select and erase objects. ; Isometric Views of lines**,** Planes**,** Simple and compound Solids.	**8**

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Use**[3] the drawing instruments effectively and able to dimension the given figures. Appreciate the usage of engineering curves in tracing the paths.
CO 2	**Understand**[2] the concept of projection and acquire visualization skills**,** projection of points.
CO 3	**Define** [1] the basic views related to projections of Solid. To know development of different types of surfaces.

CO 4	**Compare**[4] & understand isometric projection & Orthographic Projection
CO 5	**Use**[2] Autocad software.
Text Books	• N. D**,** Bhatt (2014): **Elementary Engineering Drawing,** 53rd EDITION**,** Gujarat**:** Charotar Publishing House. • Dhawan R. K (2011): **Engineering Drawing,** 2nd EDITION**,** New Delhi: S. chand publication. • Agarwal Basant and Agarwal C. M. (2019): **Engineering Drawing,** New Delhi**,** TMH publication.
Reference Books	• P. S Gill (2013): **Engineering Drawing & Engineering Graphics,** 3rd Edition**,** New Delhi: S. K. Kataria & Sons. • Lakshmi narayan L. V. and Vaish R. S (2010): **Engineering Graphics,** New Delhi: Jain Brothers.

COURSE CODE	BASIC MECHANICAL AND CIVIL ENGINEERING	Total Lecture: 45 Practical: 15
ME20B203		(LTP=3-0-2=4)

Course Objectives:

- To inculcate the essentials of Civil Engineering & Mechanical Engineering field to the students of all branches of Engineering.
- To provide the students an illustration of the significance of the Civil & Mechanical Engineering Profession in Satisfying societal needs.
- To provide a comprehensive knowledge of force, work and energy to calculate work done, power required and efficiency for various simple machines.
- To understand the importance and application of various laws.

UNIT	CONTENTS	HOURS
VI.	General introduction to Civil Engineering - Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings; Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building; Surveying – Principles, Objectives, Horizontal measurements with tapes, Ranging; Leveling – Instruments, Reduction of levels; Modern surveying instruments.	10
VII.	Building materials – Bricks, Stone, cement blocks, Cement, Cement mortar, Steel; Building construction – Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting.	10
VIII.	Fundamental Concepts and Definitions: Definition of Thermodynamics, System, surrounding and universe, Phase, Concept of continuum, Macroscopic & microscopic point of view. . Thermodynamic equilibrium, Property, State, Path, process, Cyclic process, Energy and its form, Work and heat, Enthalpy. Laws of thermodynamics: Zeroth law, First law of thermodynamics. Concept of processes, Second law: Essence of second law, Thermal reservoir, Heat engines, COP of heat pump and refrigerator. Statements of second law, Carnot cycle.	9
IX.	Properties of steam and thermodynamic cycles: Properties of steam, Use of property diagram, Steam tables, Processes involving steam in closed and open systems. Working Principle of low pressure boiler. Equivalent evaporation & efficiency of boiler, Introduction to I. C. Engines: Two, four stoke S. I. and C. I. engines. Carnot cycle, Otto Cycle, Diesel cycle.	8
X.	Fluids: Fluid properties pressure, density and viscosity etc. Types of fluids, Newton's law of viscosity, Pascal's law, Only working principle of Hydraulic machines, pumps, turbines, Reciprocating pumps . Refrigeration & Air Conditioning: History, scope & application of refrigeration, VCRS system, VARS system, introduction & concept of air conditioning system. **List of Experiments:** 1. Study of various types of Boilers. 2. Study of four stroke petrol Engines. 3. Study of four stroke diesel Engines. .	8

	4. Study of two stroke petrol Engines. 5. Study of Two stroke diesel Engines. 6. Study of different types of Boilers Mountings. 7. To determine normal consistency of cement 8. To determine compressive strength of cement & concrete 9. To determine soundness of cement 10. To determine water absorption of Aggregate & Brick 11. To perform particle size analysis of aggregate. 12. Horizontal measurement & Ranging.	

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Illustrate**[2] the fundamental aspects of Civil Engineering.
CO 2	**Demonstrate**[3] the concepts of surveying for making horizontal and vertical measurements.
CO 3	**Define**[1] basic thermodynamics concepts like system**,** path process cycle etc. Explain the laws of thermodynamics and apply them to closed**,** study flow systems.
CO 4	**Describe**[2] the properties of pure substance and their changes during phase transformations.
CO 5	**Evaluate**[3] the thermal performance of different heat engines and refrigeration cycles and calculate efficiency/coefficient of performance. Calculate the Fluid properties**,** Stability of floating bodies and hydrostatic forces on surfaces
Text Books	• Ramamrutam S. & Narayanan R. (2013): **Basic Civil Engineering,** Delhi: Dhanpat Rai Publication. • Basak N N**.** (2017): **Surveying,** 2nd edition**,** Noida: McGraw Hill • Rajput**,** R. K. (2018): **Thermal Engineering,** New Delhi**:** Laxmi Publication. • Rajput R. K**.** (2017): **Fluid Mechanics,** 6th edition New Delhi**:** S. Chand Pub.
Reference Books	• Rangwala**,** S. C. and Dalal K. B (2013): **Building Construction,** Gujarat: Charotar Publishing house Kandya. • Nag P. K (2015): **Engineering Thermodynamics**, Noida: TMH. • Bansal R. K. (2014): **Fluid Mechanics,** New Delhi: Laxmi Publications.

COURSE CODE	ENGINEERING MATHS - II	Total Lecture: 60
MA20B204		(LTP=4-0-0=4)

Course Objectives:

The objective is to acquaint the students with basic knowledge of Ordinary and Partial Differential Equations, Calculus of complex functions, Laplace and Inverse Laplace Transform, and Sequences and Series and specifically Fourier Series. The course provides good introduction and understanding about the following:

- The concept and understanding of different analytical techniques of solving first and higher order ordinary and partial differential equations.
- Introduce the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems.
- The concept of Laplace and Inverse Laplace Transform and its application.
- The method of testing convergence of sequences and series and concept of Fourier series.

UNIT	CONTENTS	HOURS
I.	Differential Equation of First Order and Higher Degree, Linear Differential Equation with Constant Coefficient of Higher Order, Cauchy's Differential Equation, Method of Variation of Parameter, Simultaneous Differential Equation, Introduction to series solution method.	12
II.	Formation of first and second order partial differential equations. Linear & Non-Linear partial differential equation of First Order, Homogeneous & Non-Homogeneous Linear P. D. E with constant coefficient of Higher Order, Separation of Variables, Wave equation & Heat Equation.	12
III.	Analytic functions, C-R equations, necessary and sufficient conditions, Harmonic conjugates, Milne's method, complex line integration, Cauchy's theorem for simply and multiply connected domains, Cauchy's integral formula for the derivatives of an analytic function, Taylor series, Laurent series, Zeros and poles of a function, residue at a singularity, Residue theorem, its applications for the Evaluation of Real Definite Integral.	12
IV.	Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem. Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Solution of differential equation by using Laplace transforms.	12
V.	Sequences, Series, Convergence, Tests for convergence of series (Comparison tests, D'Alembert's Ratio test, Integral test, Raabe's, Cauchy's Root test, Logarithmic), Fourier series: Half range sine and cosine series.	12

Course Outcome as per Bloom's Taxonomy

CO 1	**Define**[1] and differentiate between ordinary and partial differential equations and solve different boundary value problems in engineering
CO 2	**Define**[1] functions of complex variable, their differential and integral calculus and utilize it in evaluating real integrals

CO 3	**Understand**[2] and apply Laplace transformation in finding solution of differential equations in engineering
CO 4	**Evaluate**[5] the convergence or divergence of various sequences and series utilizing appropriate tests.
CO 5	**Formulate**[6] and find solution of more complicated engineering problems.
Text Books	• Grewal B. S (2017): **Higher Engineering Mathematics,** 43rd Edition**,** Delhi: Khanna Publishers. • Das H. K. (2019): **Advanced Engineering Mathematics,** New Delhi**,** 22nd Edition: S Chand**.** • Jain R. K. and Iyenger S. R. K. (2016): **Advanced Engineering Mathematics,** 5th Edition**,** New Delhi. : CRC Press**,** Narosa Publishing House.
Reference Books	• Kreyszig E. (2011)**: Advanced Engineering Mathematics,** 9th edition**,** U. K.**:** John Wiley and Sons**,** Inc. **,** • Poole D. (2005)**: Linear Algebra: A Modern Introduction,** 2nd Edition**:** Brooks/Cole. • Ramana B. V(2010)**: Higher Engineering Mathematics,** 11thReprint. **,** New Delhi**:** Tata McGraw Hill.

COURSE CODE	PROGRAMMING PRACTICE –II	Practical: 30
CS20B205		(LTP=0-0-4=2)

Course Objective: The objective of course is to develop programming skills of students**,** using object oriented programming concepts**,** learn the concept of class and object using C++ and develop classes for simple applications.

UNIT	CONTENTS	HOURS
I.	Introduction to Programming – Program and Programming –Programming Languages –Types of software's**,** Operating Systems –Dos commands –Basic Linux commands and vi editor –Compiler**,** Interpreter**,** Loader and Linker Fundamentals in C++ –History of 'C++' –Migrating from procedural oriented language –to object oriented languages Program –Keywords –Variables –Constants –Data type –Operators –Manipulators and uses –Basic Structure of a 'C++' program	**5**
II.	Control statements –Conditional Control Statements –if –if-else –nested if-else –else-if ladder –Multiple Branching Control Statement –switch-case –Loop Control Statements –while –do-while –for –Nested Loops –Jump Control statements –break –continue –goto –exit –return –Programming Examples –FAQ's	**6**
III.	Pointer array Reference –pointer variable –Reference variable/alias variables? –Reference to Reference variable? –Reference to array? –Reference vs normal variable? –Reference vs pointer variable? –1D and 2D Arrays –What is dynamic memory allocation? –The new and delete operator –new vs malloc –delete vs free –Dynamic 1D and 2D Arrays	**7**
IV.	Function –What is function ? –Why function ? –Advantages of using functions –Function Prototype –Defining a function –Calling a function –Actual and Formal Arguments –Types of functions –Parameter Passing Techniques –Call by Value –Call by Reference –Call by Pointer –Return statement –Returning More than one value From A Function –Return by value mechanism –Return by pointer mechanism –Return by reference mechanism –Inline Functions –Default Arguments –Function Overloading –Lambda function. –Recursion	**6**
V.	Introduction to oops –C structure vs C++ structuree –Class –Object –Encapsulation –Abstraction –Polymorphism –Inheritance –Message Passing Classes and Objects –Declaring / defining classes –Data members and member functions –Access specifiers**:** public and private and protected –Creating objects of a class –Pointers to object –Implicit this pointer –Static data members –Static member functions –Passing objects to a member function –Returning objects from a member function –Friend functions –Friend classes –Nested classes –Local classes –The const member functions –The const objects –Array of objects –static objects –inline functions. **List of practical** 1. Write a program to prints numbers**,** alphabets and special characters on the output screen. 2. Write a program to that accept age in years from user as input and displays his age in months and days. 3. Write a program that demonstrates the use of arithmetic and assignment operators by getting two numbers from user. 4. Write a program that to calculate area of circle**,** square**,** rectangle and triangle using switch-case statements 5. Write a program to that accepts number from user and displays all the factors of that	**6**

number.

6. Write a program that accepts a number from keyboard and find its factorial.

7. Write a program that accepts 9 numbers in form of matrix and display transpose of that matrix.

8. Write a program to count number of words in a sentence.

9. Write a program to create structure of book which contains book title, author name, publication and price as its members and displays book records for n books.

10. Write a program which accepts value of base and power from user and displays its value (base^ power) using UDF.

11. Write a program which should work like a strlen function using UDF.

12. Write a program that demonstrates the basic class program to get department, name and salary of an employee.

13. Create a class "Bank_Account" that contains Depositor_Name, Acc_No, Acc_type, Balance as its data members. Also create member functions for account creation, deposit, withdraw and balance inquiry for class. Demonstrate its use in main.

14. Define a class "Time"that contains following data members and member functions.

15. Data members: 1. Hours

1. Minutes

2. Seconds

16. Member Functions: 1. To get time from user

1. To display time on the screen

2. To calculate sum of two time objects

17. Write a program that can read values of Time for two objects T1 and T2, calculate sum and display sum using defined member functions

18. Create class "Sales"having following data members and member functions:

19. Data Members:

1. Name of Salesman

2. Sales of Salesman

20. Member functions to calculate commission

1. Commission is Rs. 10 per thousand if sales are at least Rs. 25000 or more

2. Commission is Rs. 5 otherwise

21. Write a program that calculate and print name and sales of salesman.

22. Write a program to count number objects created for particular class using constructor.

23. Create class "Person"having a two data members as person name and nationality. Also create two constructors for this class in which one has two arguments and second has one argument.

24. Write a program to declare two classes, each one have one int data member. Find the sum of data members of both classes using friend function. Create suitable objects and functions

	25. Create Class "Circle"having radius as data member**,** constructor and member function to calculate area of circle. Class should overload = = operator to compare two circle objects whether they are equal in radius. 26. Implement following class relationship and test with main class. 27. Vehicle 1. Two-Wheeler a. Bike b. Bicycle 2. Four-Wheeler a. Car b. Truck c. Taxi	
Course Outcome as per Bloom's Taxonomy		
At the end of the course the students will be able to**:**		
CO1	**Implement**[3] the algorithms and draw flowcharts for solving Mathematical and Engineering problems.	
CO2	**Demonstrate**[2] an understanding of computer programming language concepts.	
CO3	**Define**[1] data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.	
CO4	**Design**[6] and develop Computer programs**,** analyzes**,** and interprets the concept of pointers**,** declarations**,** initialization**,** operations on pointers and their usage.	
CO5	**Develop**[6] confidence for self education and ability for life-long learning needed for Computer language.	
Text Books	• Schildt Herbert (2017): **The complete reference, C++,** 4th edition**,** Noida: Mcgraw Hill. • Bjarne (2018): **A Tour of C++** 2nd edition**,** Boston: Addison-Wesley.	
Reference Books	• Lafore Robert (2008): **Object oriented programming in C++,** U. K. : Pearson. • Balagurusamy E. (2020): **Object oriented programming with C++,** Eighth edition: Mcgraw Hill	

COURSE CODE	WORKSHOP PRACTICE	Practical30
ME20B206		(LTP=0-0-4=2)

Course Objectives:

The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing / fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

UNIT	CONTENTS	HOURS
I.	Carpentry Shop: Timber: Type, Qualities of timber disease, Timber grains, Structure of timber, Timber, Timber seasoning, Timber preservation . Wood Working tools: Wood working machinery, joints & joinery. Various operations of planning using various carpentry planes sawing & marking of various carpentry joints. Suggested Jobs: Name Plate, Any of the Carpentry joint like mortise or tennon joint	7
II.	Fitting Shop: Study and use of Measuring instruments, Engineer steel rule, Surface gauges caliper, Height gauges, feeler gauges, micro meter. Different types of files, File cuts, File grades, Use of surface plate, Surface gauges drilling tapping Fitting operations: Chipping filling, Drilling and tapping. Suggested Jobs: Preparation of job piece by making use of filling, sawing and chipping, drilling and tapping operations.	6
III.	Foundry: Pattern Making: Study of Pattern materials, pattern allowances and types of patterns. Core box and core print. Use and care of tools used for making wooden patterns. Moulding: Properties of good mould & Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green and bench and pit mould dry sand bench mould using single piece and split patterns.	6
IV.	Practice on electric arc welding, Practice on oxy-acetylene gas welding, Introduction and demonstration on submerged arc welding, Metal Forming: Demonstration of deep drawing and other forming process .	6
V.	Introducing to various machine tools and demonstration on machining, Making a steel pin as per drawing by machining in centre lathe, External screw thread on lathe, Making a cast iron Vee block by shaping, Making a regular polygon prism (MS)/ hexagon by milling machine, Slot fitting by milling machine, Study of machining in machining in machining centre (CNC), Study of Electro discharge machining (EDM):	5

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Define**[1] the ability to design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint
CO 2	**Understand**[2] modern manufacturing operations, including their capabilities, limitations, and how to design economically.
CO 3	**Describe**[2] to assess the working conditions of any machining process and thus calculating the actual forces involved.

CO 4	**Demonstrate**[3] appropriate equipment and consumables for required application and also to apply knowledge of tools required for getting an object of required shape and size.
CO 5	**Explain**[2] to design and model various basic prototypes in the trade of Welding such as Lap joint**,** Lap Tee joint**,** Edge joint**,** Butt joint and Corner joint
Text Books	• Hajra Choudhury S. K (2008): **Elements of workshop Technology Vol. I,** Mumbai: Media Promoters. • Hajra Choudhury S. K. (2010): **Elements of workshop Technology Vol. II,** Mumbai: Media Promoters.
Reference Books	• Chapman W. A. J. (2020): **Workshop Technology - Part I,** Chennai: CBS Publishers. • Chapman W. A. J. (2007): **Workshop Technology - Part II,** Chennai: CBS Publishers.

DISCIPLINE SPECIFIC ELECTIVE-II		
COURSE CODE	**INTRODUCTION TO AI & DATA SCIENCE**	**Total Lecture:30** **Practical:15**
CS20B207		**(LTP=3-0-2=4)**

Course Objectives :

The objective of this course is to teach students the concepts of current main conceptual frameworks at use in AI.

UNIT	CONTENTS	HOURS
I.	**Introduction to AI:** What is AI, Turing test, cognitive modelling approach, law of thoughts, the relational agent approach, the underlying assumptions about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, history of AI	**7**
II.	**Introduction to Machine Learning:** What is Machine Learning, Learning from Data, History of Machine Learning, Big Data for Machine Learning, Leveraging Machine Learning, Descriptive vs Predictive Analytics, Machine Learning and Statistics, Artificial Intelligence and Machine Learning, Types of Machine Learning – Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Types of Machine Learning Algorithms, Classification vs Regression Problem, Bayesian, Clustering, Decision Tree, Dimensionality Reduction, Neural Network and Deep Learning, Training machine learning systems	**7**
III.	**Introduction to Data Science:** Defining Data Science and Big Data, Benefits and Uses of Data Science and Big Data, Facets of Data, Structured Data, Unstructured Data, Natural Language, Machine- generated Data, Graph based or Network Data, Audio, Image, Video, Streaming data, Data Science Process, **Applications of AI/DS by domain:** Transportation, home/service robots, healthcare, education, low- resource communities, public safety and security, employment and workplace, entertainment, finance, baking and insurance	**6**
IV.	**Role of Artificial Intelligence in Society:** Societal challenges AI presents, Ethical and Societal implications, policy and law for AI, fostering dialogue, sharing of best practices **Malicious Use of AI: Prevention and Mitigation:** Security relevant properties of AI, Security domains and scenarios: digital security, physical security, pollical security, factors affecting the equilibrium of AI and security	**5**
V.	**Data Science Processes:** Six steps of data science processes, define research goals, data retrieval, cleansing data, correct errors as early as possible, integrating – combine data from different sources, transforming data, exploratory data analysis, Data modelling, model and variable selection, model execution, model diagnostic and model comparison, presentation and automation. **Introduction to Data Analytics:** Working with Formula and Functions, Introduction to Charts, Logical functions using Excel, Analyzing Data with Excel	**5**

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Use**[3] of AI, Ethics present and future

CO 2	**Understand** [2] Machine Learning and data science process.
CO 3	**Apply**[3] AI in the societal upliftment.
CO 4	**Identify**[3] the malicious use of AI.
CO 5	**Understand** [2] Application of AI by domain, Role of AI in society
Text Books	• Artificial Intelligence 3e: A Modern Approach Paperback – By Stuart J Russell & Peter Norvig; Publisher – Pearson. • Artificial Intelligence Third Edition ByKevin Knight, Elaine Rich, B. Nair – McGrawHill. • Artificial Intelligence Third Edition By Patrick Henry Winston – Addison-Wesley Publishing Company

DISCIPLINE SPECIFIC ELECTIVE-III		
COURSE CODE	**C# PROGRAMMING**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
CS20B208		**(LTP=2-0-2=3)**

Course Objectives:

Students will learn to develop simple to advance programs in C# and use appropriate data sources in C# applications.

UNIT	CONTENTS	HOURS
I.	. NET Framework 4. 0 Framework Architecture, Common Language Runtime, Garbage Collection and MSIL, Object Oriented Programming with C# OOPs Concepts, Partial Classes and Partial Methods, Managing Types, Properties, Methods and Parameters, Named Parameters and Optional Parameters, String Handling, Abstract Classes and Interfaces, The Exception Handling in. Net 4. 0	**6**
II.	C# Advanced Features Delegates and Events, Attributes, Familiarizing Collections and Generics, Language Integrated Query (LINQ), Object and Collection Initializes, Query Expressions, Navigating the File System, Reading and writing files, Compressing Streams, Forming regular expressions, Encoding, Serializing Objects. Multithreading Creating Threads, Managing Thread class, Exploring. Net Assembly Classification of Assembly, Private Assembly and Shared Assembly, The Global Assembly Cache¬ Single File Assembly and Multiple File Assembly¬ Understanding Reflection¬ Creating and Managing Application Domains	**7**
III.	Creating and Managing Windows Services Creating Windows Services¬ Interacting with Windows Services¬ Developing Windows Applications with C# Creating a User Interface Application by Using Standard Controls Add and configure a Windows Form. ¬ Manage control layout on a Windows Form. ¬ Managing Form-Properties¬ Add and configure a Windows Forms control. ¬ Create and configure menus. ¬ Create event handlers for Windows Forms and controls¬ Construct Print documents¬ Create a customized Print Preview component¬ Implement Globalization and Localization for a windows application¬ Implement accessibility Features¬ Create and configure MDI forms¬ Drag and Drop functionality in C sharp¬ Create a User control in c sharp¬ Create a composite windows forms control¬ Create an extended control by inheriting from existing windows control.	**7**
IV.	Managing XML Manage XML with XML Document Object Model(DOM)¬ Create XML using XML Writer class¬ Read and validate XML using XML Reader class¬ Designing and Implementing Databases with SQL Server 2008 Introduction to ADO. NET¬ Creating Tables and Relationships¬ SQL Fundamentals¬ Stored Procedures¬ Introduction to Data bound Controls¬ Insert, Update, Delete, Select commands in both connected and disconnected¬ environment	**6**
V.	WPF Application Fundamentals Windows applications¬ Navigation applications / XAML Browser Applications¬ Binding to a WPF element¬ Transformations- Render, Skew, Rotate¬ Create a Windows Forms SetUp application Create Setup using Click once Technology¬ Deploy an application using setup project	**5**

Course Outcome(s) as per Blooms Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] the concepts and elementary use of. NET and the. NET library.
CO 2	**Understand**[2] the syntax and use of C# as a development tool.
CO 3	**Use**[3] C# in desktop and web application development.
CO 4	**Use**[3] newer technologies such as LINQ and WPF.
CO 5	**Implement**[3] the skills in the project.
Text Books	∉ Schildt Herbert. (2012): **The Complete Reference: C# 4. 0:** Tata McGraw Hill ∉ Nagel Christian et al., (2012): **Professional C# 2012 with. NET 4. 5,** India**:** Wiley
Reference Books	∉ Andrew Troelsen. **(**2010): **Pro C# 2010 and the. NET 4 Platform,** Fifth edition ∉ Griffiths Ian**,** Adams Matthew**,** Liberty Jesse**. (**2010): **Programming C# 4. 0,** Sixth Edition**:** O"Reilly

DISCIPLINE SPECIFIC ELECTIVE-III		
COURSE CODE	**ANALOG & DIGITAL COMMUNICATION**	**Total Lecture:30** **Practical:15**
CS20B209		**(LTP2-0-2=3)**

Course Objectives:

Students will learn Analog and digital communication including techniques of analog and digital modulation and demodulation as well as the transmitter and receiver designs for the communication systems.

