Learning Outcomes based Curriculum Framework (LOCF)

for

Bachelor of Technology (Computer Science)

B.Tech. (CS)

(Duration 4 Years)

(w.e.f. 2024-25)

Department of Computer Science and Information Technology

School of Technology

MAULANA AZAD NATIONAL URDU UNIVERSITY

1. Vision and Mission

1.1 Vision

To meet the requirements of the society by imparting knowledge, ethics and moral values with a holistic approach.

1.2 Mission

To impart quality education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens embedded with ethical values.

1.3 Strategies for Attaining the Vision and Fulfilling the Mission

Following strategies will be used to ensure the accomplishment of the stated vision and mission:

1. To create an ambiance for healthy teaching-learning process and attract the motivated students to the Department of Computer Science and Information Technology
2. Ensure that the curriculum followed is comparable to the relevance of local, national, regional and global development
3. To motivate the potential faculty members/ educators who are constantly upgrading their pedagogical approaches to motivate students and to enhance learning among them
4. Provide opportunities to students for global exposure, industrial internships, project based and research-based learning

2. Program Educational Objectives

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that CS&IT Department is preparing its graduates to achieve during the graduation. Following four PEOs are defined as:

PEO 1. Graduates using their acquired knowledge, competence and skill sets will develop into globally competent and locally relevant professionals through training and experiential learning enhancing their professional competence throughout their professional career.

PEO 2. Graduates will pursue knowledge and innovation-based development process to find solutions to problems in real life situation that satisfy technical performance specification.

PEO 3. Graduates will play adaptive leadership role in industry, government, education and R&D sectors to boost productivity and contribute economic development.

PEO 4. Graduates will be active members ready to serve the society locally and internationally apart from cultural needs, social awareness and responsibility.

3. Program Outcomes (POs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do upon graduation. POs represent the knowledge, skills and attitudes the

students should have at the end of a program. Following are the statements for POs for CSE program. At the time of completing their degree requirements, students will be able to:

PO_1: Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems **(Engineering Knowledge)**.

PO_2: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (**Problem analysis**).

PO_3: Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations (**Design/development of solutions)**.

PO_4: Use research-based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions **(Conduct investigations of complex problems**).

PO_5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling complex engineering activities with an understanding of limitations (**Modern tool usage**).

PO_6: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The engineer and society)**.

PO_7: Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments (**Environment and sustainability**).

PO_8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (**Ethics**).

PO_9: Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and team work**).

PO_{10}: 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 oral presentations, and give and receive clear instructions (**Communication**).

PO_{11}: Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments (**Project management and finance**).

PO_{12}: 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 (**Life-long Learning**).

4. Program Specific Outcomes (PSOs)

Program Specific Outcomes (PSOs) are the statements that define outcomes of a program which make students realize the fact that knowledge and techniques learnt in a specific course has direct implication for the betterment of society and its sustainability.

PSO 1: The ability to design and develop computing systems using the knowledge of Mathematics, Science and Engineering fundamentals.

PSO 2: Ability to test and analyze the quality of developed applications and to integrate them in order to evolve a larger computing system.

PSO 3: Apply appropriate techniques, resources, and modern engineering and IT tools to address societal, health, safety, legal, and cultural issues.

PSO 4: To analyze and assess various functional and technical security challenges as per local needs and global standards.

PSOs have to be attained by the students in due course of the four years program either as part of their Core, Basic Sciences, Engineering Sciences or as part of their various levels of projects, compulsory courses of Humanities & Social Sciences areas.

5. Mapping between PEOs, POs and PSOs

The following Table lists the relationships between the PEOs, POs. and PSOs. The attainment of POs can be viewed as a strategy for attaining the PEOs. Each PEO is supported by multiple POs to ensure strength in compliance. Also, the relationship between individual PO and PEOs can vary between **Reasonable (1)** and **Strong (3)**.

PEOs	POs												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
PEO1	2	2	1	2	3	2	2	2	2	2	1	2	2	1	2	2
PEO2	2	1	2	1	2	1	1	3	1	1	2	1	2	2	3	2
PEO3	1	2	2	3	3	2	2	1	2	3	1	2	1	3	1	1
PEO4	3	3	1	2	1	1	1	2	1	2	3	2	3	2	2	2

1 – Reasonable

2 – Significant

3 – Strong

6. Course Outcomes (COs)

Course Outcomes are narrower statements that describe what students are expected to know and be able to do at the end of the course. Course outcomes are defined for all courses as part of the syllabus for the course and are measured through performance on assignments, written and oral presentation reports related to individual and team projects and through the mid-term and semester end examinations. Detailed syllabi for each course associated with Course Objectives and Course Outcomes has been for specific outcomes associated with the course. Attaining the COs is at the heart of the educational activity. If COs of individual courses are successfully attained

and the curriculum has been designed to achieve the Program Outcomes, then attainment of the POs is also ensured. An effective Assessment Plan has been devised to meet the objective, quantitative and independent measures to demonstrate that all POs and PEOs are being attained by the program.