UNIT	CONTENTS	HOURS
I.	Introduction to communication systems: Elements of Communication System, Need for modulation, Technologies in Communication Systems, Signal representation and analysis Noise: External noise, Internal noise, Noise calculations, Noise figure, Noise temperature.	**6**
II.	Amplitude modulation techniques: Elements of Analog Communication, Amplitude modulation techniques, Generation of AM signals. Angle modulation techniques: Theory of Angle Modulation techniques, Practical Issues in FM, Generation of FM.	**6**
III.	Radio Transmitters and Receivers: Introduction to Radio Communication, Radio Transmitters, Receiver types, AM receivers, FM receivers, SSB Receivers. Pulse Modulation techniques: Pulse Analog modulation techniques, Pulse Digital Modulation techniques.	**7**
IV.	Digital Modulation Techniques: Introduction, basic digital modulation techniques: ASK, FSK, PSK. Digital Demodulation techniques : basic digital modulation techniques: ASK, FSK, PSK	**7**
V.	Spread Spectrum Communications: Introduction to Frequency hopping, Introduction to direct sequence Spread Spectrum, Introduction to CDMA, and Overview of latest trends in digital communication.	**5**

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Understand**[2] how the analog and digital modulation occurs.
CO 2	**Understand**[2] working of electronic communication system.
CO 3	**Learn**[1] the modulation technique
CO 4	**Identify**[2] the communication spectrum
CO 5	**Use**[3] digital modulation techniques.
Text Books	• Electronic Communications, Dennis Roddy, John Coolen. • Electronic Communication Systems, George Kennedy, Bernard Davis, S R M Prasanna
Reference Books	• Modern Digital and Analog Communication Systems, by B. P. Lathi and Zhi Ding

DISCIPLINE SPECIFIC ELECTIVE-III		
COURSE CODE	**DATA ANALYSIS USING PYTHON**	**Total Lecture:30** **Practical:15**
CS20B210		**(LTP-2-0-2=3)**

Course Objectives:

The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

UNIT	CONTENTS	HOURS
I.	**Python programming Basic:** Python interpreter, IPython Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow.	**6**
II.	**Data Structure, functions, files:** tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems	**6**
III.	**NumPy: Array and vectorized computation:** Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array	**7**
IV.	**Pandas:** Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format	**7**
V.	**Visualization with Matplotlib:** Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration **Plotting with pandas and seaborn:** line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data	**5**

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Understand**[2]Python programming
CO 2	**Implement**[3] Data Structure.
CO 3	**Learn**[1] Libraries Numpy, Pandas with the use of Data Analysis
CO 4	**Learn**[1] the visualization libraries.
CO 5	**Build**[6] a project using Python.
Text Books	• Learning Python: Powerful Object-Oriented Programming by Lutz M - Shroff; Fifth edition • Pandas for Everyone: Python Data Analysis by Daniel Y. Chen - Pearson Education; First edition
Reference Books	• Python: The Complete Reference by Martin C. Brown - McGraw Hill Education; Forth edition

COURSECODE	PROJECT BASED LEARNING-II	Total Lecture: 30 Practical: 30
PB20B201		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects.
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction 2. Review of literature 3. Methodology

	4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student**,** a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	YOGA AND MEDITATION-II	Practical: 15
IY20B101		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical, mental and spiritual faculties so that the students can become healthier, saner and more integrated members of the society and of the nation	15

COURSE CODE	GREEN CREDIT-II	Practical: 15
GC20B201		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	Green Credit helps in self-discipline and self-control, leading to immense amount of awareness, concentration and higher level of consciousness. Main objective are: • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	15

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

III Semester

School of Advanced Computing

COURSE CODE	QUANTITATIVE APTITUDE-I	Total Lecture: 30
UC20B302		(LTP=2-0-0=2)

Course Objectives:

- To enhance the problem solving skills
- To improve the basic mathematical skills.
- Enable students to manage the placement challenges more effectively

UNIT	CONTENTS	HOURS
I	Numbers, H. C. F & L. C. M of Numbers, Decimal Fraction, Codingdeductive logic, Data Sufficiency, Directional Sense	6
II	Simplification, Square root & Cube root, Average, Problem onNumbers & Problem on Ages, Percentage	6
III	Profit & Loss, Ratio & Proportion, Height & Distance Partnership, Chain Rule, Time & Work.	6
IV	Deductive Reasoning, Logical Word Sequence, Objective Reasoning, Selection decision tables, Puzzles	6
V	Inductive reasoning- Analogy Pattern Recognition, Classification Pattern Recognition, Coding Pattern Recognition, Number Series Pattern Recognition	6

Course Outcomes as per Bloom's Taxonomy

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

CO1	Make **decisions**[5] based on analysis and critique of quantitative information using proportional reasoning. Students willalso effectively justify and communicate their conclusions in ways appropriate to the audience.
CO2	**Solve**[3] real-life problems requiring interpretation and comparison of variousrepresentations of ratios (i. e. , fractions, decimals, rates, and percentages):
CO3	**Analyze**[4] and critique mathematical models and be able to describe theirlimitations.
CO4	**Apply**[3] probabilistic reasoning to draw conclusions, to makedecisions, and to evaluate outcomes of decisions.
CO5	**Distinguish**[4] between proportional and nonproportional situations and, whenappropriate, apply proportional reasoning.
Text Book	• Aggarwal R. S**. (**2020): **Quantitative Aptitude for Competitive Examinations,** New Delhi: S. Chand Publication. • Gupta D. P. & Burnwal Sanjeet (2020): **General Quantitative Aptitude for Competitive Exams** II Edition, New Delhi: Disha Publication
Reference Books	• Agrawal Deepak & Gupta D. P. (2018): **Rapid Quantitative Aptitude: WithShortcuts & Tricks for Competitive Exams,** New Delhi: Disha Publication • Guha. Abhijit (2016): **Quantitative Aptitude for All CompetitiveExaminations** VII Edition, Noida: McGraw Hill Education

COURSE CODE	OPERATING SYSTEM	Total Lecture: 60 Theory: 45 Practical: 15
CS20B301		(LTP= 3 – 0 – 2 = 4)

Course Objectives:

- Provides a comprehensive introduction of Operating System, Process Management, Memory Management, File Management and I/O management.
- To introduce the concept of Operating system concepts and designs and provide the skillsrequired to implement the services.
- To describe the trade-offs between conflicting objectives in large scale system design.
- To develop the knowledge for application of the various design issues and services
- The purpose of this subject is to cover the underlying concepts Operating System.

UNIT	CONTENTS	HOURS
I	Introduction to Operating Systems, evolution of OS, OS structure, functions of OS, Different Types of OS, Operating Systems Services: Types of Services, Different ways of providing these Services – Utility Programs, device drivers, System Calls.	8
II	CPU Scheduling: Process Concept, Scheduling Concepts, Types of Schedulers, Process State Transition Diagram, Inter- Process Communication, Scheduling Algorithms, Algorithms Evaluation, Concept of Threads. . Deadlocks: Deadlock Problems, Characterization, Prevention, Avoidance, Recovery. Process synchronization: critical sections, semaphores, monitors, classical problems in synchronization (producer-consumer, readers-writer, dining philosophers, etc	10
III	File Systems: File Concept, User's and System Programmer's view of FileSystem, Disk Organization, Tape Organization, Different Modules of a File System, Disk Space Allocation Methods – Contiguous, Linked, Indexed. Directory Structures, File Protection, System Calls for File Management, Disk Scheduling Algorithms.	10
IV	Memory Management: Different Memory Management Techniques –Partitioning, Swapping, Segmentation, Paging, Paged Segmentation, Comparison of these techniques, Techniques for supporting the execution of large programs: Overlay, Dynamic Linking and Loading, Virtual Memory – Concept, Implementation by Demand Paging etc.	10
V	Security & Protection Security Environment, Design Principles Of Security, User Authentication, and Protection Mechanism: Protection Domain, Access Control List Case Studies: Unix/Linux, WINDOWS and other Contemporary Operating Systems.	07
	List of Experiment 1. Write a program to implement various CPU Scheduling algorithm(FCFS, SJF, Priority, Round robin) 2. Write a program to implement classical inter process communicationproblems (producer consumer, Reader Writers, Dining Philosophers) 3. Write a program to implement &various page replacement algorithms. 4. Write a program to implement & Compare various Disk & Drumscheduling Algorithms	

	5. Write a program to implement Banker's algorithms. 6. Case Study**:** ios**,** Android**,** UNIX/LINUX	

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students should be able to**:**	
CO 1	**Interpret**[2] the evolution of OS functionality**,** structures and layers.
CO 2	**Apply**[3] various types of system calls and to find the stages of various process states
CO 3	**Design**[3] a model scheduling algorithm to compute various scheduling criteria.
CO 4	**Apply**[3] and analyze communication between inter process and synchronizationtechniques.
CO 5	**Implement**[3]page replacement algorithms**,** memory management problems andsegmentation.
Text Books	• Silberschatz Avi**,** Galvin Peter Baer**,** Greg Gagne. (2012): **Operating System Concepts,** U. K: Wiley**,** 9/E. • Stalling William (2012): **Operating Systems** U. K. : Pearson Education. • Tanenbaum. Andrew S. (2009)**: Modern Operating Systems 3/e,** U. S. : Prentice Hall.
Reference Books	• Bach Maurice J. (2015): **The Design of Unix Operating System,** U. S: Prentice Hallof India. • Bovet D& Cesati M (2019): **Understanding the Linux Kernel,** United States: O'Reily**,** 2/E. • Stalling William (2013): **Operating Systems: Internals and Design Principles,** 7/E**,** U. S. **:** Prentice Hall.

COURSE CODE	DATA STRUCTURE AND ALGORITHMS	Total Lecture: 60 Theory: 45 Practical: 15
CS20B302		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to:

- Introduce the fundamentals and abstract concepts of data structures.
- To design and implement various data structures.
- Understand the usage of stacks and queue.
- To teach different searching and sorting techniques
- Learn how concepts of data structures are useful in problem solving.

UNIT	CONTENTS	HOURS
I	**Introduction: Basic Terminology:** Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT)Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.	10
II	**Stacks and Queues: Abstract Data Type:** Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.	9
III	**Trees: Basic terminology** Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.	9
IV	**Graphs:** Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm, Introduction to Activity Networks.	8
V	**Searching and Sorting:** Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees(BST), Insertion and Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees Hashing: Hash Function,	9

	Collision Resolution Strategies Storage Management: Garbage Collection and Compaction.	
	List of Experiments: 1. Write a program that uses functions to perform the following operations on singly linked list i) Creation ii) Insertion iii) Deletion iv)Traversal. 2. Write a program that uses functions to perform the following operations on doubly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal. 3. Write a program that uses functions to perform the following operations on circular linked List i) Creation ii) Insertion iii) Deletion iv) Traversal. 4. Write a program that implement stack (its operations) using i) Arrays ii) Linked list(Pointers): 5. Write a program that implement Queue (its operations) using i) Arrays ii) Linked list(Pointers): 6. Write a program that implements Circular Queue using arrays. ii) Writea program that uses both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a) Linear search b) Binary search. 7. Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii)Quick sort. 8. Write a program that implements the following i) Insertion sort ii) Merge sort iii)Heap sort. 9. Write a program to implement all the functions of a dictionary (ADT) using Linked List. 10. Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree. 11. Write a program to implement the tree traversal methods 12. Write a program to perform the following operations: a) Insert an element into a AVL tree. b) Delete an element from a AVL tree. c) Search for a key element in a AVL tree.	

Course Outcomes as per Bloom's Taxonomy	
At the end of the course student will be able to**:**	
CO 1	Use and **implement**[3] appropriate data structure for the required problems using aprogramming language such as C/C++.
CO 2	**Analyze**[3] step by step and develop algorithms to solve real world problems.
CO 3	**Implement**[3] various data structures viz. Stacks**,** Queues**,** Linked Lists**,** Trees andGraphs.
CO 4	**Understand**[2] various searching & sorting techniques.
CO 5	To **apply**[3] the learned concepts in various domains like DBMS and CompilerConstruction.
Text Books	• Horowitz Ellis and Sahani Sartaj: **Fundamentals of Data Structures,** New Delhi: Galgotia Publication • Kruse R. L. **,** Leary**,** Tondo B. P. C. L. : **Data Structure and Program Design in C**: PHI. • Tenenbaum Aaron**,** Yedidyah M**,** Langsam and Moshe Augenstein J. : **DataStructures Using C and C++,** New Delhi: PHI Publications.
Reference Books	• Trembley Jean Paul and G. Sorenson. Paul: **An Introduction to Data Structures with applications,** Noida: McGraw Hill Publications • R. Kruse et. al.: **Data Structures and Program Design in C,**U. K. : Pearson Education • Lipschutz. : **Data Structures Schaum's Outline Series,**New Delhi: TMH

COURSE CODE	JAVA PROGRAMMING	Total Lecture:60Theory: 30 Tutorial: 15 Practical: 15
CS20B303		(LTP=2-2-2=4)

Course Objectives:

To introduce and understand students to programming concepts and techniques using the Java language and programming environment, class, objects, and their relationships also learn about lifetime, scope and the initialization mechanism of variables and improve the ability general problem solving abilities in programming. Be able to use the Java SDK environment to create, debug and run Java programs and able to develop software for solving problems.

UNIT	CONTENTS	HOURS
I	Basics of JAVA: Features of Java, JDK, JRE, JVM, variables, data types, Unicode system, operators, keywords, Control statements: if else, switch, for loop, while, do while, break, continue, comments, Classes and Objects: class, objects, methods, constructor, Inheritance, polymorphism, abstraction, encapsulation, Array, Packages, Modifiers, interface.	5
II	String: String class methods, StringBuffer class, StringBuilder class, Immutable class, StringTokenizer class, Java Regex, Wrapper class, Exception Handling: Try-catch block, finally block, throw and throws keyword. File handling: introduction, character Oriented Streams, Byte oriented stream, Writing and reading operations on file, File class Serialization, Deserialization	6
III	Multithreading: Thread States, Priorities and Thread Scheduling, Life Cycle of a Thread, Thread Synchronization, Creating and Executing Threads, Multithreading with GUI, Monitors and Monitor Locks. Nested Classes: Introduction, Advantages of nested classes, Nestedclasses vs inner classes, Normal Inner classes, Method local inner classes, Anonymous inner classes, Static nested classes, Functional interfaces & lambda expressions, Annotations.	6
IV	Java Collective Frame Work - Data Structures: Introduction, Type- Wrapper Classes for Primitive Types, Dynamic Memory Allocation, Linked List, Stack, Queues, Trees, Generics: Introduction, Overloading Generic Methods, Generic Classes, Collections: Interface Collection and Class Collections, Lists, Array List and Iterator, Linked List, Vector. Collections Algorithms: Algorithm sorts, Algorithm shuffle, Algorithms reverse, fill, copy, max and min Algorithm binary Search, Algorithms add All, Stack Class of Package java. Util, Class Priority Queue and Interface Queue, Maps, Properties Class, Un-modifiable Collections.	7
V	Networking: Introduction, Socket and Server Socket, URL info, Client- Server programming. AWT(Abstract Window Tool Kit): Introduction, Frame class, Different layouts, Components of AWT (TextField, Radio Button, Checkbox…. etc), Event Handling or Event delegation Model, Different types of Listeners. Swings: Difference between Awt and swings, Advantages of swings, Different components of Swings (Text Field, Radio Button, Checkbox…. etc), Event handling in Swings. JDBC(java database connectivity)	6

	List of Program: (expandable) 1. Installation of J2SDK 2. Write a program to show Scope of Variables 3. Write a program to show Concept of CLASS in JAVA 4. Write a program to show Type Casting in JAVA 5. Write a program to show How Exception Handling is in JAVA 6. Write a Program to show Inheritance 7. Write a program to show Polymorphism 8. Write a program to show Access Specifiers (Public, Private, Protected) in JAVA 9. Write a program to show use and Advantages of CONTRUCTOR 10. Write a program to show Interfacing between two classes 11. Write a program to Add a Class to a Package 12. Write a program to show Life Cycle of a Thread 13. Write a program to demonstrate AWT. 14. Write a program to Hide a Class 15. Write a Program to show Connectivity using JDBC 16. Write a program to demonstrate multithreading using Java.	

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO1	**Identify**[3] classes**,** objects**,** members of a class and relationships among them needed for a specific problem.
CO2	**Solve**[3] exception related problems and also able to handle and store data indifferent types of files.
CO3	**Apply**[3] suitable type of data structures to solve problems.
CO4	**Develop**[3] programs/software working in parallel and utilize maximum CPU time.
CO5	**Develop**[3] software/programs networking based and store data for further uses.
Text Books	• Schildt Herbert (2017): **Java The Complete Reference**, 8th edition,New Delhi: TMH. • Sierra Kathy & Bates Bert (2005): **Head First Java**, 2nd Edition, California: O'Reilly. • E. Balaguruswamy (2008): **Programming with Java A Primer,**3rd Edition,New Delhi: TMH.
ReferenceBooks	• Deitel Harvey M. & Deitel Paul(2000): **JAVA, How to Program,**3rd Edition,U. S. : ,PHI**,** Pearson. • Hughes S. Merlin (1999): **Java Network Programming,**2nd Edition, New York: Manning Publications/Prentice Hall.

DISCIPLINE SPECIFIC ELECTIVE-IV		
COURSE CODE	**PROBABILISTIC MODELING AND REASONING**	**Total Lecture:45Theory: 30 Practical: 15**
AI20B304		**(LTP=2-0-2=3)**

Course Objectives:

The course objectives are:

- Apply probabilistic models to solve real-world problems
- Design specific models for AI tasks
- Perform inference using probabilistic models
- Prove relationships between probabilities under different models
- Implement core algorithms of different models

UNIT	CONTENTS	HOURS
I	**Introduction to Statistics:** Introduction to Statistics. Role of statistics in scientific methods, current applications of statistics. Scientific data gathering: Sampling techniques, scientific studies, observational studies, datamanagement. **Data description:** Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.	6
II	**Probability Theory:** Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes' theorem. **Random Variables:** Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, Poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, χ^2distribution.Expectations, variance and covariance. Probability Inequalities. Bivariate distributions	6
III	**Point Estimations:** Methods of finding estimators, method of moments, maximum likelihood estimators, Bayes estimators. Methods of evaluating estimators, mean squared error, best unbiased estimator, sufficiency and unbiasedness Interval Estimations: Confidence interval of means and proportions, Distribution free confidence interval of percentiles	6
IV	**Test of Statistical Hypothesis and p-values:** Tests about one mean, tests of equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests Bayesian Statistics: Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean	6
V	**Univariate Statistics using Python:** Mean, Mode. Median, Variance, Standard Deviation, Normal Distribution, t-distribution, interval estimation, Hypothesis Testing, Pearson correlation test, ANOVAF-test	6

List of Experiments:

1. Data Description Single Variable
2. Data Description Bivariate Variables
3. Relationship between two or more variables
4. Covariance and Correlation
5. Binomial Distribution
6. Normal Distribution
7. Bivariate Distribution
8. Hypothesis Testing and p Value
9. Point Estimation and Interval Estimation
10. Exploratory Data Analysis.

Course Outcome as per Bloom's Taxonomy	
At the end of the course student will be able to:	
CO 1	**Understand**[2] Statistics and Probability distributions
CO 2	**Apply**[3] theory of probability and Theory of Estimation
CO 3	**Categorize**[4] various tests of Hypothesis and Significance
CO 4	**Identify**[1] Correlation and Regression and fitting of different types of curves.
CO 5	I**mplement**[3] statistic in python
Text Books	Klenke Achim (2014): **Probability Theory A Comprehensive Course** 2nd Edition, Springer, ISBN978-1-4471-5360-3. Heumann Christian, Michael Schomaker, Shalabh (2016): **Introduction to Statistics and Data Analysis with Exercises, Solutions and Applications in R** , Springer International Publishing, ISBN 978-3-319-46160-1. Montgomery Douglas C. (2012): **Applied Statistics and Probability for Engineers** , 5th Edition, New Delhi: Wiley India, ISBN: 978-8-126-53719-8.
Reference Books	• Poole David L., Mackworth Alan K. (2017): **Artificial Intelligence: Foundations of Computational Agents** , 2nd edition, Cambridge: Cambridge University Press. • Russell, Norvig (2010): **Artificial Intelligence: A Modern Approach** , 3rd edition. New Jersey: Prentice Hall series.

DISCIPLINE SPECIFIC ELECTIVE-IV		
COURSE CODE	**INFORMATION THEORY & CODING**	**Total Lecture:45Theory: 30 Practical:15**
AI20B305		**(LTP=2-0-2=3)**

Course Objectives:

- To introduce information theory, the fundamentals of error control coding techniques and their applications.
- To calculate the information content of a random variable from its probability distribution, Related to the joint, conditional, and marginal entropies of variables in terms of their probabilities.
- To understand the types of channels, Channel and their Capacities to construct efficient codes for data on imperfect communication channels.
- To understand the need & Objective of error control coding with encoding & decoding procedure to analyze error detecting & correcting capability of different codes.
- To Define & apply the basic concepts of information Theory.

UNIT	CONTENTS	HOURS
I	**INFORMATION THEORY** Introduction, Concept of information: Unit, Properties, Entropy (Average Information) : Definition, Mathematical expression of Entropy, Entropy of Binary Source, Properties and Information Rate, Joint Entropy, Conditional entropy, relation between Joint & Conditional Entropies, Mutual Information: Average Mutual Information, Expression for Mutual information and properties, Relation between Mutual Information & Entropy	**10**
II	**CHANNAL CAPACITY AND CODING** Channel Capacity, Redundancy and Efficiency of channel, Discrete memory less channel – Channel Matrix, Classification of channels: lossless Channel, Deterministic Channel, Noisefreechannel,BinarySymmetricChannel(BSC),CascadedChannelsandBi naryErasure Channel (BEC), Calculation of channel capacity of all channels,Shannon's fundamentaltheorem, Capacity of a band limited Gaussianchannel, Shannon-Hartley Theorem, Trade ofbetween Bandwidth and Signalto Noise ratio. Entropy Coding: Shannon Fano Coding, Huffman's Coding,Coding Efficiency Calculations	**10**
III	**LINEAR BLOCK CODES** Introduction: Error Control Coding: Need, Objectives & Approaches of Error Control Coding Classification, Error Detection and Error Correction Techniques, Linear Block Code: Structure, Terms Related to Block Code, Matrix Description of Linear Block Code, Generator and Parity Check Matrices, Hamming Codes, Encoder and Syndrome decoder for (n, k) block Code. **CYCLIC CODES** Algebraic structure, Properties, Polynomial representation of Codeword, Generator Polynomial, Generation of Code Vector in Nonsystematic and Systematic form, Generator and Parity check matrices in Systematic form, Encoding of Cyclic Code, Syndrome decoding for Cyclic code, Hardware Representation of (n, k) cyclic code. Cyclic Redundancy Check Code	**10**

IV	**BCH & RS CODE** Binary Field Arithmetic, BCH Code: Properties, Primitive element and primitive polynomial, Primitive BCH Code, Construction of Galois Field GF (2^m), Addition & Multiplication of GF (2^m), Properties of Galois Field GF (2m), Minimal & Generator Polynomial for BCH Code, Decoding of BCH Code, Reed-Solomon code**:** Introduction, Error correction capability of RS code, RS code in Nonsystematic & Systematic form, Decoding of RS &Nonbinary BCH code.	**10**
V	**CONVOLUTIONAL CODE** Introduction, Encoding of Convolutional Codes, Generation of Output code sequence : Time Domain Approach, Transform Domain Approach, Graphical Approach – Code Tree, State diagram and Trellis Diagram, Decoding of Codes : Maximum Likelihood Decoding -Viterbi Algorithm, Sequential Decoding . Structural & Distance properties of Convolutional codes	**5**

List of Practical's :

- Develop a program to implement The algorithm of Encoding of messages
- Develop a program to Compute the Entropy in case of Discrete Algorithm
- Develop a program to Compute Entropy of 4 Parts of Message
- To write a program to Find the Entropy of certain message.
- Develop and Implement Program to Compute the Capacity of Noiseless Binary Channel
- A simple example will be used to illustrate the Shannon Fano algorithm
- A simple example will be programmed in C++ for Huffman Coding algorithm

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Demonstrate**[3] the knowledge of analysis of basic blocks/ components of digitalCommunication system.
CO 2	**Introduce**[2]to the basic notions of information and channel capacity.
CO 3	**Analyze**[4] the channel models mathematically
CO 4	**Design**[5] encoder and decoder for various coding techniques as per the need andSpecification.
CO 5	**Analyze**[4] the error detecting and correcting capability of coding scheme.

Text Books

- Singh R.P, Sapre. S.D. (2001): **Communication Systems Analog &Digital** ,IInd Edition Noida: Mc-Graw Hill.
- Kulkarni Muralidhar, Shivprakasha K.S. (2014): **Information Theory &Coding** , New Delhi: Wiley Publication.
- Saha Arijit, Mandal Surajit (2013): **Information Theory, Coding &Cryptography** , Delhi: Pearson Education.
- Salvatore Gravano (2001): **Introduction to Error Control Codes**, Lucknow: OxfordUniversity Press.

Reference Books	• Haykin Simon(2006): **Communication Systems** , 4th Edition, New Jersey: John Wiley & Sons, Inc. • Shanmugam Sam (2005): **Digital and Analog Communication Systems**, 3rdEdition, New Jersey JohnWiley Publication. • Roden, Martin S (2003): **Analog & Digital Communication Systems**, New Delhi: Prentice Hall India. • Bose Ranjan (2008): **Information Theory Coding & Cryptography** , Noida: TataMcGraw-Hill Publishing Company Ltd.

DISCIPLINE SPECIFIC ELECTIVE-V

COURSE CODE	**LINEAR ALGEBRA**	**Total Lecture:45** **Theory: 30** **Tutorial:15**
AI20B306		**(LTP=2-0-2=3)**

Course Objectives:

The course objectives are to:

- Demonstrate an understanding of linear transformations
- Compute and interpret determinants of matrices
- Demonstrate an understanding of hypothesis
- Demonstrate an understanding of vector spaces and subspaces
- Demonstrate an understanding of Eigen values and eigenvectors

UNIT	**CONTENTS**	**HOURS**
I	**Systems of Linear Equations:** Introduction to linear equations, row reduction, echelon form **Vectors and Matrix:** Vectors, Ax=b and Ax=0 equations, Linear Independence, the matrix of linear independence **Vector Arithmetic using Python:** Vector addition, Vector subtraction, vector multiplication, vector-scalar multiplication	**6**
II	**Matrix Algebra:** Matrix Operations, Inverse of matrix, invertible matrix, partitioned matrices, Leontief Input-Output model **Determinants:** Introduction to determinants, properties of determinants, Cramer'srule, volume and linear transformation **Matrix Arithmetic using Python:** Matrix addition, subtraction, multiplication, division, matrix-matrix multiplication, matrix-vector multiplication, matrix-scalar multiplication, type of matrix, transpose, inverse, trace, determinant, rank	**6**
III	**Vector Space:** Vector spaces, subspaces, null spaces, column spaces, linear transformations, bases, rank, dimension of a vector space, change of basis Eigenvalue and Eigenvectors: Introduction to eigenvalue and eigenvectors, the characteristic equation, diagonalization, linear transformation, complex eigenvalues, eigen decomposition with python	**6**
IV	**Orthogonality and Least Square:** Orthogonality, inner product, length, orthogonal sets,orthogonal projections, The Gram – Schmidt process, least square problems, solve leastsquarewithInverse,	**6**
V	**Symmetric Matrix and Quadratic Form** Symmetric Matrices and Quadratic Form: Diagonalization of symmetric matrix, quadratic form,singular value decomposition, singular value decomposition with python	**6**

	List of Experiments: 1. Basics of Matrix Theory and Linear algebra 2. Systems of equations and vector spaces 3. Various tests of Hypothesis and Significance	

Course Outcome as per Bloom's Taxonomy	
At the end of the course student will be able to:	
CO 1	**Understand**[2] the basics of Linear Equation and Vectors
CO 2	**Understand**[2] Matrix Algebra and Determinants
CO 3	**Categorize**[4]Various tests of Hypothesis and Significance
CO 4	**Apply**[3] Concepts of Orthogonality and Least Square
CO 5	**Understand**[2] Symmetric Matrix and Diagonalization of Symmetric Matrix
Text Books	• Liesen Jörg , Mehrmann Volker (2015): **Linear Algebra** , SpringerUndergraduate Mathematics Series, ISBN978-3-319-24344-3. • Axler Sheldon (2015): **Linear Algebra Done Right ,** 3rd edition, Springer,ISBN978-3-319-11079-0.
Reference Books	• Landi Giovanni, Zampini Alessandro (2018): **Linear Algebra and Analytic Geometry for Physical Sciences**, Springer, ISBN978-3-319-78360-4.

DISCIPLINE SPECIFIC ELECTIVE-V		
COURSE CODE	**COMPUTER GRAPHICS & MULTIMEDIA**	**Total Lecture:45** **Theory:30 Practical:15**
AI20B307		**(LTP=2-0-2=3)**

Course Objective:

- Have a basic understanding of the core concepts of computer graphics.
- Be capable of using OpenGL to create interactive computer graphics.
- Understand a typical graphics pipeline.
- Have made pictures with their computer.
- Student will learn about animations & graphics.

UNIT	CONTENT	HOURS
I	**Introduction & Output primitives:** Application of Computer Graphics- overview of graphics systems-raster scan systems-random scan systems-raster scan display processors Output primitives : Points and lines-line drawing algorithms (Bresenham's and DDA Line derivations and algorithms)-mid-point circle andellipse algorithms. Filled area primitives: Inside and outside tests-Scan line polygonfill algorithm-boundary-fill and flood-fill algorithms.	10
II	**2-D Geometrical transforms & 2D-Viewing**: Translation-scaling-rotation-reflection and shear transformations-matrix representations and homogeneous coordinates-composite transforms-transformations between coordinate systems. 2- D viewing: The viewing pipeline-viewing coordinate reference frame-window to view-port coordinate transformation-viewing functions-Cohen-Sutherland and Cyrus beck line clipping algorithms Sutherland –Hodgeman polygon clipping algorithm.	8
III	**3-D object representation-Transformations & Visible Surface Detection Methods:**Polygon surfaces-quadric surfaces- spline representation -Hermite curve-Bezier curve and B-Spline curves-Bezier and B-Spline surfaces. 3-D Geometric transformations: Translation-rotation-scaling-reflection and shear transformations-composite transformations. 3D Viewing pipeline-clipping- projections (Parallel and Perspective): Visible surface detection methods: Classification-back-face detection-depth-buffer-scan-line-depth sorting BSP tree methods-area sub-division and octree methods.	7
IV	**Multimedia :** Characteristics of a multimedia presentation , Uses of Multimedia, Text –Types, Unicode Standard ,text Compression, Text file formats, Audio- Components of an audio system, Digital Audio, Digital Audio processing, Sound cards, Audio file formats ,Audio Processing software ,Video-Video color spaces, Digital Video, Digital Video processing, Video file formats.	10
V	**Animation:** Uses of Animation, Principles of Animation, Computer based animation, 3D Animation, Animation file formats, Animation softwares. Compression: Lossless/Lossy Compression techniques, Image, Audio & Video Compressions, MPEG Standards ,Multimedia Architecture, Multimedia databases	10

LIST OF EXPERIMENTS

1. To Study various in build graphics functions in C library.

2. Write a program to draw a line using DDA algorithm.

3. Write a program to draw a line using Bresenham‘s algorithm.

4. Write a program to draw a circle using midpoint algorithm.

5. Write a program to draw a circle using Bresenham‘s algorithm.

6. Write a program to draw a rectangle using line drawing algorithm.

7. Write a program to perform 2D Transformation on a line.

8. Write a program to perform shear transformation on a rectangle.

9. Write a program to rotate a circle (alternatively inside and outside) around the circumference ofanother circle.

10. Write a program to draw a car using in build graphics function and translate it from bottom left corner to right bottom corner of screen.

Course Outcomes as per Bloom’s Taxonomy

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

CO 1	**Compare**[4] raster scan and random scan systems
CO 2	**Understand**[2] the techniques of clipping, three dimensional graphics and three dimensional transformations.
CO 3	**Apply**[3] techniques of clipping, three dimensional graphics and three dimensional transformations.
CO 4	**Understand**[2] data compression techniques, image compression techniques like JPEG, video compression techniques like MPEG, and the basic concepts about animation.
CO 5	**Apply**[3]and understand of design, development and testing of modeling, rendering, shading
	and animation.
Text Books:	• **Hearn D, Baker M.P (2005): Computer Graphics , 2nd edition, New Delhi: Pearson Education.** • **Li Ze-Nian, Drew Mark S (2004): Fundamentals of Multimedia , Delhi: PHI/Pearson Education.**
Reference Books:	• **Newman W.M., Sproull R.F. (1997): Principles of Interactive Computer Graphics , 2nd Edition, New Delhi: Tata McGraw Hill Publishing Company Limited.** • **S. Harrington (1994): Computer Graphics, A Programming Approach , New Delhi: MGH Publication.**

COURSECODE	PROJECT BASED LEARNING-III	Total Lecture: 30 Practical: 30
PB20B301		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects.
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction

	2. Review of literature 3. Methodology 4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student**,** a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	**YOGA AND MEDITATION-III**	**Practical: 15**
IY20B301		**(LTP=0-0-2=0)**
	CONTENTS	**HOURS**
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical**,** mental and spiritual faculties so that the students can become healthier**,** saner and more integrated members of the society and of the nation	**15**

COURSE CODE	GREEN CREDIT-III	Practical: 15
GC20B301		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	Green Credit helps in self-discipline and self-control**,** leading to immense amount of awareness**,** concentration and higher level of consciousness. Main objective are**:** • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	**15**

GENERIC ELECTIVES

SEMESTER – III

COURSE CODE	**GENERIC ELECTIVE-I**	**TOTAL LECTURE: 30**
GE20B301	**INTRODUCTORY BIOLOGY**	**(LTP= 2-0-0=2)**
Learning Objectives:	The course will provide students the understanding of Biology. Biology is the study of organic life, from the structure and function of biomolecules through the complex evolutionary and regulatory processes of cells, organisms, populations, communities, and ecosystems. • Students will be introduced to the fundamental concepts that pass through these levels of organization. • In addition, the students should have in depth of knowledge to facilitate an integrative understanding of the interconnectedness and unity that make biology a cohesive discipline. • The main aim of this course is to provide students with the tools to become life-long learners in the field of Biology.	
UNIT	**CONTENT**	**HOURS**
I	Introduction: Themes in the study of life, Characteristics of living organisms, (properties of life), life's hierarchy of levels of organization, biological system of classification, grouping of organisms into three domains and multiple kingdoms, branches and sub-disciplines of biology. Living and non-living world, scientific method.	5
II	Chemistry of life: The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds; The water molecule is polar; Properties of water; Ionization of water.	7
III	Biomolecules: Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds. Structure and function of bimolecules. Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information.	7
IV	Introduction to Cellular Respiration: Laws of Thermodynamics, energy conversion converted through biological systems. Metabolism: (Endergonic (anabolic) reactions Exergonic (catabolic) reactions): Structure and functions of enzymes in terms of Activation energy, Active site, Co-enzymes, Denaturation, Enzyme inhibitors, Substrate. Structure and role of ATP in the cell. Process of and summary equation for cellular respiration. Major pathways used in the pathways used in the process of cellular respiration: (Glycolysis, Bridge reaction, Citric Acid Cycle, Oxidative Phosphorylation & Electron Transport Chain) Compare and contrast aerobic respiration with fermentation. Importance of carbohydrate, lipid and protein breakdown and how these molecules are utilized in aerobic respiration.	4
V	Photosynthesis: Process of and summary equation for photosynthesis, importance of photoautotroph's as producers. Basic structure of a leaf and its component parts: Basic structure of a chloroplast: Electromagnetic spectrum and the significance of visible light as an energy source for photosynthesis. The two stages of photosynthesis, including the location, raw materials and products ofLight Reactions and Calvin Cycle. Interrelationship between the Light Reactionsand the Calvin Cycle. Adaptations in relation to photosynthesis in plants in different environments. Compare the processes of aerobic cellular respiration and photosynthesis to include locations, rawmaterials and products.	7

Course Outcomes as per Blooms Taxonomy	
CO1	The student will be able to **understand**[2] Energy and information flow in living systems.
CO2	They will be able to **characterize**[2] form **analyze**[4] function of cells.
CO3	They will be able to **understand**[2]concept of Heredity**,** molecular genetics and **apply**[3] it to individuals to populations
CO4	They will be able to integrate knowledge and to **analyses**[4] and **evaluate**[5] different biological functions of life.
CO5	They will be able to **analyse**[4] ecological relationship among organisms**,** populations**,** communities and their physical environment
Text Books:	• Cooper GM and RE Hausman**,** The Cell, **(**2009): **A Molecular Approach,** 5th edition. ASM Press & Sunderland**,** Washington**,** D. C**:** Sinauer Associates**,** MA. • Kleinsmith WM **,** Hardin LJ and Bertoni GP, **(**2009) **: The World of the Cell**. 7th edition,San Francisco: Pearson Benjamin Cummings Publishing.
Reference Books:	• Campbell**,** N. A. and Reece**,** J. B San Francisco: **Biology** 8th edition: Pearson Benjamin Cummings Publishing. • Raven**,** P. H et al (2006): **Biology** 7th edition, Noida: Tata McGraw Hills Education. • Griffiths**,** A. J. F et al (2008**): Introduction to Genetic Analysis,** 9th edition**,** NY: W. H. Freeman & Co.

COURSE CODE	GENERIC ELECTIVE-II	TOTAL LECTURE: 30
GE20B302	BASIC ANALYTICAL CHEMISTRY (LTP= 2-0-0=2)	
Course Objectives:	• Prepare graduates with the basics concept of analytical chemistry. • Produce graduates with knowledge of different analytical techniques.	

UNIT	CONTENT	HOURS
I	Introduction to analytical chemistry and its interdisciplinary nature, concept of sampling, importance of accuracy, precision and sources of error in analytical measurements, presentation of experimental data and results, from the point of view of significant figures.	6
II	Analysis of soil: composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators, determination of pH of soil samples, estimation of calcium and magnesium ions as calcium carbonate by complexometric titration.	6
III	Analysis of water: definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods, determination of pH, acidity and alkalinity of a water sample, determination of dissolved oxygen (DO) of a water sample.	6
IV	Analysis of food products: nutritional value of foods, idea about food processing and food preservations and adulteration, identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. , analysis of preservatives and colouring matter.	6
V	Analysis of cosmetics: major and minor constituents and their function, analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate, determination of constituents of talcum powder: magnesium oxide, calcium oxide, zinc oxide and calcium carbonate by complexometric titration.	6

Course Outcomes as per Bloom's Taxonomy

CO1	Students will **understand**[2] basic knowledge of analytical chemistry.
CO2	They will be able to **explain**[2] different types of soil analysis.
CO3	They will learn to **analyze**[4] different water samples.
CO4	They will be able to **identify**[3] the nutrients and adulterants in common food products.
CO5	They will **develop**[3] knowledge about analysis of cosmetics.

Text Books:	• Vogel, A. I. Vogel's: **Qualitative Inorganic Analysis** 7th Ed, New Delhi: Prentice Hall India Publication.
Reference Books:	• Skoog D A, West D. M., Holler F. J., Crouch S. R (2000): **Analytical Chemistry - An Introduction,** 7th Edition, Philadelphia, London: Saunders College Publishing.

COURSE CODE	GENERIC ELECTIVE-III	TOTAL LECTURE. : 30
GE20B303	**BASIC INSTRUMENTATION SKILLS (LTP= 2-0-0=2)**	
Course Objectives:	• To understand concepts and principle of DC and AC voltage and current measuring techniques. • To familiarize with different electronic measurement instruments. • To be able to measure different physical parameters with the help of CRO.	
UNIT	**CONTENT**	**HOURS**
I	Basic of Measurement techniques**,** Instruments accuracy**,** precision**,** sensitivity**,** resolution range etc. Errors in measurements and loading effects**,** Principles of measurement of DC and AC voltage and current**,** Measurement of resistance**,** Specifications of Multimeter and uses	4
II	Electronic Voltmeter**:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage**,** measurement**,** Type of AC millivoltmeters**,** Block diagram ac millivoltmeter**,** specifications and their significance**,** Amplifier- rectifier**,** and rectifier- amplifier.	4
III	Block diagram of basic CRO**,** Construction of CRT**,** Electron gun**,** electrostatic focusing and acceleration (Derivation not required)**,** brief discussion on screen phosphor**,** visual persistence & chemical composition. Time base operation**,** synchronization. Front panel controls.	6
IV	Application of CRO for the measurement of voltage (dc and ac frequency**,** time period. Special features of dual trace**,** introduction to digital oscilloscope**,** probes. Digital storage Oscilloscope**:** Block diagram and principle of working**,** Block diagram**,** explanation and specifications of low frequency signal generators**,** pulse generator**,** and function generator. Brief idea for testing**,** specifications. Distortion factor meter**,** wave analysis.	7
V	Block diagram of bridge**,** working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge**,** Block diagram & working principles of a Q- Meter. Digital LCR bridges**,** Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Students will able to **understand**[2] working principle of AC and DC measurement instruments.	
CO2	Students will able to **apply**[3] miltimeter in voltage and current measurement.	
CO3	Students will able to **demonstrate**[3] the operating principle CRO and its use in physical quantity measurement.	
CO4	Students will able to **compute**[4] different parameters for characterizing different circuits like rectifiers and amplifier.	
CO5	Students will able to **distinguish**[4] working of analog and digital instruments.	
Text Books:	• Theraja B. L.**, A text book in Electrical Technology,** New Delhi: S. chand publication. • Venugopal**, Digital Circuits and systems,** Noida: Tata McGraw Hills Education. • Ghishal S.**, Digital Electronics (**2012): Cengage Learning. • Salivahanan S. & Kumar N. S. **Electronic Devices and circuits,** 3rd Ed., Noida: Tata McGraw Hills Education.	

Reference Books:	• Say M. G.**, Performance and design of AC machines** - ELBS Edn. • Tietze U.**,** Schenk Ch.**, Electronic circuits: Handbook of design and applications, (**2008): London: Springer. • Thomas L. Floyd**,** Electronic Devices**, (**2008): 7th Ed., New Delhi: Pearson India**.**

COURSE CODE	GENERIC ELECTIVE-IV	TOTAL LECTURE. : 30
GE20B304	**ELEMENTARY NUMBER THEORY (LTP=2-0-0=2)**	
Course Objectives:	To present a rigorous development of Number Theory using axioms, definitions, examples, theorems and their proofs.	
UNIT	**CONTENT**	**HOURS**
I	**The Integers:** Numbers and Sequences. Sums and Products. Mathematical Induction. The Fibonacci Numbers.	5
II	**Primes and Greatest Common Divisors:** Prime Numbers. The Distribution of Primes. Greatest Common Divisors. The Euclidean Algorithm. The Fundamental Theorem of Arithmetic. Factorization Methods and Fermat Numbers. Linear Diophantine Equations.	7
III	**Congruences:** Introduction to Congruences. Linear Congrences. The Chinese Remainder Theorem. **Applications of Congruences:** Divisibility Tests. Check Digits.	5
IV	**Multiplicative Functions:** The Euler Phi-Function. The Sum and Number of Divisors. Perfect Numbers and Mersenne Primes. Mobius Inversion.	6
V	**Primitive Roots:** The Order of an Integer and Primitive Roots. Primitive Roots for Primes. **Quadratic Residues:** Quadratic Residues and Nonresidues. The Law of Quadratic Reciprocity	7
Course Outcomes as per Blooms Taxonomy		
CO1	Students will be able to: 1) Effectively express the concepts and results of Number Theory.	
CO2	2) Construct mathematical proofs of statements and find counterexamples to false statements in Number Theory.	
CO3	3) Collect and use numerical data to form conjectures about the integers.	
CO4	4) Understand the logic and methods behind the major proofs in Number Theory.	
CO5	5) Work effectively as part of a group to solve challenging problems in Number Theory	
Text Books:	K. Rosen, Elementary Number Theory and its Applications (5^{th} Edition), Addison-Wesley (2005):	
Reference Books:	• T. Koshy, Elementary Number Theory with Applications, Harcourt/Academic Press (2002) • G. Andrews, Number Theory, Dover Publications (1994) • O. Ore, Number Theory and Its History, Dover Publications (1988)	

COURSE CODE	GENERIC ELECTIVE-V	TOTAL LECTURE : 30
GE20B305	PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICES (LTP=2-0-0=2)	

Learning Objectives

Understanding the importance of vegetables, spices, kitchen gardening in human nutrition & in national economy. To know about various vegetables – their origin, area, climate, soil, improved varieties, spacing, transplanting, fertilizer requirement, irrigation, weed management, harvesting and yield.

Unit	Contents	Hours
I	Importance of vegetables & spices in human nutrition and national economy. Kitchen gardening. Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, harvesting and yield, : Tomato, Brinjal, Chilli, Capsicum, French bean, Peas;	3
II	Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, harvesting and yield, : Cucumber, Melons, Gourds, Pumpkin.	2
III	Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, harvesting and yield, : Cole crops such as Cabbage, Cauliflower, Knol-khol	5
IV	Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, harvesting and yield, : Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato;	3
V	Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, harvesting and yield, Leafy vegetables such as Amaranth, Palak. Perennial vegetables):	4
	COURSE OUTCOMES At the end of the course the students should be able to	

COURSE CODE	GENERIC ELECTIVE-VI	TOTAL LECTURE. : 30
GE20B306	GENERAL STUDIES-I	(LTP=2-0-0=2)
Learning Objectives:	• The purpose of orienting students to General Studies is to develop in them an appreciation for the holistic nature of knowledge • In contemporary times, familiarity with General Studies is indispensable because at the senior learning stage there is an element of specialization due to which the students do not get exposed to some vital disciplines/areas of study that are not covered in their specialized field. • The whole course of General Studies is, therefore, focused on proper development of the 'affective domain' by exposing the students to varied domains of study.	

UNIT	CONTENT	HOURS
I	**Innovation: (Science & Technology)** 1. Computer VIRUS 2. Cybercrime 3. Computer terms 4. Programming Language 5. Buccal Cavity of human beings & Knock-Knee syndrome	6
II	**The Political India:** 1. Amendment Acts 2. Committee related to Panchayati Raj Institutions 3. CAG and related articles 4. Cyber laws 5. Indian Ministry related to FDI	6
III	**The Democratic India** 1. Make in India 2. Indian Ministry related to FDI 3. Election Commission 4. SC/ST Act 1989, etc 5. Special Acts of law for minorities	6
IV	**Contemporary Problems of Indian Society:** 1. Rural versus Urban **Social Issues**. 2. Poverty. 3. Unemployment. 4. Illiteracy. 5. Caste System & Communalism.	6

V	**Human Rights** 1. Introduction of Human Rights 2. Protection of Human Rights Act 3. State Human Rights Commission 4. National Human Rights Commission 5. Article 21	6

Course Outcome	
At the end of the course the students will be able to**:**	
CO 1	The course for General Studies for graduation level students has been revised keeping in mind the changing dynamics of today's society.
CO 2	The purpose behind revising the curriculum is to make it more relevant.
CO 3	It is hoped that this course will develop responsible citizens. .
CO 4	In the following sections**,** a brief introduction to each unit has been provided**,** along with its specific objectives. Further**,** contemporary issues have been included in each unit to make it pertinent to the lives of students
CO 5	Suggestive transactional strategies have also been incorporated in each unit to facilitate teachers in effectively planning the learning activities
Text Books:	• Singh Ramesh **General Knowledge** New Delhi: McGraw-Hill publication • Laxmikant M.**, Indian Polity** (4th Edition or 5th Edition)
Reference Books:	• Ahir Rajiv **Spectrum for Modern Indian History** (Latest Edition) • **Madhya pradesh Ek Parichaya** by New Delhi: McGraw-Hill publication

COURSE CODE	GENERIC ELECTIVE -VII	TOTAL LECTURE: 30
GE20B307	**BASICS OF ACTING**	**(LTP= 0-0-2=2)**
Course Objectives:	The subject aims the students to provide • Demonstrate the ability to accurately interpret and utilize written and verbal directions provided for performances. • Apply feedback and criticism from previous performances toward improving and refining skills and techniques in subsequent performances. • Provide constructive feedback to performances by classmates and Audiences. • Compose written criticism of live theatrical productions. • Maintain a detailed journal of the theatrical process.	
UNIT	**CONTENT**	**HOURS**
I	Principles and Styles of Acting**:** Stanislavsky's system**,** Chekov**,** Brechtian and alienation Theatre. (Lecture with PPT presentation)	5
II	Dimensions of Acting**:** 1. Body Movement (Aangik)**,** 2. Speech**,** Improvisation**,** pronunciation (Vachik)**,** 3. Costume (Aharya)**,** 4. Emotions (Satvik): (lecture and practice of different dimension of drama)	9
III	Relationship and Importance between different elements of Drama. (Set design**,** lightning**,** sound**,** stage etc.) (Lecture and understand the production with multiple studio Arrangements.)	9
IV	Study of Drama works Pre Independence- (1) Bhartendu Harishchandra (2) Jai Shankar Prasad (3) Dharmveer Bharti etc. (lecture and individual presentation)	5
V	Modern Drama works**:** Mohan Rakesh**,** Girish Karnad**,** BheeshmSahini**,** Badal Sarkar**,** Saadat Hasan Manto**,** Habib Tanveer**,** Vijay Tendulkar. (lecture and individual presentaion)	9
Course Outcomes		
CO1	Student will perform a broad spectrum of dramatic material both improvised and scripted**,** ranging from Realism to non-Realism**,** classical to contemporary.	
CO2	Student will develop vocal**,** physical and imaginative skills to express a broad spectrum of dramatic material.	
CO3	Student will review**,** analyze and give constructive criticism on performance.	
CO4	Student will work as an ensemble/collective group.	
CO5	Student will understand the rehearsal and performance process**,** including the relationship between the actor and the director**,** the actor and stage manager**,** actor and production crew**,** actor and fellow actors.	
Text Books:	• Stanislavski Constantin**,** An Actor Prepares • Meisner Sanford**,** Sanford Meisner on Acting	
Reference Books:	• Improvisation for the Theatre - Spolin Viola	

COURSE CODE	GENERIC ELECTIVE -VIII	Total Lecture: 30
GE20B308	C++ PROGRAMMING	(LTP=2-0-0=2)

Course Objective: The objective of course is to develop programming skills of students**,** using object oriented programming concepts**,** learn the concept of class and object using C++ and develop classes for simple applications.