7. Continuous Quality Improvement and Assessment Plan

The purpose of the Assessment Plan is to ensure attainment of all Program Outcomes (POs) and also the attainment of the Program Educational Objectives (PEOs) and to independently confirm that the POs and PEOs are being attained. Periodic monitoring of progress allows faculty members and the leadership to take corrective actions where the POs and PEOs are not meeting established targets. The process consists of assessing and evaluating the extent to which the student outcomes are being attained. The results of these assessments and evaluations are subsequently used as the primary inputs for making improvements to the program.

MAULANA AZAD NATIONAL URDU UNIVERSITY

SCHOOL OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & IT

B.Tech. (Computer Science)

General, Course structure & Theme & Semester-wise credit distribution

A. Definition of Credit:		
1	1 Hr. Lecture (L) per week	1 credit
2	1 Hr. Tutorial (T) per week	1 credit
3	2 Hours Practical (Lab)/week	1 credit

B. Range of credits:
A student requires to complete total 180 credits to be eligible to get Under Graduate degree in Engineering.

C. Structure of Undergraduate Engineering program:		
S. No.		Credit Breakup for B.Tech. Students
1	Humanities and Social Sciences including Management courses	09
2	Basic Science courses	24
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	28
4	Professional core courses	66
5	Professional Elective courses relevant to chosen specialization/branch	32
6	Open subjects – Electives from other technical and/or emerging subjects	6
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution]	(non-credit)
Total		**180**

PROFESSIONAL CORE COURSES [PCC]

SL. No.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1	BTCS311PCT	Data Structure & Algorithms	3	1	0	4	3
2	BTCS362PCP	IT Workshop Python	0	0	4	2	3
3	BTCS407PCT	Discrete Mathematics	3	1	0	4	4
4	BTCS511PCT	Computer Organization	3	1	0	4	5
5	BTCS403PCT	Operating Systems	3	1	0	4	4
6	BTCS513PCT	Design & Analysis of Algorithms	3	1	0	4	5
7	BTCS402PCT	Database Management Systems	3	1	0	4	4
8	BTCS512PCT	Formal Language & Automata Theory	3	1	0	4	5
9	BTCS405PCT	Object Oriented Programming	3	1	0	4	4
10	BTCS611PCT	Compiler Design	3	1	0	4	6
11	BTCS612PCT	Computer Networks	3	1	0	4	6
12	BTCS312PCT	Digital Electronics	3	1	0	4	3
					Total	**46**	

PROFESSIONAL ELECTIVE [PEC]

SL. No.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1	PEC	Elective – I	3	1	0	4	5
2	PEC	Elective – II	3	1	0	4	6
3	PEC	Elective – III	3	1	0	4	6
4	PEC	Elective – IV	3	1	0	4	7
5	PEC	Elective – V	3	1	0	4	7
6	PEC	Elective – VI	3	1	0	4	8
7	PEC	Elective – VII	3	1	0	4	7
8	PEC	Elective – VIII	3	1	0	4	8
					Total	**32**	

OPEN ELECTIVE [OEC]

SL. No.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1	OEC	Open Elective – I	3	0	0	3	6
2	OEC	Open Elective – II	3	0	0	3	7
					Total	**6**	

MAULANA AZAD NATIONAL URDU UNIVERSITY

DEPARTMENT OF CS&IT

SCHEME OF INSTRUCTIONS, EXAMINATION & EVALUATION

(Effective for Batch Admitted from 2022-23 Academic Year)

B.Tech. (Computer Science)

Total Credits (4 Year Course): 180

I. **INDUCTION PROGRAM (PLEASE REFER APPENDIX-A FOR GUIDELINES)**	
Induction Program (mandatory)	**3 Weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	▪ Physical activity ▪ Creative Arts ▪ Universal Human Values ▪ Literary ▪ Proficiency Modules ▪ Lectures by Eminent People ▪ Visits to local Areas ▪ Familiarization to Dept./Branch & Innovations

Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

INITIAL PHASE	
Time	**Activity**
DAY-0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre-allotment)
DAY-1	
09:00 am - 03:00 pm	Academic registration
04:30 pm - 06:00 pm	Orientation
DAY-2	
09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective department
12:30 pm - 01:55 pm	Lunch
02:00 pm - 02:55 pm	Director's address
03:00 pm - 05:00 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)
Regular Phase	
After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.	
3.2.1 Daily Schedule	
Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.	