UNIT	CONTENT	HOURS
I	Introduction to Programming – Program and Programming –Programming Languages –Types of software's**,** Operating Systems –Dos commands –Basic Linux commands and vi editor – Compiler**,** Interpreter**,** Loader and Linker Fundamentals in C++ –History of 'C++' – Migrating from procedural oriented language –to object oriented languages Program –Keywords –Variables –Constants –Data type –Operators –Manipulators and uses –Basic Structure of a 'C++' program	5
II	Control statements –Conditional Control Statements –if –if-else –nested if-else – else-if ladder –Multiple Branching Control Statement –switch-case –Loop Control Statements –while –do-while –for –Nested Loops –Jump Control statements –break –continue –goto –exit –return –Programming Examples –FAQ's	6
III	Pointer array Reference –pointer variable –Reference variable/alias variables? – Reference to Reference variable? –Reference to array? –Reference vs normal variable? –Reference vs pointer variable? –1D and 2D Arrays –What is dynamic memory allocation? –The new and delete operator –new vs malloc –delete vs free – Dynamic 1D and 2D Arrays	7
IV	Function –What is function ? –Why function ? –Advantages of using functions – Function Prototype –Defining a function –Calling a function –Actual and Formal Arguments –Types of functions –Parameter Passing Techniques –Call by Value – Call by Reference –Call by Pointer –Return statement –Returning More than one value From A Function –Return by value mechanism –Return by pointer mechanism –Return by reference mechanism –Inline Functions –Default Arguments –Function Overloading –Lambda function. –Recursion	6
V	Introduction to oops –c structure vs c++structuree –Class –Object –Encapsulation – Abstraction –Polymorphism –Inheritance –Message Passing Classes and Objects – Declaring / defining classes –Data members and member functions –Access specifiers**:** public and private and protected –Creating objects of a class –Pointers to object –Implicit this pointer –Static data members –Static member functions – Passing objects to a member function –Returning objects from a member function – Friend functions –Friend classes –Nested classes –Local classes –The const member functions –The const objects –Array of objects –static objects –inline functions.	6

Course Outcome(s) as per Blooms Taxonomy

Upon completion of this course**,** students will acquire knowledge about**:**

CO1	Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
CO2	Demonstrate an understanding of computer programming language concepts.
CO3	Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration

	user defined data types.
CO4	Ability to design and develop Computer programs**,** analyzes**,** and interprets the concept of pointers**,** declarations**,** initialization**,** operations on pointers and their usage.
CO5	Develop confidence for self education and ability for life-long learning needed for Computer language.
Text Books	• Schildt Herbert (2017): **The complete reference C++,** 4th edition**,** New Delhi: Mcgraw Hill. • Bjarne**, A Tour of C++,** 4th edition**,** Addison-Wesley.

COURSE CODE	GENERIC ELECTIVE-IX	TOTAL LECTURE. : 30
GE20B309	**Photography**	**(LTP=2-0-0=2)**
Course Objectives:	Students undergo a sound learning on technical aspects of photography ranging from using various formats of digital technology in photography; identify different kinds of still camera**,** camera shots**,** and moments. Compositions. Along with basic operations and the function of a still camera. Lighting techniques**,** fundamentals of photography & editing for photography using high end professional equipment and resources.	
UNIT	**CONTENT**	**HOURS**
I	History of Photography Introduction to camera**,** Types of a Still camera**,** Part of a still camera**,** parts of camera functions**,** other equipment.	5
II	Origin of Photography- early cameras and technology Photography as art Evolution of Camera- From film to digital era History of different genres of photography Current trends in technology and style	7
III	Depth of field**,** aperture**,** shutter speed**,** lenses and functions**,** Composition- different types of shots**,** camera angle and camera movements**,** subject and camera relationship.	7
IV	Lights and its properties**,** Different types of lights**,** other tools used in lighting**,** diffuser**,** reflectors**,** cutter and Gels. Basic lighting techniques accessories used in the lightning.	7
V	Scanning and Image Editing; SCANNING**:** Scanners as input devices- Working of a Scanner– Scanning procedure – Scanning resolution. IMAGE EDITING**:** Image editing through image editing software's like Adobe Photoshop – Adjustment of Brightness**,** Contrast**,** Tonal and Color Values – Experimenting with Level and Curve.	4
Course Outcomes		
CO1	Students will Understand History of Photography Introduction to camera	
CO2	Characterize and analyze Origin of Photography- early cameras and technology	
CO3	They will learn to different types of shots**,** camera angle and camera movements	
CO4	They will have capacity to integrate knowledge and to analyses uses of lighting in different conditions.	
CO5	They will also have capacity to obtain prints through Scanning & photo editing	
Text Books:	1. **Digital Photography**- evans Duncan	
Reference Books:	1. **Digital Photography**- Ang Tom 2. **Art History:** The Basics By Diana Newall**,** Grant Pooke	

COURSE CODE	GENERIC ELECTIVE-X	TOTAL LECTURE: 30
GE20B310	INTRODUCTION TO RETAIL CHAIN SYSTEM	(LTP=2-0-0=2)

Course Objectives

1 To develop the analytical ability of the students to attain an insight into Retail Management contexts

2 To Understand the techniques for optimal utilization of resources

Unit	Contents	Hours
I	An Introduction to Retailing: Factors Influencing Retailing, Basic Retail Models, Modern Retail format & Retailing in rural India	6
II	Strategic Planning in Retailing: Setting up Retail organization, Site analysis, Store Design / Layout, Cost & inventory control, Designing an information system for retail, Store based Strategy Mix, Store branding and Promotions	6
III	Retail Formats: Types, E-tailing, Ownership structures	6
IV	Retail Supply Chain: Issues in managing supply chains Networks, Demand Forecasting, sourcing & vendor selection, Overall Inventory Management	6
V	Store Operations Store Atmosphere, In-store service, Visual Merchandising, Store-wise inventory Management	6

COURSE OUTCOMES

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

CO 1	To Understand basics of Retailing
CO 2	Elaborate the Key elements in Retail planning process
CO 3	Know Different Retail formats
CO 4	Illustrate issues in supply chain
CO 5	Review the customer experience and engagement
Text Books	• **Retail Management** – Bajaj Chetan; Tuli Rajnish; Varma Nidhi – Oxford • **Fundamentals Of Retailing** - Madaan K. V. S. - New Delhi: Tata McGraw-Hill Education • **Retail Management:** A Strategic Approach, - Berman - New Dehli: Pearson Education.
Reference Books	• **International Retail Marketing:** A Case Study Approach - Bruce Margaret, Moore Christopher, Birtwistle Grete - Elsevier Butterworth-Heinemann, • **Strategic Retail Management:** Text and International Cases - Joachim Zentes, Dirk Morschett, Hanna Schramm-Klein - Springer Science & Business Media

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

IV Semester

School of Advanced Computing

COURSE CODE	QUANTITATIVE APTITUDE-II	Total Lecture: 30
UC20B402		(LTP=2-0-0=2)

Course Objectives

This course will enable students to

- Enhance the problem solving skills
- Improve the basic mathematical skills.
- Enable students to manage the placement challenges more effectively

UNIT	CONTENTS	HOURS
I	Time & Distance, Problem on Trains, Boats & Streams Simple Interest, Compound Interest, Stocks & Shares, True Discount	6
II	Area, Volume & Surface Area, Permutation & Combination, Race & Game of Skill, Calendar, Clock, Probability	6
III	Data Interpretation: Tabulation, Bar Graphs, Pie chart & Line Graphs, Information Ordering, Information Processing Engineering Mathematics-Logarithms, Permutation and Combinations, Probability	6
IV	Exploratory Analysis- Design of experiments, Sampling, Sampling Error, Sampling Bias, Measures of Central Tendency and Dispersion, Statistical survey and Presentation of data, Statistical Inference	6
V	Correlation, Formulating Null & Alternate Hypothesis, Type I and Type II errors, Regression, z-test/t-test, p-value	6

Course Outcomes as per Bloom's Taxonomy

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

CO1	Make **decisions**[5] based on analysis and critique of uantitative information using proportional reasoning. Students will lso effectively justify and communicate their conclusions in ways appropriateo the audience.
CO2	**Solve**[3] real-life problems requiring interpretation and comparison of variousepresentations of ratios (i. e. , fractions, decimals, rates, and percentages):
CO3	**Analyze**[4] and critique mathematical models and be able to describe their imitations
CO4	**Apply**[3] probabilistic reasoning to draw conclusions, to make decisions, and to evaluate outcomes of decisions.
CO5	**Distinguish**[4] between proportional and non proportional situations and, whenappropriate, apply proportional reasoning.

Text Books	• Aggarwal RS . (2020): **Quantitative Aptitude for Competitive Examinations**, New Delhi: S. Chand Publication • Gupta D P & Burnwal. (2020): **General Quantitative Aptitude for Competitive Exams**, II Edition Disha Publication
Reference Books	• Agrawal Deepak & Gupta D P. (2018): **Rapid Quantitative Aptitude: With Shortcuts & Tricks** for **Competitive Exams,** New Delhi: Disha Publication • Guha Abhijit. (2016): **Quantitative Aptitude for All Competitive Examinations**, VII Edition**,** New Delhi: McGraw Hill Education

COURSE CODE	OBJECT ORIENTED ANALYSIS & DESIGN	Total Lecture: 60Theory: 30 Tutorial: 15 Practical: 15
CS20B401		(LTP=2-2-2=4)

Course Objectives:

- To Understand the Object Oriented Life Cycle
- To Know how to identify Objects, Relationships, Services and Attributes through UML
- To Understand the Use case Diagram
- To Know the Object Oriented Design Process
- To Know about Software Quality and Usability

Unit	Contents	Hours
I	Introduction to UML, Importance of Modeling, Principles of Modeling, Object oriented modeling, Conceptual model of the UML, Architecture of UML, Software Development Life Cycle.	6
II	Basic Structural Modeling, Classes, Relationships, Common Mechanisms, Basic Diagrams, Advanced Structural Modeling, Advanced Classes, Advanced Relationships, Interfaces, Types and Roles, Packages. Class and Object Diagrams, Terms, Concepts, Modeling Techniques for Class Diagrams	6
III	Basic Behavioral Modeling-I, Interactions, Interaction Diagrams. Basic behavioral Modeling-II, Use cases, Use case Diagrams, ActivityDiagrams.	6
IV	Advanced Behavioral Modeling, Events and Signals, State Machines, Processes and Threads, Time and Space, State Chart Diagrams.Architectural Modeling, Component, Deployment, Component Diagrams, Deployment Diagram.	6
V	Case Study, The Unified Library application	6
	List of Experiments: 1. Library Management System 2. Point of Sale 3. E-Commerce web portal 4. Online Banking web portal 5. Online Travel Ticket Booking Portal 6. Online Hotel Booking portal 7. Hospital Management System 8. e-Governance portal 9. Content Management System 10. Web Counseling portal	

COURSE OUTCOMES	
At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] Unified Modelling Language and Rational Rose for object orientedmodelling
CO 2	**Illustrate**[2] the conceptual model of UML & Represent Behavioral diagrams in UML
CO 3	**Identify**[2] the basic and advanced structural diagrams
CO 4	**Relate**[3] forward and reverse engineering for a software system
CO 5	**Assess**[6] the architectural modelling of UML
Text Books	• Page Meilir**,** Jones. (2000): **Fundamentals of Object Oriented Design in UML,** India: Pearson Education. • Kahate Atul. (2018): **Object Oriented Analysis & Design,** New Delhi: The McGraw-Hill Companies
ReferenceBooks	• Booch Grady**,** Rumbaugh James and Jacobson Ivar**, The Unified ModelingLanguage User Guide,** 1st Edition**,** Addison Wesley. • Bahrami Ali**, Object Oriented Systems Development using the unified modelinglanguage,** 1st Edition**,** Noida: Tata Mcgraw Hills Education.

COURSE CODE	DATA COMMUNICATION	Total Lecture: 60 Theory: 45 Practical: 15
CS20B402		(LTP=3-0-2=4)

Course Objectives:

- Students are expected to learn basics of Communication Technologies and data communication which will help them to build fundamentals for learning Computer Networksin higher semester.
- The course is designed to let students demonstrate an understanding of the fundamentals ofdata communication,
- Understand types of transmission mediums and interfacing standards along with current edgeof the data compression techniques.
- Students are introduced to data communication network design and its operations
- Student should understand Transmission media & switching elements.

UNIT	CONTENTS	HOURS
I	**Signal Characteristic:** Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission Impairments, Data rate limits, Performance **Data Communication:** Basics of data communication, Networks, Internet and protocol standards, OSI, TCP-IP models.	10
II	**Signal Encoding Techniques:** Digital to digital Conversion, Data transmission modes, Analog to analog transmission, Digital to analog transmission, Bandwidth Utilization: Multiplexing and Spreading. Frequency division multiplexing (FDM), Time division multiplexing (TDM), T1 multiplexing hierarchy, E1 multiplexing hierarchy, Statistical TDM, Spread Spectrum, SONET/SDH	10
III	**Transmission Media:** Guided media, optical fiber, wireless media, Switching System and Communication Networks: Circuit Switching, Datagram and virtual network, structure of switch networks, Telephone network, Modem and DSL, cable TV networks	10
IV	**Wireless WAN:** Cellular telephone, Satellite communication. Communication Technologies: Ethernet, Bluetooth, Wifi, RF, Infrared, Zigbee, NFC	10
V	**Data Link Control:** Framing, Flow and error control, protocols, noiseless channels, noisy channel, HDLC, Point to Point Protocol	5

LIST OF EXPERIMENTS:

1. Perform pulse coded modulation for analog to digital conversion. Analyze bandwidth requirement**,** data rate generation**,** synchronous and asynchronous mode of transmission.

2. Perform bandwidth utilization technique time division multiplexing.

3. Perform various line coding formats and compare transmission characteristic of each formats.

4. Perform digital carrier modulation techniques used in wireless communication.

5. Perform amplitude modulation and demodulation.

6. Perform serial data communication between two data terminal equipment using optical link.

7. Perform digital data transfer through RF transmitter and receiver.

8. Demonstration of different types of cables used in data communication.

9. Demonstration of different types of cables used in data communication.

10. Perform Installation of LAN and troubleshooting of frequently occurred problems.

11. Create and test wireless sensor networks using zigbee.

12. To study various aspects of data communication by field visit at data centre.

13. Perform data communication using IR.

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] importance of data communication systems and fundamentals. UnderstandPhysical layer of LAN**,** MAN and WAN
CO 2	**Distinguish**[4] and relate various physical Medias**,** interfacing standards and adapters
CO 3	**Explain**[2]various flow control techniques
CO 4	**Analyze**[4] various modulation technique in analog and digital system
CO 5	**Analyze**[4]short range and long range wireless technologies
Text Books	• Andrew S. Tanenbaum**: Computer Networks,** Fifth Edition**,** New Dehli: Pearson Education. • Behrouz A. Forouzan**: Data Communication and Networking,** Fourth Edition**,** New Dehli: Tata McGraw Hill. • Gupta Prakash C. : **Data Communication**, New Delhi: Prentice Hall India Publication
Reference Books	• Godbole A. : **Data Communication & Network**, Noida: Tata Mcgraw Hills Education. • Miller**: Data Network and Communication**: Cengage Delmar Learning • Stallings William**: Data & Computer Communication**, New Dehli: Pearson Education. .

COURSECODE	DATABASE MANAGEMENT SYSTEM	Total Lecture: 60 Theory: 45 Practical: 15
CS20B403		(LTP=3-0-2=4)

Course Objectives:

- To Understand the basic concepts and the applications of database systems
- To Master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrencycontrol
- To become familiar with database storage structures and access techniques

UNIT	CONTENTS	HOURS
I	**Data base System:** Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models, the ER Model , Relational Model, Other Models, Database Languages, DDL, DML , database Access for applications Programs, data base Users and Administrator, Transaction Management, data base Architecture, Storage Manager, the Query Processor Data base design and ER diagrams, ER Model, Entities, Attributes and Entity sets, Relationships and Relationship sets, ER Design Issues, Concept Design, Conceptual Design for University Enterprise, Introduction to the Relational Model, Structure, Database Schema, Keys , Schema Diagrams	9
II	**Relational Query Languages:** Relational Operations. Relational Algebra, Selection and projection set operations, renaming , Joins , Division, Examples of Algebra overviews, Relational calculus, Tuple relationalCalculus, Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, GROUPBY, HAVING, Nested Sub queries, Views, Triggers.	9
III	**Normalization:** Introduction, Non loss decomposition and functionaldependencies, First, Second, and third normal forms, dependency preservation, Boyee/Codd normal form. Higher Normal Forms, Introduction, Multivalued dependencies and Fourth normal form, Join dependencies and Fifth normal form.	9
IV	**Transaction Concept:** Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability , Implementation of Isolation, Testing for serializability, Lock –Based Protocols, Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log, Based Recovery , Recovery with Concurrent Transactions, Buffer Management, Failure with loss of nonvolatile storage, Advance Recovery systems, Remote Backup systems.	9
V	**File organization:** File organization, various kinds of indexes. Query Processing, Measures of query cost, Selection operation, Projection operation, Join operation, set operation and aggregate operation, Relational Query Optimization, Transacting SQL queries, Estimating the cost, Equivalence Rules.	9
	List of experiments:	

	1. Creating and Manipulating Database objects and Applying Constraints (DDL): **2.** Manipulating Data with Database Objects (DML): **3.** Retrieving**,** Restricting and Sorting Data (DRL): **4.** SQL Single Row Functions **5.** SQL Multiple Row Functions (Aggregate Function): **6.** Displaying Data from Multiple Tables (Join): **7.** Using Commit and Rollback show Transaction ACID Property. **8.** Securing data using Views and Controlling User Access (DCL): **9.** Write a join query based on two tables and analyse the query using action planAnd Audit Trails. **10.** PL/SQL Block Syntax and DML Operation through PL/SQL Block. **11.** Control Structures in PL/SQL. **12.** Working with Cursor. **13.** Creating Procedures and Functions in PL/SQL. **14.** Creating Database Triggers. **15.** Database Recovery Scenarios using Recovery Manager (RMAN):	

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Demonstrate**[2] the basic elements of a relational database management system
CO 2	**Identify**[4] the data models for relevant problems
CO 3	**Design**[6] entity relationship and convert entity relationship diagrams into RDBMS
CO 4	**Formulate**[5] SQL queries on the respect data
CO 5	**Apply**[3] normalization for the development of application software's.
Text Books	• Silberschatz**,** Korth. (2011): **Data base System Concepts,** Sixth Edition**,**New Delhi: McGraw hill. • Raghurama Krishnan**,** Johannes Gehrke**: Database Management Systems,** 3rd Edition**,** New Dehli: McGraw hill.
Reference Books	• Navathe Elmasri**: Fundamentals of Database Systems,** New Dehli: Pearson Education. • Date C. J.**,** Kannan A.**,** Nadhan S. Swami**: An Introduction to Database systems,** Eight Edition**,** New Delhi: Pearson Education.

COURSE CODE	COMPUTER ORGANIZATION ANDARCHITECTURE	Total Lecture: 60Theory: 30 Tutorial: 15 Practical: 15
CS20B404		(LTP=2-2-2=4)

Course Objectives:

- The objective of this course is to introduce the organization of a computer and its principalcomponents.
- The course will also enable the student to understand the design components of a digitalsubsystem.
- To understand the memory organization of computer.
- To understand the importance of Computer Arithmetic.
- To know the integrated role of computers and its components.
- To understand the process model of computer

UNIT	CONTENT	HOURS
I	**Basic Structure of Computer:** Structure of Desktop Computers, CPU: General Register Organization- Memory Register, Instruction Register, Control Word, Stack Organization, Instruction Format, ALU, I/O System, bus, CPU and Memory Program Counter, Bus Structure, Register Transfer Language-Bus and Memory Transfer, addressing modes. Control Unit Organization: Basic Concept of Instruction, Instruction Types, Micro Instruction Formats, Fetch and Execution cycle, Hardwired control unit, Microprogrammed Control unit microprogram sequencer Control Memory, Sequencing and Execution of Micro Instruction	6
II	Computer Arithmetic: Addition and Subtraction, Tools Compliment Representation, Signed Addition and Subtraction, Multiplication and division, Booths Algorithm, Division Operation, Floating Point Arithmetic Operation, design of Arithmetic unit	6
III	I/O Organization: I/O Interface –PCI Bus, SCSI Bus, USB, Data Transfer: Serial, Parallel, Synchronous, Asynchronous Modes of Data Transfer, Direct Memory Access(DMA), I/O Processor.	6
IV	Memory Organization: Main memory-RAM, ROM, Secondary Memory – Magnetic Tape, Disk, Optical Storage, Cache Memory: Cache Structure and Design, Mapping Scheme, Replacement Algorithm, Improving Cache Performance, Virtual Memory, memory management hardware.	6
V	Multiprocessors: Characteristics of Multiprocessor, Structure of Multiprocessor-Inter processor Arbitration, Inter-Processor Communication and Synchronization. Memory in Multiprocessor System, Concept of Pipelining, Vector Processing, Array Processing, RISC And CISC, Study of Multicore Processor –Intel, AMD.	6

LIST OF EXPERIMENTS:

1. Write the working of 8085 simulator GNUsim8085 and basic architecture of 8085 alongwith small introduction.

2. Study the complete instruction set of 8085 and write the instructions in the instruction setof 8085 along with examples.

3. Write an assembly language code in GNUsim8085 to implement data transfer instruction.

4. Write an assembly language code in GNUsim8085 to store numbers in reverse order inmemory location.

5. Write an assembly language code in GNUsim8085 to implement arithmetic instruction. **6.** Write an assembly language code in GNUsim8085 to add two numbers using lxiinstruction. **7.** Write an assembly language code in GNUsim8085 to add two 8 bit numbers stored inmemory and also storing the carry. **8.** Write an assembly language code in GNUsim8085 to find the factorial of a number. **9.** Write an assembly language code in GNUsim8085 to implement logical instructions. **10.** Write an assembly language code in GNUsim8085 to implement stack and branchinstructions.	
Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] theory of Digital Design and Computer Organization to provide aninsight of how basic computer components are specified.
CO 2	**Understand**[2] the functions of various hardware components and their building blocks.
CO 3	**Understand**[2] and appreciate Boolean algebraic expressions to digital design
CO 4	**Apply**[3] different combinational / sequential circuits.
CO 5	**Compare**[4] and Understand memory hierarchy and design of primary memory.
Text Books:	• Mano Morris**, : Computer System Organization** 3rd Edition**,** India**:** PHI**.** • Ghosal Subrata. (2011): **Computer Architecture and Organization**, India**:** Pearson.
Reference Books:	• Usha M.**,** Shrikant T. S. (2012): **Computer System Architecture andOrganization**, India: Willey. • Sarangi. (2017): **Computer Organization and Architecture**, New Dehli: McGraw hill.

DSE-VI		
COURSE CODE	**MACHINE LEARNING AND PATTERNRECOGNITION**	**Total Lecture:60** **Theory:45** **Practical:15**
AI20B405		**(LTP=3-0-2=4)**

Course Objectives:

The objective of this course is to teach students the basic concepts of machine learning, supervised learning, unsupervised learning, and reinforcement learning

UNIT	CONTENTS	HOURS
I	**Introduction:** Learning systems, real world applications of machine learning, why machine learning, variable types and terminology function approximation. **Types of machine learning:** Supervised learning, unsupervised learning ,reinforcement learning. **Important concepts of machine learning:** Parametric vs. non-parametric models, the trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no freelunch theorem	10
II	**Linear Regression:** Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors **Classification:** Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes' theorem of classification, LDAfor p=1,LDA for p>1, quadratic discriminant analysis	10
III	**Resampling Methods, Model Selection and Regularization:** Cross- validation, leave-one-out cross- validation, k-fold cross-validation, the bootstrap, subset selection, shrinkage methods, ridge and lasso regression, dimension reduction methods, principal components regression, partial least square **Tree Based Methods:** Advantages and disadvantages of trees, regression Trees, classification trees, bagging, random forest, boosting	10
IV	**Support Vector Machine**: Maximum margin classifier, classification using a separating hyperplane, the maximal margin classifier, support vector classifier, support vector machines, classification with non-linear decision boundaries, support vector machine, one-versus-one classification,one-versus-many classification	8
V	**Unsupervised Learning:** Principle component analysis, what are principal components, clustering methods, k-means clustering, hierarchical clustering, Independent component analysis,latent semantic indexing, Markov Models, Hidden Markov Models	7

	List of Experiments: 1. Project on Linear Regression 2. Multiple Regression 3. Classification: Logistic Regression 4. Linear Discriminant Analysis 5. Bagging Boosting 6. Random Forests 7. Support Vector Machines 8. PCA 9. Singular Value Decomposition 10. K Mean Clustering	

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	**Understand**[2] algorithms of Machine Learning
CO 2	**Classify4** Supervised and Unsupervised Learning
CO 3	**Apply**[3] Linear Regression, Classification, Tree, PCA,SVD,SVM
CO 4	**Understand**[2]Resampling Methods and Optimization Techniques
CO5	**Implement**[3] different machine learning algorithms
Text Books	• Mitchell Tom M: **Machine Learning**, 1st edition, Noida: McGraw Hill Education. • Bishop Christopher M (2011): **Pattern Recognition and Machine Learning(Information Science and Statistics)**, 2nd edition.
Reference Books	• Hastie Trevor, Tibshirani Robert, Friedman Jerome (2017): **The Elements of Statistical Learning: Data Mining, Inference, and Prediction** , 9th edition.

DSE-VI		
COURSE CODE	**BIG DATA ANALYTICS**	**Total Lecture:60** **Theory:45** **Practical:15**
AI20B406		**(LTP=3–0–2= 4)**

Course Objectives

- To understand Big Data Analytics for different systems like Hadoop.
- To learn the design of Hadoop File System.
- To learn how to analyze Big Data using different tools.
- To understand the importance of Big Data in comparison with traditional databases.
- To understand the concept of Hive Shell.

UNIT	CONTENTS	HOURS
I	Introduction To Big Data And Hadoop: About database analytics,Database, Design, Model, Functions, Tools. Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to InfosphereBigInsights and Big Sheets.	10
II	HDFS(Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.	10
III	Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	8
IV	Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore,Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. HbaseHBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction	10
V	Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.	7

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Understand**[2] the working of Hadoop File System. .
CO 2	**Analyze**[4] Big Data using different tools.
CO 3	**Integerate**[3] complete business data analytics solution
CO 4	**Analyze**[4] efficient algorithms for mining the data from large volumes
CO 5	**Analyze**[4]theHive Shell.
Text Books	• White Tom (2012): **Hadoop: The Definitive Guide**, 3rd Edition, California O'Reilly Publications. • Roos Dirk de, Eaton Chris, Lapis George, Zikopoulos Paul, Deutsch Tom (2012): **Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data** , 1st Edition,Noida: TMH.
Reference Books	• Marconi Katherine, Lehmann Harold (2014): **Big Data and Health Analytics Hardcover** , CRC Press. • Baesens Bart (2014): **Analytics in a Big Data World: The Essential Guide to DataScience and its Applications** , 1st Edition, New Jersey: Wiley Publications.

COURSECODE	PROJECT BASED LEARNING-IV	Total Lecture: 30 Practical: 30
PB20B401		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects.
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction 2. Review of literature

	3. Methodology 4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student**,** a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	**YOGA AND MEDITATION-IV**	**Practical: 15**
IY20B401		**(LTP=0-0-2=0)**
	CONTENTS	**HOURS**
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical**,** mental and spiritual faculties so that the students can become healthier**,** saner and more integrated members of the society and of the nation	**15**

COURSE CODE	GREEN CREDIT-IV	Practical: 15
GC20B401		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	Green Credit helps in self-discipline and self-control**,** leading to immense amount of awareness**,** concentration and higher level of consciousness. Main objective are**:** • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	**15**

COURSE CODE	GENERIC ELECTIVE -I	TOTAL LECTURE: 30
GE20B401	**GENETICS AND SOCIETY**	**(LTP=2-0-0=2)**
Course Objectives:	• The course intends to teach concepts and application of modern transmission and molecular genetics. • To identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.	
UNIT	**CONTENT**	**HOURS**
I	Basic unit of life- Cell: Microscopy. Eukaryotic and prokaryotic cells. Cell size, shape and complexity. Compare the relative sizes of plant, animal and bacterial cells. Plasma membrane. "Fluid Mosaic Model"of the plasma membrane, Cell wall. Sub cellular organelles structure and function. Microtubules, Intermediate filaments, Microfilaments Flagella and Cilia	5
II	Cell cycle and genetics, Stages of Cell cycle: Interphase (G1, S, and G2): Structure of chromosome. Homologous chromosomes, Mitosis, cytokinesis in animal cells and plant cells (include cleavage furrow formation, cell plate formation): Cell cycle control and the relevance of uncontrolled growth in cancer cells.	7
III	Genetics: Chromosomes and cell division, patterns of inheritance and sex determination, population genetics, Genetic Variation, Methodologies used to study genes and gene activities, Developmental noise, Detecting macromolecules of genetics Mendel's Law Model organisms for the genetic analysis, Distinction between Phenotype and Genotype.	7
IV	Introduction to ecology and Evolution, Darwin's theory of evolution, The evolution of populations, Concepts of species, Mechanism of speciation. Genetic approach to Biology Patterns of inheritance and question of biology, Variation on Mendel's Law.	4
V	Diversity and classification of life, evidence for evolution, natural selection and adaptation, speciation, evolutionary trees. Regulation and exploitation of populations, ecosystem energy and nutrient flow, species interactions, biodiversity, human impacts. In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.	7
Course Outcomes as per Blooms Taxonomy		
CO1	Display a broad **understanding**[2] of core genetics concepts Mendelian Genetics.	
CO2	**Explain**[2] key concepts of genome organization and repetitive DNA.	
CO3	**Develop**[3] quantitative reasoning and analytical skills.	
CO4	Indepth**understanding**[2]about genetic sequences and their significance in inheritance.	
CO5	**Analyze**[4]**, interpret**[5], and present methodology and results from primary literature in the discipline.	
Text Books:	• Gardner EJ, Simmons MJ, Snustad(2006): DP **Principles of Genetics**. , VIII Edition,, U. K. : John Wiley and Sons.	

	• Griffiths AJF, Wessler SR**,** Lewontin RC**,** and Carroll S: **Introduction to Genetic Analysis,** IX Edition : W. H. Freeman & Co.
Reference Books:	• Klug WS**,** Cummings MR, Spencer CA (2009): **Concepts of Genetics**. IX Edition**,:** Benjamin Cummings. • Russell PJ (2009): **Genetics- A Molecular Approach** 3rd Edition**:** Benjamin Cummings.

COURSE CODE	GENERIC ELECTIVE -II	TOTAL LECTURE: 30
GE20B402	**Green Chemistry and Green Methods in Chemistry (LTP=2-0-0=2)**	
Course Objectives:	• Prepare graduates with the basic concept of Green Chemistry. • Produce graduates with knowledge of different types of green methods in chemistry.	
UNIT	**CONTENT**	**HOURS**
I	Introduction**:** Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry with examples**,** special emphasis on atom economy**,** reducing toxicity**,** green solvents**,** Green Chemistry and catalysis and alternative sources of energy**,** Green energy and sustainability	10
II	Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.	5
III	Designing of environmentally safe marine antifoulant	5
IV	Rightfit pigment**:** Synthetic azo pigments to replace toxic organic and inorganic pigments.	5
V	An efficient**,** green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.	5
Course Outcomes as per Bloom's Taxonomy		
CO1	Students will be able to **understand**[2] Green Chemistry	
CO2	They will be able to **explain**[2] the green methods for dry cleaning process	
CO3	They will **develop**[3] the knowledge of use of green methods in real world cases	
CO4	They will be able to **identify**[3] the toxic organic and inorganic pigments and their replacements.	
CO5	They will be able to **explain**[3] the green methods of few synthesis.	
Text Books:	• Matlack**,** A. S. (2001): **Introduction to Green Chemistry,** New York: Marcel Dekker	
Reference Books:	• Cann**,** M. C. & Connely**,** M. E. (2000): **Real-World cases in Green Chemistry,** Washington : American Chemical Society**.**	

COURSE CODE	GENERIC ELECTIVE-III	TOTAL LECTURE. : 30
GE20B403	**ELECTRICAL CIRCUIT NETWORK SKILLS**	**(LTP=2-0-0=2)**
Course Objectives:	• The course enables the students to design and trouble shoots the electrical circuits, networks. • Students learn the fundamentals of Ohm's law, Kirchhoff's current and voltage laws and its practical implementation • Designing of circuits (at least proto type models) for a given set of specifications.	
UNIT	**CONTENT**	**HOURS**
I	Voltage, Current, Resistance, and Power, Ohm's law. Series, Parallel, and series-parallel combinations, AC Electricity and DC Electricity, Main electric circuit elements and their combination, Rules to analyze DC sourced electrical circuits, Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources, Rules to analyze AC sourced electrical circuits, Real, imaginary and complex power components of AC source, Power factor, Saving energy and money.	7
II	Drawing symbols, Blueprints, Reading Schematics, Ladder diagrams, Electrical Schematics, Power circuits. Control circuits, Reading of circuit schematics, Tracking the connections of elements and identify current flow and voltage drop.	5
III	AC/DC generators, Inductance, capacitance, and impedance and their response with DC or AC sources, Operation of transformers, Electric Motors, Single-phase, three-phase & DC motors, Interfacing DC or AC sources to control heaters & motors, Speed & power of ac motor, Diode and rectifiers. Components in Series or in shunt.	6
IV	Electrical Protection, Relays, Fuses and disconnect switches, Circuit breakers, Overload devices, Ground-fault protection, Grounding and isolating, Phase reversal, Surge protection. Interfacing DC or AC sources to control elements (relay protection device)	5
V	Different types of conductors and cables, Basics of wiring-Star and delta connection, Voltage drop and losses across cables and conductors, Instruments to measure current, voltage, power in DC and AC circuits, Insulation, Solid and stranded cable, Conduit, Cable trays, Splices: wirenuts, crimps, terminal blocks, split bolts, and solder, Preparation of extension board.	7
Course Outcomes as per Bloom's Taxonomy		
CO1	Students will able to **apply**[3] the basics law of circuit analysis in real world.	
CO2	Students will able to **understand**[2] basic symbol theory of electrical circuits	
CO3	Student will able to **distinguish**[3] working AC and DC motors and **develop** the interface between them.	
CO4	Student will able to **implement**[3] the electrical protection methods.	
CO5	Student will able to **design**[5] extension board as per requirement.	

Text Books:	• B. L. Theraja: **A text book in Electrical Technology,** New Delhi: S. chand Publication. • Venugopal **(**2011): **Digital Circuits and systems,** Noida: Tata McGraw Hill**.** • Ghishal S. (2012): **Digital Electronics**: Cengage Learning**.** • Salivahanan S. & Kumar N. S. (2012): **Electronic Devices and circuits,** 3rd Edition, Noida: Tata McGraw Hill**,**
Reference Books:	• Say M. G. (2002): **The Performance and design of AC machines** : ELBS Edn. • Tietze U. **,** Schenk Ch. (2008): **Electronic circuits: Handbook of design and applications,** London: Springer**.** • Floyd Thomas L. **(**2008): **Electronic Devices,** Seventh Edition, India: Pearson**.**

COURSE CODE	GENERIC ELECTIVE-IV	TOTAL LECTURE. : 30
GE20B404	**INTRODUCTION TO STATISTICAL METHODS AND PROBABILITY** **(LTP=2-0-0=2)**	
Course Objectives:	The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modelling, climate prediction and computer networks etc.	
UNIT	**CONTENT**	**HOURS**
I	Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic.	6
II	Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.	6
III	Standard probability distributions: Binomial, Poisson, Normal, geometric, negative binomial, hypergeometric.	6
IV	Uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases.	6
V	Statistics: Scatter diagram; graphical residual analysis, Q-Q plot to test for normality of residuals, autocorrelation and autocovariance functions; stationarity and non stationarity ; correlation and covariance	6
Course Outcomes as per Blooms Taxonomy		
CO1	Understand and critically discuss the issues surrounding sampling and significance	
CO2	Discuss critically the uses and limitations of statistical analysis	
CO3	Solve a range of problems using the techniques covered	
CO4	Discuss critically the uses and limitations of statistical analysis	
CO5	Describe and discuss the key terminology, concepts tools and techniques used in statistical analysis	
Text Books:	• Hogg R. V. ,Tanis, E. A. and Rao J. M. (2009): **Probability and Statistical Inference,** Seventh Edition, New Dehli: Pearson Education. • Miller, Irwin and Miller, Marylees (2006): **John E. Freund's Mathematical Statistics with Applications,** 7th Edition, Asia: Pearson Education. • Myer, P. L. (1970): **Introductory Probability and Statistical Applications,** New Delhi: Oxford & IBH Publishing. • Sheldon M. Ross (2009): **Introduction to Probability and Statistics for Engineers and Scientists,** United States: Academic Press.	
Reference Books:	• Montgomery D. C. and Runger G. C (2009): **Applied Statistics and Probability for Engineers**, 5th Edition,U. k. : John Wiley & Sons. • Robert H. Shumway and David S. Stoffer (2006): **Time Series Analysis and Its Applications with R Examples,** Third Edition, London: Springer Texts in Statistics.	

COURSE CODE	GENERIC ELECTIVE-V	TOTAL LECTURE. : 30
GE20B405	FARMING SYSTEM & SUSTAINABLE AGRICULTURE (LTP=2-0-0=2)	

Course Objectives

To teach the students about farming systems, their types and management, cropping systems and sustainable agriculture. To give the knowledge of integrated farming systems and their interactions.

Unit	Contents	Hours
I	Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance,	6
II	Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system;	6
III	Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability,	6
IV	Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones,	6
V	Resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.	6

COURSE OUTCOMES

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

CO 1	Well acquainted with farming systems and their components.
CO 2	Well acquainted with cropping systems and allied enterprises.
CO 3	Understand sustainable agriculture, their problems and management.
CO 4	Know about integrated farming systems and their interactions.
CO 5	Well exposed to use resources efficiently in different activities of farming.
Text Books	• Jayanthi C, Devasenapathy P and Vinnila C (2008): **Farming systems principles and practice**. Delhi: Satish serial publishing house, Panda. • S. C. (2011): **Cropping and farming systems**: Agrobios(India) Jodhpur.
Reference Books	• Sharma Arun K. (2006): **A hand book of organic farming**: Agrobios (India) Jodhpur.

COURSE CODE	GENERIC ELECTIVE-VI	TOTAL LECTURE : 30
GE20B406	GENERAL STUDIES-II	(LTP=2-0-0=2)
Course Objectives:	• The purpose of orienting students to General Studies is to develop in them an appreciation for the holistic nature of knowledge • In contemporary times, familiarity with General Studies is indispensable because at the senior learning stage there is an element of specialization due to which the students do not get exposed to some vital disciplines/areas of study that are not covered in their specialized field. • The whole course of General Studies is, therefore, focused on proper development of the 'affective domain' by exposing the students to varied domains of study.	

UNIT	CONTENT	HOURS
I	**Current National issues:** This part is intended to test the Candidate's awareness of current national issues.	6
II	**International Affairs & Institutions:** This part will include questions on important events in world affairs and on international institutions.	6
III	**Indian Economy:** In this part, questions will be on the planning and economic development in India, economic & trade issues, Foreign Trade, the role and functions of I. M. F. , World bank, ADB, W. T. O. etc.	6
IV	**Games & Sports:** Questions will assess the awareness of candidates in respect of games and sports at international and national level. It will also have questions pertaining to different awards and personalities in the context of India.	6
V	**Indian Agriculture** Attempt will be made to assess the general awareness of candidates in respect of crops, white revolution, green revolution, agriculture production and their impact on development of rural economy.	6

Course Outcome

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

CO 1	The course for General Studies for graduation level students has been revised keeping in mind the changing dynamics of today's society.
CO 2	The purpose behind revising the curriculum is to make it more relevant.
CO 3	It is hoped that this course will develop responsible citizens.
CO 4	In the following sections, a brief introduction to each unit has been provided, along with its specific objectives.
CO 5	Suggestive transactional strategies have also been incorporated in each unit to facilitate teachers in effectively planning the learning activities
Text Books:	• Laxmikant M. : **Indian Polity:** 4th Edition or 5th Edition. • Ahir Rajiv: **A brief History of Modern India,** Latest Edition. • Gautam Rakesh (2015): **MadhyapradeshEkParichaya,**Noida: McGraw-Hill publication.

Reference Books:	• Singh Ramesh (2021): **General Knowledge,** Noida: McGraw-Hill publication. • Current magazines, News Papers & Journals.

COURSE CODE	GENERIC ELECTIVE-VII	TOTAL LECTURE. : 30
GE20B407	BOLLYWOOD SIGNATURE MOVES	(LTP=2-0-0=2)

Course Objective:

• To Identify basic characteristics and vocabulary in Bollywood dance.

• To Establish the capacity to recognize the difference, interconnectedness, and diversity of Bollywood and classical Indian dance, and Indian folk dance.

• To Understand the key concepts, discourses, and formulaic storytelling elements involved in the practice of this form.

• To Understand the transformation of this form from a cinematic experience to a live theatrical experience, and participatory dance culture.

• To Recognize the relationship between the movement and music.

• To Develop an awareness of the context and politics related to performing and viewing Bollywood dance.

• To Recognize how the integration of Western dance styles and forms contributed to the development of a Bollywood dance vocabulary and style.

• To Develop an understanding of personal and collective voice and style

UNIT	CONTENTs	HOURS
I	**Basic Bollywood:** Introduction to Bollywood dance and cinema. Basic Bollywood combinations/choreography.	5
II	**Bollywood Vocabulary:** Introduction to and basic vocabulary of classical Indian dances, rhythmic footwork and hand gestures Introduction to folk dances of the subcontinent and their inclusion in Bollywood cinema.	6
III	**Indo Jazz & Contemporary Bollywood:** Contemporary and jazz Bollywood Dance: Analyzing it through the Interplay of Social Forces. Introduction of styles of Bollywood: Mujra, Item Number. Introduction of dance choreographies from classic and modern Bollywood films, exploring the differences, and learning choreography from film	7
IV	**On-Off Screen Bollywood:** Transition to more intricate and longer combinations/choreography Bollywood in the global landscape for both stage and film, influence and inclusion of western dance Live vs. Film Bollywood Dance: clips provided by lecturer.	6
V	**Synergetic Effects of Bollywood:** Group projects: Part One As a small group, learn and execute choreography from your choice of Hindi Film; Part Two- Add original choreography on to Part One as a group, to be performed live as part of final, and to be filmed and edited for resentation as part of final grade.	6

Course Outcome(s) as per Blooms Taxonomy	
Upon completion of this course**,** students will acquire knowledge about**:**	
CO1	Identify basic characteristics and vocabulary in Bollywood dance.
CO2	Understanding the key concepts**,** discourses**,** and formulaic storytelling elements involved in the practice of this form
CO3	Recognize the relationship between the movement and music.
CO4	Recognize how the integration of Western dance styles and forms contributed to the development of a Bollywood dance vocabulary and style.
CO5	Deeper ability to perform as in Group projects.
Text Books	• Garg Lakshminarayan (2016): **Kathak Nritya** : Anubhav Publishing. • Purudadheech (2016): **Kathak Nritya Siksha Vol 1**, 9th Edition, M. P. : Bindu Prakashan • Purudadheech (2010): **Abhinaya Darpan**,M. P. : Bindu Prakashan. • Sharma Bhagwatsharan (2014): **Tal Prakash,**M. P. : Sangeet Karyalaya. • Damodar Pandit(2018): **Sangeet Darpan,** M. P. : Sangeet Karyalaya.
Reference Books	• Ghosh Manmohan (2018): **Nandikeshwar's Abhinaya Darpan :** Indian Mind/Dist Indica. • Singh Mandavi (1990): **Kathak Parampara** : Swati Prakashan. • Shri Kartikram ji (2016): **Raigarhmein Kathak** : Vijaya Books. • Nagar Vidhi (2013): **Kathak Nartan** : B R Rhythms**.** • Saxena Mansi (2020): **The kathak quiz book**: Independently Published. • Kapranova Tetiana (2020): **Kathak – Indian Classical Dance**: Independently Published.

COURSE CODE	GENERIC ELECTIVE-VIII	TOTAL LECTURE. : 30
GE20B408	R PROGRAMMING	(LTP=2– 0–0=2)

Course Objective

- To learn how to program in R
- To learn how to use R for effective data analysis.
- You will learn how to install and configure software necessary for a statistical programming environment.
- The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, and organizing and commenting R code.

UNIT	CONTENTS	HOURS
I	Introduction: Introducing to R, R Data Structures, Help functions in R, Vectors, Scalars, Declarations, recycling, Common Vector operations, Using all and any, Vectorized operations, NA and NULL values, Filtering, Vectorized if-then else, Vector Equality, Vector Element names	5
II	Matrices, Arrays And Lists: Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, Vector/Matrix Distinction, Avoiding Dimension Reduction, Higher Dimensional arrays, lists, Creating lists, General list operations, Accessing list components and values, applying functions to lists, recursive lists	6
III	Data Frames: Creating Data Frames, Matrix-like operations in frames, Merging Data Frames, Applying functions to Data frames, Factors and Tables, factors and levels, Common functions used with factors, Working with tables, Other factors and table related functions, Control statements, Arithmetic and Boolean operators and values, Default values for arguments, Returning Boolean values, functions are objects, Environment and Scope issues, Writing Upstairs, Recursion, Replacement functions, Tools for composing function code, Math and Simulations in R	7
IV	OOP: S3 Classes, S4 Classes, Managing your objects, Input/Output, accessing keyboard and monitor, reading and writing files, accessing the internet, String Manipulation, Graphics, Creating Graphs, Customizing Graphs, Saving graphs to files, Creating three-dimensional plots	6
V	Interfacing: Interfacing R to other languages, Parallel R, Basic Statistics, Linear Model, Generalized Linear models, Non-linear models, Time Series and Auto-correlation, Clustering	6

COURSE OUTCOMES (CO)

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

CO 1	Understand the basics in R programming in terms of constructs, control statements, string functions
CO 2	Understand the use of R for Big Data analytics

CO 3	Create applications using R programming
CO 4	Learn to apply R programming for Text processing
CO 5	Able to appreciate and apply the R programming from a statistical perspective
Text Books	• Matloff Norman **(**2011): **The Art of R Programming: A Tour of Statistical Software Design:** No Starch Press**.** • Lander Jared P. (2013): **R for Everyone: Advanced Analytics and Graphics:** Addison-Wesley Data & Analytics Series**.**
Reference Books	• Gardener Mark **(**2013): **Beginning R – The Statistical Programming Language,** New jersey United States: Wiley**.** • Robert Knell (2013): **Introductory R: A Beginner's Guide to Data Visualization, Statistical Analysis and Programming in R,** Amazon Digital South Asia Services Inc**.**

COURSE CODE	GENERIC ELECTIVE-IX
GE20B409	**TYPOGRAPHY** **(LTP=2-0-0=2)**

Course Objective

- Develop an understanding of the important role of typography in design**,** including the formal elements of Typography.
- You will learn how to configure typographical elements
- The course covers practical issues Design

UNIT	CONTENTS
I	Visualization and application of Typography. Exploration of various typography styles.
II	Logic**,** basic characteristics and difference of Serif and Sans Serif. Understanding the natural form of Typeface and its anatomy.
III	Psychological**,** Semantic and Expressive value of Typography and its applications. Guidelines for Typography in printing and production.
IV	Grids and Various sizes of printing products for Typography application. Layout making.
V	Ability to play with various other graphic elements emphasizing Typography. Choosing the right Font**,** size**,** orientation**,** balancing the Type forms with space.

COURSE OUTCOMES (CO)

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

CO 1	Acquire understanding of various typefaces and develop sensitivity.
CO 2	Develop skills to use Typography in engaging visual compositions
CO 3	Develop skills to reproduce type in appropriate media and printing method
CO 4	Acquire neatness and ability to present high quality output
CO 5	Develop skills to develop new types in a specific context. Acquire skills to creatively intervene type to emote a specific expression
Text Books	• Jute Andre (1996): **Grids: The structure of graphic design**, New York: Crans-Pres-Celigny Rotovision**.** • Schmid Helmut**(** 2003): **Typography Today,** 2nd Edition**:** Seibundo Shinkosha**.**

	• Rand, Paul(1993): **Design, Form, and Chaos:** Yale University Press.
Reference Books	• Robert Bringhurst**:** The Elements of Typographic Style Version 4. 0 • Brown Tim**:** Flexible Typesetting

COURSE CODE	GENERIC ELECTIVE-X	TOTAL LECTURE : 30
GE20B410	BUILDING LEADERSHIP & FELLOWSHIP SKILLS	(LTP= 2-0-0=2)

Course Objectives:

Learning is achieved through a variety of teaching methods; such as class discussions, interactive exercises, mini-lectures, readings, and videos.

- Deepen your knowledge of what leadership means, and what it takes to successfully lead and inspire teams in a global environment
- Recognize, differentiate, and critique observable leadership styles and behaviors, based upon the Mastering Leadership framework introduced in the course
- Increase your personal effectiveness by understanding your leader tendencies, strengthening your self-awareness, and practicing new skills

UNIT	CONTENTS	HOURS
I	What Does It Mean to be a "Leader?" Leadership Defined Leadership in Transition	6
II	Understanding the Foundations of Leadership Leadership Models Leadership Trait Theory Leadership Behavior Theory Contingency Theory and Situational Leadership Theory	6
III	What's Your Leadership Style? Authoritarian vs. Democratic Leadership Power and Leadership The Charismatic Leader Transactional Leadership Transformational Leadership The Servant Leader Situational Leadership Conclusions About Leadership Styles	6
IV	Learning Leadership Skills Hard vs. Soft Skills Interpersonal Skills Communicate Effectively Conflict Resolution Negotiation	6

	Problem-Solving and Critical Thinking Decision-Making Facilitation	
V	The Visionary Leader Envisioning Strategic Thinking	6

COURSE OUTCOMES

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

CO 1	Understand your motivational drivers**,** emotional intelligence**,** and communication methods to establish a personal leadership style
CO 2	Apply or adapt your leadership style to meet specific challenges
CO 3	Manage the conditions that drive team performance
CO 4	Handle stressful and demanding leadership situations
CO 5	Take charge of your professional development as you navigate the challenges of transitioning from an individual contributor to a leader
Text Books	• Aviolio**,** Bruce J. (2005): **Leadership Development in Balance: MADE/Born,** Mahway NJ, U. S. A: Lawrence Erlbaum Associates Publishers. • Baker**,** Michael T. (2010): **People: the Real Business of Leadership,** BookLocker. Com**.** • Bennis**,** Warren (1989): **Why Leaders Can't Lead** San Francisco, California U. S. A. **:** Jossey-Bass Publishers**.**
Reference Books	• Gordon**,** Thomas (1977): **Leader Effectiveness Training: The No-Lose Way to Release the Productive Potential of People**, New York: Bantam Books • Herman**,** Robert D. and Heimovics**,** Richard D. (1991): **Executive Leadership in Nonprofit Organizations: New Strategies for Shaping Executive-Board Dynamics**, San Francisco CA: Jossey-Bass Publishers**.**

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

V Semester

School of Advanced Computing

Course Code	Introduction to Management & Leadership	Theory Lectures: 60 Practical: 0
UC20B501		4-0-0-4

Course Objectives:

1. To introduce the students to the basic concepts and function of management.
2. To establish concept of the planning and decision-making process.
3. To understand the organizing process, structure and principle of business.
4. To apply the knowledge of directing and communication to solve complex business problems.
5. To analyze the skills, qualities, traits and styles of Leaders.

Units	Contents	Hours
1.	Introduction: Concept, Significance and Nature of Management and Leadership, Management Process, Management and Administration, Functions and Principles of Management, Levels of Management, Functional areas of Management and Leaders.	15
2.	Planning and Decision Making: Concept and Nature of planning, Objectives and Components of planning, Nature and Process of planning. Process of Planning, Dimensions / Types of Planning, Tools and Techniques of planning. Decision-Making – Nature, Significance and Process, Techniques of decision making.	15
3.	Organizing: Concept, Importance and Elements of Organization, Process and Principles of organization, Theories of Organization, Organization structure, Organization charts and manuals.	10
4.	Directing and Communication: Concept, Nature, Scope, Principles and Techniques of direction, Concept and Process of communication, Channel/Media of communication, Barriers to effective communication. Controlling: Concept, Objectives, Process and Principles of control, Various control technique.	10
5.	Leadership –Leadership Qualities, Traits and Personalities, Leadership Skills, Leadership Styles - Theories of Leadership – Trait Theory, Behavioral Theory, Fiedler's Contingency Models. Leaders as Change agent and Visionary, Leadership & culture, Ethics and Conflicts.	10

Course Outcomes

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

CO1	Identify concepts of management and its importance in the various areas of the business.
CO2	Demonstrate interactive use of planning and decision making.
CO3	Obtain an understanding of the organizing process, structure and principle of business.
CO4	Apply the knowledge of directing and communication to solve complex business problems.
CO5	Be able to use analytic skills in addressing business problems using various Leadership styles.

Books:	
Text Books	• Durai, P. (2015). Principles of Management, Text and Cases. New Delhi: Pearson Education. • Luthans, F. (2010). Organizational Behaviour. New York: McGraw-Hill. • L.M. Prasad, Principles & Practices of Management, Sultan Chand, 2010.
Reference Books	• Stoner, Freeman & Gilbert Jr. (2009). Management. New Delhi: Prentice Hall. • Weihrich, H. & Koontz, H. (2010). Management- A Global Perspective: New Delhi: Tata McGraw-Hill Education. • 3. Robbins, S.P. & Decenzo, D. A. (2014). Fundamentals of Management: Essential Concepts and Applications. New Delhi: Pearson Education.

COURSE CODE	COMPUTER NETWORKS	Total Lecture:60 Theory:30 Tutorial:15 Practical:15
CS20B501		(LTP=2-2-2=4)

Course Objectives:

1. To develop an understanding of computer networking basics.
2. To develop an understanding of different components of computer networks
3. To understand various protocols, modern technologies and their applications.
4. Understand the services of network layer, transport layer and application layer.
5. Understand the concepts of data communication and networks, TCP/IP and OSI reference models.

UNIT	CONTENTS	HOURS
I	Computer Network: Definitions, goals, components, Architecture, Classifications & Types. Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, Connection Oriented & Connectionless Services, Service primitives, Design issues & its functionality. ISO-OSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations	10
II	Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary & Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP	7
III	MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and SlottedALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), Collision Free Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.	10
IV	Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least Cost Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing, Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding, Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6	8
V	Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, Carrying Unicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of Data Transfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP Timer Management. Session layer: Authentication, Authorization, Session layer protocol (PAP, SCP, H.245). Presentation layer: Data conversion, Character code translation, Compression, Encryption and Decryption, Presentation layer protocol (LPP, Telnet, X.25 packet Assembler/Disassembler).Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).	10

	List of Experiments: 1 Study of Different Type of LAN & Network Equipments. 2. Study and Verification of standard Network topologies i.e. Star, Bus, Ring etc. 3. LAN installations and Configurations. 4. Write a program to implement various types of error correcting techniques. 5. Write a program to Implement various types of framing methods. 6. Study of Tool Command Language (TCL). 7. Study and Installation of Standard Network Simulator: N.S-2, N.S-3.OpNet,QualNet etc . 8. Study & Installation of ONE (Opportunistic Network Environment) Simulator for High Mobility Networks . 9. Configure 802.11 WLAN. 10. Implement & Simulate various types of routing algorithm. 11. Study & Simulation of MAC Protocols like Aloha, CSMA, CSMA/CD and CSMA/CA using Standard Network Simulators. 12. Study of Application layer protocols- DNS, HTTP, HTTPS, FTP and TelNet	

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	**Describe** the functions of each layer in OSI and TCP/IP model.
CO2	**Explain** the functions of Application layer and Presentation layer paradigms and Protocols
CO3	**Describe** the Session layer design issues and Transport layer services.
CO4	**Model** a problem or situation in terms of layering concept and map it to the TCI/IP stack
CO5	**Classify** the routing protocols and analyze how to assign the IP addresses for the given network
Text Books	• Tanenbaum A. S ,"Computer Networks "Pearson Education. • Stalling W, "Computer Networks", Pearson Education • Douglas E. Comer & M.S Narayanan,"Computer Network & Internet", Pearson Education • Prakash C. Gupta, "Data Comunications and Computer Networks", PHI • Bertsekas & Gallager "Data Network" , PHI • Gallo,"Computer Communication & Networking Technologies",Cengage Learning
Reference Books	• Behraj A Forouzan,"Data Communication & Networking", McGraw-Hill. • Natalia Olifar& Victor Olifer,"Computer Networks", Willey Pub.

COURSE CODE	THEORY OF COMPUTATION	Total Lecture :60Theory :45 Tutorial :15
CS20B502		(LTP=3-2-0=4)

Course Objectives:

∉ The course begins with the basic mathematical preliminaries and goes on to discuss the general theory of automata.

∉ To learn properties of regular sets and regular expressions, and the basics of formal languages.

∉ To learn pushdown automata and its relation with context free languages.

∉ To learn Turing machines and linear bounded automata.

∉ The basic concepts of computability such as primitive recursive functions and partial recursive functions.

UNIT	CONTENTS	HOURS
I	Introduction of Automata Theory: Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and mealy machines, composite machine, Conversion from Mealy to Moore and vice versa.	10
II	Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Meaning of union, intersection, concatenation and closure, 2 way DFA.	10
III	Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, killing null and unit productions. Chomsky normal form and Greibach normal form.	10
IV	Push down Automata: example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model.	8
V	Turing Machine: Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem.	7

COURSE OUTCOMES

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

CO 1	**Explain**[1] the models of computation, including formal languages, grammars and automata, and their connections.
CO 2	**Discuss**[2] key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity through problem solving.
CO 3	**Analyze**[4] the grammar, its types, simplification and normal form.
CO 4	**Analyze**[4] and design finite automata, pushdown automata, Turing machines, formal languages and grammars.

CO5	**Develop**[6] an overview of how automata theory, languages and computation are applicable in engineering application.
Text Books	• Hopcroft and Ullman (2007): **Introduction to Automata Theory, Languages, and Computation:** Addision Wesley, 3rd Edition . • Linz P.(2013): **Formal Languages And Automata Theory:** Noida, Pearson Education India, 4th Edition.
Reference Books	∉ Mishra KLP, Chandrasekaran N. (2008): **Theory of Computer Science:** PHI Learning Pvt. Ltd. ∉ Pandey (2013): **Introduction to Automata Theory & Formal Languages:**Delhi: S.K. Kataria & Sons. Publication.

COURSE CODE	ANALYSIS AND DESIGN OF ALGORITHMS	Total Lecture:60 Theory:45 Practical:15
		(LTP=3-0-2=4)

Course Objectives:

Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand and analyze efficient algorithms for various applications.

UNIT	CONTENTS	HOURS
I	**INTRODUCTION:** Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation n and little (o) notation, recurrences, probabilistic analysis, disjoint set operations, union and find algorithms.	10
II	**DIVIDE AND CONQUER**: General method, applications-analysis of binary search, quick sort, merge sort, AND OR Graphs. **GREEDY METHOD**: General method, Applications-job sequencing with deadlines, Fractional knapsack problem, minimum cost spanning trees, Single source shortest path problem.	10
III	**GRAPHS (Algorithm and Analysis)**: Breadth first search and traversal, Depth first search and traversal, Spanning trees, connected components and bi-connected components, Articulation points. **DYNAMIC PROGRAMMING**: General method, applications - optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.	10
IV	**BACKTRACKING**: General method, Applications- n-queen problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles. BRANCH AND BOUND: General method, applications - travelling sales person problem, 0/1 knapsack problem- LC branch and bound solution, FIFO branch and bound solution.	8
V	**NP-HARD AND NP-COMPLETE PROBLEMS**: Basic concepts, non-deterministic algorithms, NP-hard and NP-complete classes, Cook‘s theorem.	7
	List of Experiments: 1. Implementation and Time analysis of sorting algorithms. Bubble sort, Selection sort, Insertion sort, Merge sort and Quicksort 2. Implementation and Time analysis of linear and binary search algorithm. 3. Implementation of max-heap sort algorithm 4. Implementation and Time analysis of factorial program using iterative and recursive method 5. Implementation of a knapsack problem using dynamic programming.	

	6. Implementation of chain matrix multiplication using dynamic programming. 7. Implementation of making a change problem using dynamic programming 8. Implementation of a knapsack problem using greedy algorithm 9. Implementation of Graph and Searching (DFS and BFS). 10. Implement prim's algorithm 11. Implement kruskal's algorithm. 12. Implement LCS problem.	

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	**Analyze**[3] the efficiency of algorithms using time and space complexity theory.
CO 2	**Understand**[2] the mathematical foundation in analysis of algorithms.
CO 3	**Understand**[2] different algorithmic design strategies.
CO 4	**Evaluate**[4] problems using algorithm design techniques such as backtracking and branch & bound.
CO5	Using the existing algorithms understand and **create**[5] solutions for various types of problems.
Text Books	• Ellis Horowitz, Satraj Sahni, Rajasekharam (2007), **Fundamentals of Computer Algorithms**, 2nd edition, University Press, New Delhi.
Reference Books	• R. C. T. Lee, S. S. Tseng, R.C. Chang and T. Tsai (2006), **Introduction to Design and Analysis of Algorithms A strategic approach**, McGraw Hill, India. • Allen Weiss (2009), **Data structures and Algorithm Analysis in C++**, 2nd edition, Pearson education, New Delhi. • Aho, Ullman, Hopcroft (2009), **Design and Analysis of algorithms**, 2nd edition, Pearson education, New Delhi

COURSE CODE	MICROPROCESSOR AND MICROCONTROLLER	Total Lecture: 60 Theory: 45 Practical: 15
CS20B504		(LTP: 3-0-2=4)

Course Objectives:

- To develop an in-depth understanding of the operations of microprocessors.
- To create an exposure to basic peripherals, its programming and interfacing techniques.
- To impart the basic concepts of serial communication in 8086.

UNIT	CONTENT	HOURS
I	**8086 architecture:** 8086 architecture, functional diagram, register organization, memory segmentation, programming model, memory addresses, physical memory organization, signal descriptions of 8086, common function signals, timing diagrams, Interrupts of 8086.	9
II	**Instruction set and assembly language programming of 8086** Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.	10
III	**I/O interface:** 8255 PPI, various modes of operation and interfacing to 8086, interfacing of keyboard, display, stepper motor interfacing, D/A & A/D converter. Interfacing with advanced devices, memory interfacing to 8086, interrupts of 8086, vector interrupt table, interrupt service routine, serial communication standards, serial data transfer schemes, 82 51 USART architecture and Interfacing.	10
IV	**Introduction to microcontrollers:** Overview of 8051 microcontroller, architecture, I/O ports, memory organization, addressing modes, instruction set of 8051, simple programs.	8
V	**8051 real-time control:** Programming timer interrupts, programming external hardware interrupts, programming the serial communication interrupts, programming 8051 timers and counters.	8

LIST OF EXPERIMENTS

(Assembly Language Programming)

1. Write a program for addition of two 16-bit numbers
2. Write a program for subtraction of two 16-bit numbers
3. Write a program for multiplication of two 16-bit numbers
4. Write a program for division of two 16-bit numbers
5. Write program to sort the given numbers in ascending and descending order
6. Write a program to search a number or character from a string

7. Write a program for transfer block of data from one memory location to another memory location 8. Write a program to reverse a given string 9. Write a program for conversion of analog data to digital output 10. Write a program for conversion of digital data to analog output	
COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	**Understand**[2] the architecture of microprocessor and microcontroller
CO 2	**Understand**[2] the programming model of microprocessor and microcontroller
CO 3	**Interface**[6] different external peripheral devices with microprocessors and microcontrollers
CO 4	**Analyze**[4] a problem and **formulate**[6] appropriate computing solution for processor or controller-based applications
CO5	**Develop**[6] assembly language programs for specified applications
Text Books	• D V Hall, **Microprocessors and Interfacing**, Tata McGraw Hill, 2nd edition. • A K Ray and K M Bhurchandani, **Advanced Microprocessors and Peripherals**, Tata McGraw Hill, 2nd edition, 2006.
Reference Books	• K Uma Rao and Andhe Pallavi, **The 8051 Microcontrollers, Architecture and Programming and Applications**, Pearson Education, 2009. • Liu and GA Gibson, **Microcomputer system 8086/8088 Family Architecture, Programming and Design**, PHI, 2nd edition. • Kenneth J Ayala, **The 8051 Microcontroller**, Cengage Learning, 3rd edition, 2010.

DISCIPLINE SPECIFIC ELECTIVE-VII

COURSE CODE	**NEURAL NETWORK AND DEEP LEARNING**	**Total Lecture:60** **Theory: 45** **Practical: 15**
AI20B501		**(LTP=3-0-2=4)**

Course Objectives:

The course begins with key concepts of neural networks, feed-forward neural network, and backpropogation. The student gets an opportunity to learn the programming languages (TensorFlow) to design the deep learning models. The student learns the concepts behind CNN, RNN, LSTM, Autoencoders, and GANs. The hands on learning will help build strong knowledge base for designing advanced deep learning models.

UNIT	**CONTENTS**	**HOURS**
I	The neural network: The neuron, linear perceptron, feed-forward neural network, limitations of linear neurons, sigmoid, tanh, relu neurons, softmax output layer, information theory, cross entropy, Kullback-Leibler divergence Training feed-forward neural network: Gradient Descent, delta rules and learning rates, gradient descent with sigmoidal neurons, the backpropagation algorithms, stochastic and minibatch gradient descent, test sets, validation sets and overfitting, preventing overfitting	6
II	TensorFlow: Computation graphs, graphs, sessions and fetches, constructing and managing graph, flowing tensors, sessions, data types, tensor arrays and shapes, names, variables, placeholders and simple optimization, linear regression and logistic regression using tensorflow Implement Neural Network: Introduction to Keras, Build neural network using Keras, Evaluating models, data preprocessing, feature engineering, feature learning, overfitting, underfitting, weight regularization, dropout, universal workflow of deep learning	6
III	Moving beyond gradient descent: Local minima vs global minima vs saddle, model identifiability, correcting gradient points in wrong directions, Momentum based optimization, second order methods, learning rate adaption, adagrad, rmsprop, adam Convolutional Neural Network: Convolution operation, filters and feature maps, motivation, sparse interactions, parameter sharing and equivariant representation, padding and stride, max pooling, full architectural description of convolutional network, build cnn using data augmentation, using pretrained convnet, visualize what convnet learn.	6
IV	Embedding and Representation Learning: Principle component analysis, working with text data, one-hot encoding of words and characters, word embedding, autoencoder architecture, denoising, sparsity, Word2vec framework, Skip-Gram architecture.	6
V	Models for Sequence Analysis: Analysing Variable-length inputs, Seq2seq with neural n-gram, part of speech tagger, dependency parse, syntaxnet, recurrent neural network, challenges with vanishing gradients, long short term memory units.	6

COURSE OUTCOMES

At the end of the course student will be able to:	
CO 1	**Understand** Neural Network, Feed Forward and Backpropogation
CO 2	**Use** Tensorflow and Keras
CO 3	**Identify** the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
CO 4	**Model** Neuron and Neural Network, and to analyze ANN learning, and its applications.
CO5	**Implement** deep learning algorithms and solve real-world problems.
Text Books	• Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016. • B. Yegnanarayana - Artificial neural network PHI Publication.
Reference Books	• Deep Learning with Python by Francois Chollet - Manning Publications; 1 edition • Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach - MIT Press (3 January 2017) • Tensor Flow for Deep Learning by Reza Zadeh, Bharath Ramsundar - Shroff/O'Reilly; First edition (2018)

DISCIPLINE SPECIFIC ELECTIVE-VII		
COURSE CODE	**BIOMETRICS**	**Total Lecture: 60** **Theory: 45** **Practical: 15**
AI20B502		**(LTP: 3-0-2=4)**

Course Objectives:

- To study the concepts of various biological based information security systems.

UNIT	CONTENT	HOURS
I	**Overview of Biometrics:** Definitions, biometric modalities, course outline, basic applications: access control, e-commerce, forensics.	6
II	**Design of a Biometric System:** Building blocks, modes of operation, fingerprint verification: minutiae-based fingerprint matching, non-minutiae-based representations, fingerprint enhancement, fingerprint classification, face recognition: introduction, authentication vs. identification, challenges in face recognition, algorithms for face recognition.	10
III	**Iris Recognition:** Introduction, devices for capturing Iris, Iris representation schemes, Iris recognition algorithms, biometrics based on hand geometry, signature, ear, palm, voice and DNA.	10
IV	**Multimodal Biometrics:** Limitations of unimodal systems, multibiometric scenarios, levels of fusion, system design, score fusion techniques, score normalization, user-specific parameters, and soft biometrics.	10
V	**Case Study Presentations:** Biometrics in banking industry, biometrics in computerized, patient records, biometrics in credit cards, biometrics in mass disaster victim, identification forensic odontology	9

COURSE OUTCOMES

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

CO1	**Understand**[2] the basics of biometric matching, authentication, identification, and verification approaches on real time problems.
CO2	**Analyze**[4] the data for development of personal identification in real time.
CO3	**Design**[6] and develop different algorithms of a biometric system.
CO4	**Identify**[1] the sociological and acceptance issues associated with the design and implementation of biometric systems.
CO5	**Analyze**[4] and design basic biometric system applications.
Text Books	A.K. Jain, R. Bolle, S. Pankanti, **BIOMETRICS: Personal Identification in Networked Society**, Kluwer Academic Publishers, 1999. Ted Dunstone and Neil Yager, **Biometric System and Data Analysis: Design, Evaluation, and data Mining**, Springer.
Reference Books	R. M. Bolle, J. H. Connell, S. Pankanti, N. K. Ratha, and A. W. Senior, **Guide to Biometrics**, Springer. John R. Vacca, **Biometric Technologies and Verification Systems**, Elsevier Inc, 2007.

COURSE CODE	PROJECT BASED LEARNING-V	Total Lecture: 30 Practical: 30
PB20B501		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects.
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction 2. Review of literature 3. Methodology

	4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	YOGA AND MEDITATION-V	Practical: 15
IY20B501		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical, mental and spiritual faculties so that the students can become healthier, saner and more integrated members of the society and of the nation	15

COURSE CODE	GREEN CREDIT-V	Practical: 15
GC20B501		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	Green Credit helps in self-discipline and self-control, leading to immense amount of awareness, concentration and higher level of consciousness. Main objective are: • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	15

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

VI Semester

School of Advanced Computing

COURSE CODE	SOFTWARE ENGINEERING	Total Lecture:45 Theory:45
CS20B601		(LTP=2-2-2=4)

Course Objectives:

- To introduce software development life cycle and various software process models
- To introduce measures and metrics for software quality, reliability and software estimation techniques
- To develop an understanding of software analysis and design phases
- To introduce coding standards, guidelines and various software testing techniques
- To introduce various activities for software maintenance and quality assurance

UNIT	CONTENTS	HOURS
I	The Software Product and Software Process Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics	10
II	Requirement Elicitation, Analysis, and Specification Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications, Requirement Validation, Traceability	7
III	Software Design, The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function oriented Design, SA/SD Component Based Design, Design Metrics	10
IV	Software Analysis and Testing Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Unit Testing and Unit, Testing Frameworks, Integration Testing, System Testing and other Specialized, Testing, Test Plan, Test Metrics, Testing Tools. , Introduction to Object-oriented analysis, design and comparison with structured Software Engg.	10
V	Software Maintenance & Software Project Measurement Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Feasibility Analysis, Project and Process Planning, Resources Allocations, Software efforts, Schedule, and Cost estimations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, Project Metrics	8

COURSE OUTCOMES

At the end of the course student will be able to:	
CO1	**Develop** an estimation of the cost, quality, and management issues involved in software construction
CO2	**Identify** and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
CO3	**Develop** and apply testing strategies for software applications
CO4	**Develop** a thorough understanding of software development lifecycle principles
CO5	**Design** and plan software solutions to problems using an object oriented strategy
Text Books	• Fundamentals of Software Engineering, Rajib Mall, PHI, 2014. • Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill.
Reference Books	• Software Engineering, I. Sommerville, 9th Ed. PearsonEducation. • Software Engineering, an Engineering approach- James F. Peters, WitoldPedrycz, John Wiley. • Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies. • Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

COURSE CODE	DATA MINING AND WAREHOUSING	Total Lecture:60 Theory: 45 Practical:15
AI20B601		(LTP=3-0-2=4)

Course Objectives

To extract knowledge from data repository for data analysis, frequent pattern, classification and prediction.

UNIT	CONTENTS	HOURS
I	Data Warehousing: Introduction to data warehousing- Data warehousing components, Building a data warehouse, Difference between database system and data warehouse, Data warehouse architecture-3 Tier architecture, Warehouse schema design, Data extraction, Cleanup & transformation tools, Multi-dimensional data model, Data cubes- Stars, Snowflakes, Fact constellations, Concept hierarchy, Online analytical processing Typical OLAP operations.	10
II	Data Mining: Introduction of data mining - Definition and functionalities, Classification of DM systems, DM task primitives, Integration of a data mining system with a database and data warehouse - Issues in DM, KDD process.	8
III	Data Preprocessing: Data Pre-processing, Data cleaning, Data integration and transformation, Data reduction, Discretization and concept hierarchy generation, Data mining primitives, Languages and system architectures, Concept description: Characterization and comparison, Analytical characterization, Mining class comparison.	9
IV	Association Rule Mining: Association rule mining, Mining of single dimensional Boolean association rules, Multilevel association rules and multidimensional association rules, Correlation analysis, Constraint based association mining.	9
V	Classification: Basic issues regarding classification and predication, Classification by decision Tree, Bayesian classification, Classification by back propagation, Associative classification, Prediction, Classifier accuracy. Basics of Clustering: Cluster analysis, Basic issues, Clustering using partitioning methods.	9

COURSE OUTCOMES

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

CO1	**Understand** warehousing architectures and tools for systematically organizing large database and use their data to make strategic decisions.
CO2	**Understand** KDD process for finding interesting pattern from warehouse.
CO3	**Compare** different approaches of data ware housing and data mining with various technologies.
CO4	**Characterize** the kinds of patterns that can be discovered by association rule mining.
CO5	**Discover** interesting patterns from large amounts of data to analyze for predictions and classification.

Text Books	• Jiawei Han and Micheline Kamber : “Data Mining Concepts and Techniques”, 3rd Edition,Elsevier, 2012. • Arun K. Pujari, "Data Mining",University Press. • Paulraj Ponnian, “Data Warehousing Fundamentals”, John Willey.
Reference Books	

DISCIPLINE SPECIFIC ELECTIVE-VIII		
COURSE CODE	**DATA SCIENCE TOOLS AND TECHNIQUES**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B602		**(LTP: 2-0-2=3)**

Course Objectives:

The objective of this course is to teach students the conceptual framework of Big Data, Virtualization, MapReduce, HDFS, Pig, Hive, Spark, ZooKeeper, HBase

UNIT	CONTENT	HOURS
I	**Big Data:** Fundamentals of Big Data, defining big data, building successful big data management architecture, big data journey **Big Data Types:** Structured and unstructured data types, real time and non-real time requirements **Distributed Computing:** History of distributed computing, basics of distributed computing.	7
II	**Big Data Technology** Foundation: Big Data stack, redundant physical infrastructure, security infrastructure, operational databases, organising data services and tools, analytical data warehouse, big data analytics. **Virtualization**: Basics of virtualization, hypervisor, abstraction and virtualization, implementing virtualization with big data **Cloud and Big Data:** Defining cloud, cloud deployment and delivery models, cloud as an imperative for big data, use the cloud for big data	8
III	**Operational Databases**: Relational database, nonrelational database, key-value pair databases, document databases, columnar databases, graph databases, spatial databases **MapReduce Fundamentals:** Origin of MapReduce, map function, reduce function, putting map and reduce together, optimizing map reduce **Hadoop:** Discovering Hadoop, Hadoop distributed file system, Hadoop MapReduce, Hadoop file system, dataflow, Hadoop I/O, data integrity, compression, serialization, file-based data structure	8
IV	**Avro:** Avro data types and schemas, in-memory serialization and deserialization, avro datafiles, schema resolution **Pig:** Comparison with databases, pig latin, user defined functions, data processing operators **Hive:** Running hive, comparison with traditional databases, HiveQL, tables, querying data, user-defined functions **Spark:** Resilient distributed datasets, shared variables, anatomy of a spark job run, executors and cluster managers, **HBase:** HBasics, concepts, clients, HBase vs RDBMS, Praxis **ZooKeeper:** ZooKeeper services, building application with ZooKeeper	7

List of Experiments: Based on the above contents

COURSE OUTCOMES

At the end of the course student will be able to:	
CO1	**Understand** the Concepts of Hadoop and HDFS
CO2	**Understand** Concepts of MapReduce
CO3	**Use** Big data tools Pig, Hive, Spark, Zookeeper, HBase
CO4	**Implement** virtualization with Big Data
CO5	**Represent** the analytical aspects of Big Data
Text Books	• Mayank Bhushan , "Big Data and Hadoop – learn by Example", BPB publication 2018. • Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media,2012. • Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
Reference Books	• Hadoop: The Definitive Guide, 4th Edition by Tom White - Shroff Publishers & Distributers Private Limited - Mumbai; Fourth edition (2015) • Big Data: Principles and Best Practices of Scalable Real-time Data Systems by James Warren and Nathan Marz, Manning Publications (2015)

DISCIPLINE SPECIFIC ELECTIVE-VIII		
COURSE CODE	**DIGITAL IMAGE PROCESSING**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B603		**(LTP: 2-0-2=3)**

Course Objectives:

- To know the fundamentals of image processing
- To perform image enhancement and segmentation
- To know importance feature selection and extraction from images
- To perform object recognition and to perform real time video processing for embedded control.

UNIT	CONTENT	HOURS
I	**FUNDAMENTALS OF IMAGE PROCESSING:** Introduction – Steps in image processing systems – Image acquisition -Sampling and Quantization, Pixel relationships – Color fundamentals and models, File formats, Image operations – Arithmetic and Morphological.	**6**
II	**IMAGE ENHANCEMENT:** Spatial Domain: Gray level Transformations – Histogram processing – Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – DFT, FFT, DCT – Smoothing and sharpening filters – Homomorphic Filtering.	**6**
III	**IMAGE SEGMENTATION AND FEATURE ANALYSIS:** Detection of Discontinuities – Edge operators - Edge linking and Boundary Detection - Thresholding - Region based segmentation – Morphological Watersheds – Motion Segmentation	**7**
IV	**OBJECT RECOGNITIO:** Introduction – Pattern and Pattern Class – Selection Measurement Parameters – Approaches – Types of Classification – Bayes, Template matching, Non parametric density estimation, Neural Network approach – Applications.	**6**
V	**VIDEO PROCESSING:** Real time image and Video processing – Parallelism – Algorithm simplification strategy – Hardware platforms – DSP, FPGA, GPU, General purpose processors.	**5**

List of Experiments:

1. Conversion of 24 bit color image to 8 bit , 4 bit, 1 bit image
2. Image negation, power Law correction
3. Histogram mapping & equalisation, stretching
4. Image smoothing , sharpening
5. Edge detection – use of Sobel, Prewitt and Roberts operators
6. Morphological operations on binary images
7. DCT/IDCT computation 8. Transform application assignment.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	**Understand**[2] need for image transforms different types of image transforms and their properties.
CO2	**Classify**[4] different techniques employed for the enhancement of images.
CO3	**Apply**[3] images in the frequency domain using various transforms.
CO4	**Understand**[2] the rapid advances in Machine vision.
CO5	**Implement**[3] different image processing application.
Text Books	• Digital Image Processing, Gonzalez, Woods, PHI , 2nd edition • Digital Image Processing, Pratt W.K., John Wiley, 200
Reference Books	• Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Eduction, 2009. • Nasser Kehtarnavaz, Mark Noel Gamadia, "Real-time image and video processing: from research to reality", Morgan Claypool publishers, 2006. • S. Jayarman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2010. • Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2003. • Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson, 2007. • Related journal and conference publications

DISCIPLINE SPECIFIC ELECTIVE-VIII		
COURSE CODE	**BIOMEDICAL IMAGE AND SIGNAL PROCESSING**	**Total Lecture:45** **Theory:30** **Practical:15**
A120B604		**(LTP=2-0-2=3)**

Course Objectives:

- To introduce the concepts of medical decision support systems,
- To provide an insight on deep learning architectures,
- To impart knowledge on application of deep learning for biomedical problems
- To introduce characteristics of biomedical signals
- To provide understanding of artifact removal in biomedical signals
- To enhance knowledge in event detection and waveform analysis of biomedical signals
- To provide insight on pattern classification in biomedical signals

UNIT	CONTENTS	HOURS
I	**Introduction of biomedical image analysis:** Computer aided diagnosis, Nature of medical images, X-ray imaging, Tomography, Nuclear medicine imaging, SPECT imaging, Positron imaging tomography, Ultrasonography, Magnetic resonance imaging, Removal of artifacts, Image Enhancement, Gray level transforms, Histogram transformation, Spatial domain filters, Frequency domain filters, Morphological image processing, Edge detection	06
II	**Analysis of shape and texture**: Representation of shapes and contours, Shape factors, Models for generation of texture, Statistical analysis of texture, Fractal analysis, Fourier domain analysis of texture, Applications, Contrast enhancement of mammograms, Shape and texture analysis of tumors	06
III	**Fundamentals of Signal Processing:** Sampling and aliasing, Signal reconstruction, Signal conversion systems, Circular convolution Correlation- Autocorrelation – Cross correlation, FFT-decimation in time algorithm, Decimation in Frequency algorithm, Digital Filter Design, FIR filter design using windowing techniques- Rectangular window, Hamming window, Hanning window	06
IV	**Wavelet and Speech Processing:** Introduction to wavelets, Time frequency representation, Discrete wavelet transform, pyramid algorithm, Comparison of Fourier transform and wavelet transform, Speech analysis – Cepstrum – Homomorphic filtering of speech signals, ECG signal characteristics – EEG analysis.	06
V	**Analysis of Bio-signals:** Automatic analysis and classification of ECG, P-wave detection, QRS complex detection, Correlation analysis of ECG signals, Signal averaged ECG, Analysis of Heart Rate variability, Synchronized averaging of PCG envelopes, Analysis of PCG signal, Analysis of EMG signal	06

	List of Experiments: Implement the following Substitution & Transposition Techniques concepts: a) Caesar Cipherb) Rail fence row & Column Transformation. Implement the following Substitution & Transposition Techniques concepts: a) Caesar Cipherb) Rail fence row & Column Transformation. Implement the following Substitution & Transposition Techniques concepts: a) Caesar Cipherb) Rail fence row & Column Transformation. 1. Basic operations on images 2. Image enhancement using point operations 3. Image enhancement using spatial domain filters 4. Histogram processing of images 5. Image enhancement using frequency domain filters 6. Denoising of medical images 7. Medical image segmentation using edge and region-based methods 8. Extraction of shape and texture features from a medical image 9. Design of pattern classification system for biomedical images 10. Performance metrics in bioimages 11. Implementation of CNN 12. Implementation of LSTM 13. Feature extraction of biomedical signals 14. Simulation of biomedical signals 15. ECG analysis using CNN	

COURSE OUTCOMES

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

CO 1	**Understand**[2] the basic concepts and tools for real time Processing of signals
CO 2	**Understand**[2] concepts of signal processing
CO 3	**Apply**[3] algorithms for signal processing
CO 4	**Analyze**[4] biomedical signals and systems

CO5	**Evaluate**[5] biomedical signal processing systems
Text Books	• Rangaraj M. Rangayyan: **Biomedical Image Analysis**, CRC Press, 2004 2. • Rangaraj M Rangayan: **Biomedical signal analysis-A Case-Study Approach**, WileyInterscience, John Wiley & Sons, Inc.
Reference Books	• R C Gonzalez & R E Woods: **Digital Image Processing** , Pearson Education,3e, 2008 • Atam P Dhwan: **Medical image analysis**, 2nd Edition, John Wiley & Sons. • John G, Proakis and Dimitris G Manolakis: **Digital Signal Processing, Principles Algorithms and Applications**, Third edition, (Prentice Hall) • A K Jain: **Fundamentals of Digital Image processing** , PHI / Pearson Education, 1 edition, 2011 • Chanda and Majumder: **Digital Image Processing and Analysis**, PHI Learning Pvt. Ltd., 2004 • Taylor & Francis, Richard A. Robb: **Biomedical Imaging, Visualization, and Analysis**, John Wiley & Sons, 1999

DISCIPLINE SPECIFIC ELECTIVE-IX		
COURSE CODE	**PRINCIPLE AND DESIGN OF IOT SYSTEMS**	**Total Lecture:45** **Theory:30** **Practical:15**
AI20B605		**(LTP=2-0-2=3)**

Course Objectives:

- To understand various building blocks and working of state-of-the-art IoT systems.
- To provide enough insights to conceive and build IoT systems by the students.
- To give students hands-on experience using different IoT architectures and provide skills for interfacing sensors and actuators with different IoT architectures.
- To apply Cloud computing, Machine learning and Data analytics for industrial applications based on IoT.

UNIT	CONTENTS	HOURS
I	**Introduction to IoT:** Introduction, IoT Reference Model, and architecture, IoT reference Mode, Edge Devices, NodeMCU/ESP 32, Programming edge node, Gateways, Gateways types and configurations, Gateway as an extension of the cloud, HTTP access method using API.	**06**
II	**IoT and data analytics:** IoT and Data Management, Data cleaning and processing, Data storage models. Search techniques, Deep Web, Semantic sensor web, Semantic Web Data Management, Searching in IoT, Real-time and Big Data Analytics for The Internet of Things, Heterogeneous Data Processing, High-dimensional Data Processing, Parallel and Distributed Data Processing.	**06**
III	**Cloud of Things:** IoT Physical Servers, Cloud Offerings, and IoT Case Studies, Introduction to Cloud Storage Models, Communication API, Eclipse IoT, AWS IoT, Google Cloud IoT, ThingWorx.	**06**
IV	**Raspberry Pi:** Raspberry Pi, Introduction and installing the Raspbian Stretch OS, Headless, Computer and Rpi configuration to connect Rpi remotely without Ethernet cable via SSH, IP address, Rpi, Testing the GPIO pins through Scripts, Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi python library install and reading sensor feed, Storing sensor data in cloud and in database, MySQL server on Raspi	**06**
V	**Machine Learning using Python:** Pyhton basics and its libraries for machine learning, NumPy, Pandas, SciPy, MatPlotLib and SciKit Learn	**06**
	List of Experiments: **1.** Calibration and accessing real-time sensors data **2.** Accessing and observing inertial sensors' data **3.** Updating sensors' parameters and observing the impact **4.** Calibrating multi-IMU system and calibration compensation with WiFi **5.** Gaining familiarity with an IoT Sensor	

	6. Connecting smart IoT sensor with cloud (Firebase Integration with Python) **7.** Firmware Modification & Compilation, USB Bootloading and Clock Budgeting **8.** Getting Familiar with Raspberry Pi 3	

COURSE OUTCOMES

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

CO 1	**Understand**[2] Python for Machine learning applications
CO 2	**Understand**[2] Raspberry PI along with critical protocols and its communication to cloud.
CO 3	**Create**[6] web/cloud based IoT applications.
CO 4	**Apply**[3] AWS CLI and SDK on a Linux system with applications of various AWS services.
CO5	**Understand**[2] principle and architecture for Internet of Things
Text Books	• Sudip Misra, Chandana Roy and Anandarup Mukherjee: **Introduction to Industrial Internet of Things and Industry 4.0**, CRC Press • Rahul Dubey: **An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications**, Cengage India Publication
Reference Books	• Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier: **Technologies Sensors for the Internet of Things Businesses & Market Trends** 2014 -2024',Yole Development Copyrights ,2014 • Peter Waher: **Learning Internet of Things,** Packt Publishing, 2015 • Richardson, M., & Wallace: **Getting started with raspberry PI.**, O"Reilly Publisher Media, Inc., 2012 • Shrirang Ambaji Kulkarni: **Introduction to IOT with Machine learning and Image Processing using Raspberry Pi**, CRC Press • Rao, M.: **Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects**, Packt Publishing Ltd, 2018.

DISCIPLINE SPECIFIC ELECTIVE-IX		
COURSE CODE	**NATURAL LANGUAGE PROCESSING**	**Total Lecture:45** **Theory:30** **Practical:15**
AI20B606		**(LTP=2-0-2=3)**

Course Objectives:

- To boost student knowledge to research level where they can conduct new level of research. It really helpful for undergraduate students.
- To get introduced to language processing technologies for processing the text data.
- To acquire knowledge on text data analytics using language model.
- To understand the role of Information Retrieval and Information Extraction in Text Analytics

UNIT	CONTENTS	HOURS
I	**Introduction to NLP:** Real world implementations of NLP, NLP Tasks, Introduction to Language, Building blocks, Heuristic based NLP, Machine Learning and Deep Learning for NLP, Challenges for using Deep Learning in NLP	**06**
II	**NLP Project Pipeline**: Data Acquisition, Text Extraction and Clean-up, HTML Parsing and Clean-up, Unicode Normalization, Spelling Correction, System-Specific Error Correction, Pre-Processing, Feature Engineering, Machine Learning Project Pipeline, Deep Learning Project Pipeline, Modeling, Simple Heuristics, Evaluation, Post-Modeling Phases, Deployment, Monitoring	**06**
III	**Text Representation:** Vector Space Models, Basic Vectorization Approaches, One-Hot Encoding, Bag of Words, Bag of N-Grams, TF-IDF, Distributed Representations, Word Embeddings, Going Beyond Words, Distributed Representations Beyond Words and Characters, Universal Text Representations, Visualizing Embeddings, Handcrafted Feature Representations	**06**
IV	**NLP for Social Media:** Applications, Unique Challenges, NLP for Social Data, Word Cloud, Tokenizer for SMTD, Trending Topics, Understanding Twitter Sentiment, Pre-Processing SMTD, Text Representation for SMTD, Customer Support on Social Channels, Memes and Fake News, Identifying Memes, Fake News	**06**
V	**Chatbot:** A Simple FAQ Bot, A Taxonomy of Chatbots, Goal-Oriented Dialog, Chitchats, A Pipeline for Building Dialog Systems, Dialog Systems in Detail, PizzaStop Chatbot, Deep Dive into Components of a Dialog System, Dialog Act Classification	**06**
	List of Experiments: Based on above contents	

COURSE OUTCOMES

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

CO 1	**Understand** the concepts of Natural Language Processing.
CO 2	**Apply** Hidden Markov model and Speech Recognition

CO 3	**Describe** application of context free grammar and language parsing
CO 4	**Implement** probabilistic and language parsing.
CO5	**Use** appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.
Text Books	• Jurafsky Daniel and Martin H. James (2008): **Speech and Language Processing**, IInd Edition, Prentice Hall. • Aggarwal C. Charu (2018): **Machine Learning for Text**, Ist Edition Springer. • D.Manning Christopher and Schuetze Hinrich (1999): **Foundations of Statistical Natural Language Processing**, MIT press. • Bird Steven, Klein Ewan and Loper Edward (2009): **Natural Language Processing with Python**, Ist Edition, O'Reilly Media.
Reference Books	• Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit (O'Reilly 2009, website 2018) http://www.nltk.org/book/ • Dipanjan Sarkar, Text Analytics with Python (Apress/Springer, 2016) https://link-springer-com.proxy.uchicago.edu/book/10.1007%2F978-1-4842-2388-8

DISCIPLINE SPECIFIC ELECTIVE-IX		
COURSE CODE	**BLOCK CHAIN AND DISTRIBUTED LEDGERS**	**Total Lecture:45Theory:30 Practical:15**
CY20B607		**(LTP=2-0-2=3)**

Course Objectives:

The objective of this course is to familiarize with the concepts of Block chain technology, understand the concepts of Bitcoin and distributed ledger.

UNIT	CONTENTS	HOURS
I	Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.	6
II	Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.	6
III	What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether's What's a Transaction?, Smart Contracts.	6
IV	Introduction to Hyperledger: What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.	6
V	Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.	6
	List of Experiments: 1. Create a Simple Blockchain in any suitable programming language. 2. Use Geth to Implement Private Ethereum Block Chain. 3. Build Hyperledger Fabric Client Application. 4. Build Hyperledger Fabric with Smart Contract. 5. Create Case study of Block Chain being used in illegal activities in real world. 6. Using Python Libraries to develop Block Chain Application.	

COURSE OUTCOMES

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

CO 1	**Understand**[2] and explore the working of Blockchain technology

CO 2	**Analyze**[3] the working of Smart Contracts
CO 3	**Illustrate**[3] the concepts of Bitcoin and their usage.
CO 4	**Understand**[2] the working of Ethereum
CO5	**Utilize**[3] the blockchain concepts in various applications.
Text Books	• Narayanan, Bonneau, Felten, Miller and Goldfeder, "**Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction**", Princeton University Press. • Josh Thompson, '**Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming'**, Create Space Independent Publishing Platform, 2017.
Reference Books	• Imran Bashir, "**Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained**", Packt Publishing. • Merunas Grincalaitis, "**Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols**", Packt Publishing. • Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "**Blockchain Architecture Design And Use Cases**" [MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

DISCIPLINE SPECIFIC ELECTIVE-IX		
COURSE CODE	**COMPUTER VISION**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B608		**(LTP: 2-0-2=3)**

Course Objectives:

- To analyze and interpret the visible world around us.
- To understand the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis, visual geometric modeling, stochastic optimization etc.
- To explore and contribute research in the field of computer vision.

UNIT	CONTENT	HOURS
I	**Digital image formation and processing:** Overview, fundamentals of digital image, image formation, transformation, orthogonal, Euclidean, affine projection, Fourier transformation, convolution, filtering, image enhancement, restoration, histogram processing, rectification, 3D reconstruction framework, auto-calibration.	6
II	**Feature extraction:** Edges, canny, LOG, DOG, line detectors, corners Harris and Hessian affine, orientation histogram, SIFT, SURF, HOG, GLOH, scale-space analysis, image pyramids, Gaussian derivative filters, Gabor filters, DWT.	6
III	**Image segmentation:** Region growing, edge-based approaches to segmentation, graph-cut, mean-shift, MRF, texture segmentation.	4
IV	**Pattern analysis:** Probability and statistics, clustering, k-means, k-medoids, mixture of Gaussians, classification, discriminant function, supervised, unsupervised, semi-supervised, classifiers, Bayes, KNN, ANN, dimensionality reduction, PCA, LDA, ICA, non-parametric methods.	7
V	**Motion analysis:** Background subtraction and modeling, optical flow, KLT, spatio-temporal analysis, motion parameter estimation. Shape from X, illumination models, reflectance map, Albedo estimation, photometric stereo, surface smoothness constraint, shape from texture, color, motion and edges.	7

LIST OF EXPERIMENTS

1. Pre-process the given image with a filter that computes the mean value of a 3-by-3 pixel window function (2D convolution).
2. Compute and visualize the filter's 2D amplitude transfer function using FFT analysis.
3. Pre-process the given image for reduction of image noise. Compute and visualize global grayscale histograms before and after filtering of image.
4. Use Matlab function edge to find the edges of coins.
5. Convert the input color image into a grayscale image.
6. Examine intensity histogram of grayscale image.
7. Find regions by global fixed value thresholding.
8. Apply component labelling on the segmented image (use bwlabel in Matlab).

9. Apply colour coding of the labelled image (use label2rgb in Matlab).	
10. Write a Matlab script that computes COG (centre of gravity) in vertical direction across the line and for all image columns along the horizontal direction.	
COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	**Understand**[2] geometric relationship between 2D images and the 3D world
CO 2	**Apply**[3] mathematical modeling methods for image processing tasks.
CO 3	**Perform**[3] experiments on computer vision problems and **compare**[2] their performance.
CO 4	**Design**[6] new algorithm to solve recent computer vision problem.
CO 5	**Build**[6] a system to solve computer vision problem.
Text Books	• Richard Szeliski, **Computer Vision: Algorithms and Applications**, Springer-Verlag London Limited, 2011 • Richard Hartley and Andrew Zisserman, **Multiple View Geometry in Computer Vision**, 2nd Edition, Cambridge University Press, 2004
Reference Books	• R. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2006 • K. Fukunaga, **Introduction to Statistical Pattern Recognition**, 2nd Edition, Academic Press, Morgan Kaufmann, 1990 • R.C. Gonzalez and R.E. Woods, **Digital Image Processing**, Addison- Wesley, 1992

COURSECODE	PROJECT BASED LEARNING-VI	Total Lecture: 30 Practical: 30
PB20B601		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

Course Outcome as per Bloom's Taxonomy

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

CO 1	**Apply**[3] a sound knowledge/skills to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.
General Guidelines:	• PBL will be an integral part of UG/PG Programs at different levels. • Each semester offering PBL will provide a separate Course Code, twocredits will be allotted to it. • Faculty will be assigned as mentor to a group of 30 students minimum byHoS. • Faculty mentor will have 4 hours/week to conduct PBL for assigned students. • Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals): • Student may work as a team maximum 3 or minimum 2 members for single topic. • For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks. • 20 marks would be allotted for continuous performance assessment by concerned guide/mentor. For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components: 1. Introduction 2. Review of literature 3. Methodology

	4. Result and Discussion 5. Conclusion and Project Outcomes 6. References • Student will need to submit three copies for 1. Concerned School 2. Central Library 3. Self • The integrity of the report should be maintained by student. Any malpractice will not be entertained. • Writing Ethics to be followed by student**,** a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report. • Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

COURSE CODE	YOGA AND MEDITATION-I	Practical: 15
IY20B601		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	• To practice mental hygiene. • To possess emotional stability. • To integrate moral values. • To attain higher level of consciousness. It will prepare the students physically and mentally for the integration of their physical**,** mental and spiritual faculties so that the students can become healthier**,** saner and more integrated members of the society and of the nation	**15**

COURSE CODE	GREEN CREDIT-I	Practical: 15
GC20B601		(LTP=0-0-2=0)
	CONTENTS	HOURS
Course Objectives:	Green Credit helps in self-discipline and self-control**,** leading to immense amount of awareness**,** concentration and higher level of consciousness. Main objective are**:** • To provide the basic practical understanding about plantation. • To familiarize the various issues related with plantation and associated problems. • To make a bonding between tree and students. • Preparing basic awareness about the environmental issues confronted by the humanity in the present global scenario and to equip the students to understand the environmental movements and basic of plantations.	**15**

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

VII Semester

School of Advanced Computing

COURSE CODE	TCP/IP AND WEB TECHNOLOGY	Total Lecture: 60 Theory: 45 Practical: 15
CS20B708		(LTP: 3-0-2=4)

Course Objectives:

To present basic networking technology and terminology, including the ISO/OSI Network Reference Model, DoD networking model, IP addressing and name resolution, and other concepts and information relevant to setting up and using TCP/IP-based networks.

This will also expose students to the basic tools and applications used in Web publishing.

UNIT	CONTENT	HOURS
I	Networking Protocols and Internet: Introduction, Protocols in Computer Communications, the OSI Model, OSI Layer Functions. Why Internet Working?, Problems in Internet Working, Dealing with Incompatibility Issues, A VSirtual Network, Internet Working Devices, Repeaters, Br idges, Routers, Gateways, A Brief History of the Internet, Growth of the Internet.	7
II	WWW, HTTP, TELNET: Introduction, Brief History of WWW, the Basics of WWW and Browsing, Hyper Text Markup Language, Common Gateway Interface, Remote Login.	8
III	JavaScript and AJAX: Introduction, JavaScript, Basic Concepts, Controlling JavaScript Execution, Miscellaneous Features, JavaScript and Form Processing, Pop-up Boxes. AJAX: Introduction, How AJAX Works? Life without AJAX, AJAX Coding, Life with AJAX.	8
IV	Introduction to XML: What is XML? XML versus HTML, Electronic Data Interchange, XML Terminology, Introduction to DTD, Document-Type Declaration, Element-Type Decl aration, Attribute Declaration, Limitations of DTDs, Introduction to Schema, Complex Types, Extensible Style sheet Language Transformations, Basics of Parsing, JAXP	10
V	Creating Good Web Pages: Introduction, Top Level Navigation, Creating Sample Layouts, Metaphor, Theme, and Storyboard, Screen Resolution,3-Column Layout, Using Frameworks, Using Graphics, Usability for the Handheld Devices, Creating Multilingual Web sites, XHTML and Web Browser Compatibility Issues, Designing the Basic Elements of a Home Page.	12

LIST OF EXPERIMENTS

1. Write an HTML page to print Hello World in bold and italic font.
2. Display various text formatting methods available in HTML ie. <H1>, <B>, <U>, etc.
3. Create an HTML file using special characters.
4. Create table with ROWSPAN and COLSPAN attribute.
5. Create table with CELSPACING and CELLPADDING.
6. Create a simple web form that will show all input methods available in HTML.

7.	Write an XML of given tree that demonstrates the creation of user-designed tags and display it in browser.
8.	Write an XSL code for the above XML file that displays the information in a table structure.
9.	Create an AJAX login form.
10.	Create a web form with validation using JavaScript.

COURSE OUTCOMES

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

CO 1	**Analyze**[4] a webpage and **identify**[1] its elements and attributes.
CO 2	**Create**[6] webpages using XHTML and cascading style sheets.
CO 3	**Build**[6] dynamic webpages using JavaScript.
CO 4	**Create**[6] XML documents and schemas.
CO5	**Build**[6] interactive web applications using AJAX.
Text Books	• Behrouz A Forouzan, **TCP/IP Protocol Suite**, TMH, 3rd edition. • Achyut Godbole, Atul Kahate, **Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing**, Third Edition, McGraw Hill Education.
Reference Books	• Douglas. E.Comer, **Internetworking with TCP/IP**, Volume I, PHI. • Jochen Schiiler, **Mobile Communications**, Pearson, 2nd edition. • Deitel, Deitel, Goldberg, **Internet & World Wide Web How to Program**, Third Edition, Pearson Education, 2006.

DISCIPLINE SPECIFIC ELECTIVE-X		
COURSE CODE	**DATA ANALYTICS AND VISUALIZATION**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B703		**(LTP: 2-0-2=3)**

Course Objectives:

- The basic objective is to understand the data analysis & visualize your data & method, understanding models not just a tool-oriented Analyst.

UNIT	CONTENT	HOURS
I	INTRODUCTION TO DATA HANDLING Overview of Data analysis, Introduction to Data visualization, Working with statistical formulas - Logical and financial functions , Data Validation & data models, Power Map for visualize data , Power BI-Business Intelligence , Data Analysis using statistical methods, Dashboard designing.	6
II	INTRODUCTION TO DATA MANIPULATION USING FUNCTION: Heat Map, Tree Map, Smart Chart, Azure Machine learning , Column Chart, Line Chart , Pie,Bar, Area, Scatter Chart, Data Series, Axes , Chart Sheet , Trendline , Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart , Gantt Chart , Pareto Chart etc , Frequency Distribution, Pivot Chart, Slicers , Tables: Structured References, Table Styles , What-If Analysis: Data Tables, Goal Seek, Quadratic Equation , Transportation Problem, Maximum Flow Problem, Sensitivity Analysis, Histogram, Descriptive, Statistics, Anova, F-Test, t-Test, Moving, Average, Exponential Smoothing | Correlation model | Regression model, Practical Lab	8
III	TABLEAU SOFTWARE: GETTING STARTED WITH TABLEAU SOFTWARE: What is Tableau? What does the Tableau product suite comprise of? How Does Tableau Work? Tableau Architecture, What is My Tableau Repository? Connecting to Data & Introduction to data source concepts, Understanding the Tableau workspace, Dimensions and Measures, Data Types & Default Properties, Building basic views, Saving and Sharing your work-overview, Practical Lab	8
IV	TABLEAU: BUILDING VIEWS (REPORTS): Date Aggregations and Date parts, Cross tab & Tabular charts, Totals & Subtotals, Bar Charts & Stacked Bars, Trend lines, Forecasting, Filters, Context filters, Line Graphs with Date & Without Date, Tree maps, Scatter Plots	8

LIST OF EXPERIMENTS:

Based on above contents.

COURSE OUTCOMES

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

CO 1	Understand the basic of data analytics using concepts of statistics and probability.
CO 2	Understand the needs of data processing techniques.

CO 3	Having computational thinking (Ability to translate vast data into abstract concepts and .to understand database reasoning.
CO 4	Implement the data analytics techniques using R, MATLAB and Python.
CO 5	Apply the data analytics techniques in real life applications.
Text Books	• Mining of Massive Datasets. v2.1, Jure Leskovek, Anand Rajaraman and Jefrey Ullman., Cambridge University Press. (2019). • Big Data Analytics, paperback 2nd ed., Seema Acharya, Subhasini Chellappan, Wiley (2019). • Big Data and Business Analytics, Jay Liebowitz, CRC press (2013) . • Data mining methods,2nd edition, C. Rajan, Narosa (2016).
Reference Books	• "Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few • "Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsky" • "The Accidental Analyst: Show Your Data Who's Boss" by Eileen and Stephen McDaniel

DISCIPLINE SPECIFIC ELECTIVE-X		
COURSE CODE	**CLOUD COMPUTING**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B704		**(LTP: 2-0-2=3)**

Course Objectives:

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.

UNIT	CONTENTS	HOURS
I	Recent Trends in Distributed Computing: P2P Computing, Cluster Computing, Utility Computing, Grid Computing, Cloud Computing, Fog Computing, Jungle Computing, Comparison of various computing technology, Vision of Cloud Computing, Cloud Application.	6
II	Roadmap For Cloud Computing: Cloud Computing Characteristic, Challenges of Cloud Computing, Cloud Adoption And Rudiments, Cloud Computing Environment, Cloud Service Requirement, Cloud And Dynamic Environment, Pro's And Con's Cloud Computing.	6
III	Cloud Virtualization Technology: Virtualization, Characteristic, Virtualization Types, Benefits, Hypervisor Management Software, Advantages of Hypervisor based system, Hypervisor Classification, Virtualization Applications, Storage Virtualization, Network Virtualization, Desktop Virtualization, Compute Virtualization, Application/ Appliance Virtualization, Memory Virtualization, Server Virtualization.	6
IV	Cloud Computing Architecture: Service Oriented Computing, Architecture, Services, Working, Benefit, Cloud Computing NIST Model, Cloud Computing Stack, Cloud Reference Model, Cloud Deployment Model/ Types Of Cloud, Inter Cloud / Federated Cloud, Cloud Federation stack, Cloud Service, Cloud Solution, Cloud Ecosystem, Cloud Business Process Management, Business Process Management Lifecycle, Cloud Service Management, Cloud Offering, Cloud Analytics, Testing Under Control, Mapreduce, HDFS and HADOOP.	6
V	Cloud Management: Cloud Management Platform, Scalability, Fault tolerance, Resiliency, Provisioning, Asset Management, Cloud Governance, High Availability, Disaster Recovery, Multi-Tenancy	6

List of Experiments:

1. Installation and configuration of Hadoop/Euceliptus etc.
2. Service deployment & Usage over cloud.
3. Management of cloud esources.
4. Using existing cloud characteristics & Service models.
5. Cloud Security Management.
6. Performance evaluation of services over cloud.

Course Outcomes

At the end of the course the students should be able to:	
CO1	**Understand** the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
CO2	**Understand** the concepts, characteristics, delivery models and benefits of cloud computing
CO3	**Understand** the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
CO4	**Identify** the technical foundations of cloud systems architectures.
CO5	**Identify** and define technical challenges for cloud applications and assess their importance.
Text Books	• Rehman B T,"CLOUD COMPUTING BASICS", July-2019, Mercury Learning and Information. • Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
Reference Books	• Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010 • Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010

DISCIPLINE SPECIFIC ELECTIVE-X		
COURSE CODE	**COGNITIVE MODELING**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B705		**(LTP: 2-0-2=3)**

Course Objectives:

- To scientifically explain the basic cognitive processes of perception, thinking, problem-solving, decision making, and moving in the environment.
- To develop and test computational models of cognitive processes.
- To present psychological, mathematical, statistical, and computational methods used in different areas of cognitive thinking.

UNIT	CONTENT	HOURS
I	**Introduction to cognitive modeling:** Cognitive models, advantages, practical uses of cognitive models, steps involved in cognitive modeling, introduction to neural networks, semantic nets, reinforcement learning.	6
II	**Quantitative model:** Maximum likelihood estimation, Bechara's simulated gambling task (BSGT), cognitive models on BSGT, parameter estimation, quantitative model comparisons using AIC and BIC, cross-validation and generalization.	6
III	**Qualitative model:** Category learning experiment, models of category learning, qualitative model comparisons.	4
IV	**Basic parameter estimation techniques:** Linear and nonlinear parameter estimation, retention experiment and model, aggregate modeling versus individual modeling, objective function and searching for optimal parameters. Applications of choice and response time measures, signal detection task, dynamic signal detection model, parameter estimation, goodness of fit, lack of fit tests.	7
V	**Connectionist vs Rational approaches** Instance-based learning, k-nearest neighbor learning, case-based reasoning, similarity, activation, neural networks, Rescorla-Wagner/delta rule, multi-layer feed-forward networks, merits and demerits of different learning approaches.	7

LIST OF EXPERIMENTS

1. Install Matlab as a cognitive modeling software
2. Create single-layer perceptron network in Matlab
3. Create models on BSGT in Matlab
4. Simulate parameter estimation on BSGT in Matlab
5. Simulate parameter estimation using retention model in Matlab
6. Simulate parameter estimation using Wiener Diffusion model in Matlab
7. Simulate qualitative model comparison using Exemplar model in Matlab
8. Create & simulate cognitive model for connectionist approach in Matlab

9. Create & simulate cognitive model for rational approach in Matlab 10. Create & simulate multi-layer feed-forward neural network in Matlab	
COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	**Describe**[1] frameworks for modeling human cognition.
CO 2	**Classify**[2] how the cognitive models can be employed in real-world application domains.
CO 3	**Build**[6] running simulation models of cognition
CO 4	**Analyze**[4] performance of various cognitive models
Text Books	• J. Busemeyer and A. Diederich, **Cognitive Modeling**, Sage Publication, 2009 • Konar, **Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain**, CRC Press, 1st edition, 1999
Reference Books	• S. Farrel and S. Stephan, **Computational Modeling in Cognition: Principles and Practice**, Sage Publication, 2010 • R. Sun, **Cognition and Multi-Agent Interaction**, Cambridge University Press, 2006 • B. Hahn, **Essential Matlab for Engineers and Scientists**, Academic Press, 4th edition, 2009

DISCIPLINE SPECIFIC ELECTIVE-XI		
COURSE CODE	**SELF DRIVING CAR**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B706		**(LTP: 2-0-2=3)**

Course Objectives:

This course will introduce you to the terminology, design consideration and safety assessment of self-driving cars.

UNIT	CONTENT	HOURS
I	**Introduction:** What is SDV (self-driving vehicle)? history of SDV technology, benefits offered by SDV technology, need for autonomous cars.	4
II	**Hardware:** Sensors, types of sensors, radars, lidars, ultrasonic sensors, cameras, global navigation satellite system, inertial measurement units, odometry sensors, computing platform, actuator interface, in-vehicle networks.	5
III	**Perception:** Localization, localization based on GNSS, localization based on wheel odometry, localization based on INS, localization based on lidar, localization based on cameras, localization based on multi-sensor data fusion, localization with external references, mapping, SLAM, Kalman filter, particle filter, graph-based SLAM, object detection, feature extraction, classification, multi-sensor data fusion.	7
IV	**Architecture:** Functional architecture, planning, route planning, behavioral planning, motion planning, vehicle control, lane keeping, adaptive cruise control, lane changing, system architecture, hardware layer, middleware layer, application layer, SDV middleware examples, robot operating system, automotive data and time-triggered framework, automotive open system architecture.	7
V	**Putting it all together:** Choosing your vehicle, vehicle network, sensor selection and calibration, open source car control, OSCC controller, X-by-wire systems, OSCC software, sensor drivers, CAN driver, implementing the software, reading vehicle data, recording and visualization, testing, functional safety, challenges, cyber security.	7

COURSE OUTCOMES

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

CO 1	**Understand**[2] commonly used hardware used for self-driving cars
CO 2	**Identify**[1] the main components of self-driving software stack
CO 3	**Program**[3] vehicle modelling and control
CO 4	**Analyze**[4] the safety frameworks and current industry practices for vehicle development
Text Books	Hanky Sjafrie, **Introduction to Self-Driving Vehicle Technology**, CRC Press, 2020
Reference Books	Sumit Ranjan and S. Senthamilarasu, **Applied Deep Learning and Computer Vision for Self-Driving Cars: Build Autonomous vehicles using deep neural networks and behavior-cloning techniques**, Packt, 2020 Lawrence D Burns, **Autonomy: The Quest to Build the Driverless Car – And How it will Reshape Our World**, Harper Collins, 1st edition, 2018

DISCIPLINE SPECIFIC ELECTIVE-XI		
COURSE CODE	**VIRTUAL AND AUGMENTED REALITY**	**Total Lecture: 45** **Theory: 30** **Practical: 15**
AI20B708		**(LTP: 2-0-2=3)**

Course Objectives:

To establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable field of Computer Science.

Integrating AR/VR in development can provide many advantages like: Improved Experience for Learning in sectors like education, Increasing Efficiency In Business, Unmatchable Virtual Experience, Increase In User Engagement, Boost In Brand Loyalty, Mobility, Better Advertising of products and many more.

UNIT	CONTENT	HOURS
I	**Introduction to virtual reality:** Virtual reality and virtual environment: introduction, computer graphics, real-time computer graphics, flight simulation, virtual environment requirement, benefits of virtual reality, historical development of VR, scientific landmark.	6
II	**Computer graphics and geometric modeling:** The virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, color theory, conversion from 2D to 3D, 3D space curves, 3D boundary representation, simple 3D modelling, 3D clipping, illumination models, reflection models, shading algorithms, geometrical transformations: introduction, frames of reference, modelling transformations, instances, picking, flying, scaling the VE, collision detection.	7
III	**Virtual Environment:** Input: tracker, sensor, digital gloves, movement capture, video-based input, 3D menus & 3D scanner etc. Output: visual /auditory / haptic devices. Generic VR system: introduction, virtual environment, computer environment, VR technology, model of interaction, VR systems, animating the virtual environment: introduction, the dynamics of numbers, linear and nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system. physical simulation: introduction, objects falling in a gravitational field, rotating wheels, elastic collisions, projectiles, simple pendulum, springs, flight dynamics of an aircraft.	8
IV	**Augmented Reality:** Taxonomy, technology and features of augmented reality, difference between AR and VR, challenges with AR, AR systems and functionality, augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	5
V	**Development Tools and Frameworks:** Human factors: introduction, the eye, the ear, the somatic senses.	4

COURSE OUTCOMES

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

CO 1	**Understand**[2] fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR
CO 2	**Understand**[2] geometric modeling and virtual environment

CO 3	**Relate**[4] and differentiate VR/AR technology
CO 4	**Use**[3] various types of hardware and software in virtual reality systems
CO 5	**Implement**[3] virtual/augmented reality applications
Text Books	• Grigore C. Burdea, Philippe Coiffet, **Virtual Reality Technology**, Wiley 2016 • Alan B. Craig, **Understanding Augmented Reality, Concepts and Applications**, Morgan Kaufmann, 2013
Reference Books	• Alan Craig, William Sherman and Jeffrey Will, **Developing Virtual Reality Applications, Foundations of Effective Design**, Morgan Kaufmann, 2009. • John Vince, **Virtual Reality Systems**, Pearson Education Asia, 2007 • Anand R, **Augmented and Virtual Reality**, Khanna Publishing House, Delhi

DISCIPLINE SPECIFIC ELECTIVE-XI		
COURSE CODE	**BIOINORMATICS**	**Total Lecture:45** **Theory:30** **Practical:15**
AI20B709		**(LTP=2-0-2=3)**

Course Objectives:

Objective of this course is

- To provide a national bio-information network designed to bridge the inter-disciplinary gaps in biotechnology information.
- To establish link among scientists in organizations involved in R & D and manufacturing activities in biotechnology.
- To build up information resources, prepare database on biotechnology and to develop relevant information handling tools and techniques.

UNIT	CONTENTS	HOURS
I	What is Bioinformatics and its relation with molecular biology Examples of related tools(FASTA,BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer), Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).Applications of Bioinformatics.	06
II	Biological Database and its Types, Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary).Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).	06
III	Data storage and retrieval and Interoperability, Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE	06
IV	Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming, Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.	06
V	Gene Expression and Representation of patterns and relationship, General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS.Introduction to Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.	06

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO 1	Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
CO 2	Explain about the methods to characterize and manage the different types of Biological data.
CO 3	Classify different types of Biological Databases
CO 4	To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
CO5	Overview about biological macromolecular structures and structure prediction methods.
Text Books	• Arachne Gig. Introduction to bioinformatics. • Westhead, Parish and Twyman. Instant notes in bioinformatics.
Reference Books	• David W. Mount. 2005. Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory Press • Baxevanis, D. A and Ouellette, F. B., Bioinformatics: A practical guide to the analysis of Genes and proteins, 2001, (IIndedi) a John Wiley & sons, inc., publication • Mount, W. D.2005. Bioinformatics: Sequence and genomic analysis (2nd eds.) CBS publishers and distributors New Delhi.

COURSE CODE	SUMMER INTERNSHIP PROJECT	Duration: 04 Weeks
AI20B701		**(LTP=0-0-8=4)**
Learning Objective:	• Integrating the knowledge and skills gain through industry exposure. • Develop the skills of critical thinking and evaluation. • To make students to learn themselves by choosing the internship as per there area of interest.	
General Guidelines:	• **STUDENT'S DIARY** The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit. Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria: • Regularity in maintenance of the diary. • Adequacy & quality of information recorded. • Drawings, sketches and data recorded. • Thought process and recording techniques used. • Organization of the information. • **INTERNSHIP REPORT** After completion of Internship, the student should prepare a comprehensive report to indicate observations and learning in the training period. The student may contact Industrial Supervisor/ Faculty Mentor for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, CPDD and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria: i. Originality. ii. Adequacy and purposeful write-up. iii. Organization, format, drawings, sketches, style, language etc. iv. Variety and relevance of learning experience. Practical applications, relationships with basic theory and concepts taught in the course. • **INTERNAL EVALUATION OF INTERNSHIP** Evaluation by faculty supervisor on the basis of internship report/report received by industry. • **EXTERNAL EVALUATION OF INTERNSHIP** Evaluation through seminar presentation/viva-voce at the Institute by external examiner.	

COURSE CODE	MINOR PROJECT	Total Hours:40
AI20B702		(LTP=0-0-16=8)
Learning Objective:	• Integrating the knowledge and skills of various courses available in online mode. • Develop the skills of critical thinking and evaluation. • To make students to learn themselves by choosing the course as per there area of interest.	
General Guidelines:	• This course creates an excellent opportunity for students to acquire the necessary skill set for research, employability through massive open online courses (MOOCs) where the rare expertise of world famous experts from academics and industry are available. • The basket for MOOCs will be a dynamic one, as courses keep on updating with time (Preferable NPTEL/SWAYAM Couses). • In this semester 8 credits will have to be acquired with online courses (MOOCs). Students will have to complete 2 MOOC's of their choice in the VII Semester. • The MOOC-1 carries internal marks of 50, which will be attained after he/she gets the MOOC certificate for which he/she got himself/herself enrolled. For end sem evaluation a Viva-Voce examination shall be conducted and it will carry 50 marks.	

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Hons) CSE –Artificial Intelligence

VIII Semester

School of Advanced Computing

COURSE CODE	MOOC-1	Total Hours:40
MO20B801		(LTP=0-0-8=4)
Learning Objective:	• Integrating the knowledge and skills of various courses available in online mode. • Develop the skills of critical thinking and evaluation. • To make students to learn themselves by choosing the course as per there area of interest.	
General Guidelines:	• This course creates an excellent opportunity for students to acquire the necessary skill set for research, employability through massive open online courses (MOOCs) where the rare expertise of world famous experts from academics and industry are available. • The basket for MOOCs will be a dynamic one, as courses keep on updating with time (Preferable NPTEL/SWAYAM Couses). • In this semester 8 credits will have to be acquired with online courses (MOOCs). Students will have to complete 2 MOOC's of their choice in the VII Semester. • The MOOC-1 carries internal marks of 50, which will be attained after he/she gets the MOOC certificate for which he/she got himself/herself enrolled. For end sem evaluation a Viva-Voce examination shall be conducted and it will carry 50 marks.	

COURSE CODE	MOOC-2	Total Hours:40
MO20B802		(LTP=0-0-8=4)
Learning Objective:	• Integrating the knowledge and skills of various courses available in online mode. • Develop the skills of critical thinking and evaluation. • To make students to learn themselves by choosing the course as per there area of interest.	
General Guidelines:	• This course creates an excellent opportunity for students to acquire the necessary skill set for research, employability through massive open online courses (MOOCs) where the rare expertise of world famous experts from academics and industry are available. • The basket for MOOCs will be a dynamic one, as courses keep on updating with time (Preferable NPTEL/SWAYAM Couses). • In this semester 8 credits will have to be acquired with online courses (MOOCs). Students will have to complete 2 MOOC's of their choice in the VII Semester. • The MOOC-2 carries internal marks of 50, which will be attained after he/she gets the MOOC certificate for which he/she got himself/herself enrolled. For end sem evaluation a Viva-Voce examination shall be conducted and it will carry 50 marks.	

COURSE CODE	MAJOR PROJECT	Total Hours:40
AI20B801		(LTP=0-0-40=20)
Learning Objective:	• Integrating the knowledge and skills of various courses available in online mode. • Develop the skills of critical thinking and evaluation. • To make students to learn themselves by choosing the course as per there area of interest.	
General Guidelines:	• This course creates an excellent opportunity for students to acquire the necessary skill set for research, employability through massive open online courses (MOOCs) where the rare expertise of world famous experts from academics and industry are available. • The basket for MOOCs will be a dynamic one, as courses keep on updating with time (Preferable NPTEL/SWAYAM Couses). • In this semester 8 credits will have to be acquired with online courses (MOOCs). Students will have to complete 2 MOOC's of their choice in the VII Semester. • The MOOC-1 carries internal marks of 50, which will be attained after he/she gets the MOOC certificate for which he/she got himself/herself enrolled. For end sem evaluation a Viva-Voce examination shall be conducted and it will carry 50 marks.	