Session.	Time	Activity	Remarks
Day 3 onwards			
	06:00 am	Wakeup call	
I	06:30 am - 07:10 am	Physical activity (mild exercise/yoga)	
	07:15 am - 08:55 am	Bath, Breakfast, etc.	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	
		Half the groups do Creative Arts	
III	11:00 am - 12:55 pm	Universal Human Values /	
		Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	Lunch	
IV	02:30 pm - 03:55 pm	Afternoon Session See below.	
V	04:00 pm - 05:00 pm	Afternoon Session See below.	
	05:00 pm - 05:25 pm	Break / light tea	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	Rest and Dinner	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off and Saturdays have the same schedule as above or have outings.

Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	Session	Remarks
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	for 3- days For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

Closing Phase

Time	Activity
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

II. **SEMESTER WISE STRUCTURE OF CURRICULUM**
[L= Lecture, T= Tutorials, P=Practical, C= Credits]

PROGRAM		**YEAR**				**SEMESTER**			
B.Tech. (CS)		I				I			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS101BST	Basic Science	Engineering Mathematics-I	3	1	0	4	30	70	3 Hrs
BTCS102BST	Basic Science	Engineering Physics	3	1	0	4	30	70	3 Hrs
BTCS101EST	Engineering Science	Basic Electrical Engineering	3	1	0	4	30	70	3 Hrs
BTCS111EST	Engineering Science	Engineering Graphics & Design	1	1	4	4	30	70	3 Hrs
BTCS150BSP	Basic Science	Engineering Physics Lab	0	0	4	2	50	50	3 Hrs
BTCS150ESP	Engineering Science	Basic Electrical Engineering Lab	0	0	4	2	50	50	3 Hrs
Total Credits per semester						**20**	**600**		
Mandatory Induction Program- 3 Weeks Duration									
Note: End Semester Examinations of the subject(s) weighted more than 2 credits will be for three Hrs duration with maximum 100 marks score (30+70)									

PROGRAM		**YEAR**				**SEMESTER**			
B.Tech. (CS)		I				II			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS201BST	Basic Science	Engineering Mathematics – II	3	1	0	4	30	70	3 Hrs
BTCS211BST	Basic Science	Engineering Chemistry	3	1	0	4	30	70	3 Hrs
BTCS211EST	Engineering Science	Programming for Problem Solving	3	1	0	3	30	70	3 Hrs
BTCS211HST	Humanities & Social Sciences including Management	English Communication	2	0	0	2	15	35	2 Hrs
BTCS212EST	Engineering Science	Engineering Mechanics	3	1	0	4	30	70	3 Hrs
BTCS260BSP	Basic Science	Engineering Chemistry Lab	0	0	4	2	50	50	3 Hrs
BTCS260ESP	Engineering	Basic Programming	0	0	4	2	50	50	3 Hrs

	Science	Lab							
BTCS251ESP	Engineering Science	Engineering Workshop	0	0	6	3	50	50	3 Hrs
BTCS260HSP	Humanities & Social Sciences including Management	English Communication LAB	0	0	2	1	50	50	3 Hrs
		Total				**25**	**850**		

PROGRAM		**YEAR**				**SEMESTER**			
B.Tech. (CS)		II				III			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS311EST	Engineering Science Course	Analog Electronic Circuits	3	1	0	4	30	70	3 Hrs
BTCS311PCT	Professional Core Courses	Data structure & Algorithms	3	1	0	4	30	70	3 Hrs
BTCS312PCT	Professional Core Courses	Digital Electronics	3	1	0	4	30	70	3 Hrs
BTCS311BST	Basic Science course	Engineering Mathematics-III	3	1	0	4	30	70	3 Hrs
BTCS311HST	Humanities & Social Sciences including Management courses	Technology & Society	2	0	0	2	15	35	2 Hrs
BTCS360ESP	Engineering Science Course	Analog Electronic Circuits LAB	0	0	4	2	50	50	3 Hrs
BTCS360PCP	Professional Core Courses	Data structure & Algorithms LAB	0	0	4	2	50	50	3 Hrs
BTCS361PCP	Professional Core Courses	Digital Electronics LAB	0	0	4	2	50	50	3 Hrs
BTCS362PCP	Professional Core Courses	IT Workshop Python	0	0	4	2	50	50	3 Hrs
BTCS312HST	Mandatory Courses	Environmental Sciences	2	0	0	-	15	35	2 Hrs
		Total				**26**	**900**		

PROGRAM		YEAR				SEMESTER			
B.Tech. (CS)		II				IV			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS402PCT	Professional Core Courses	Database Management Systems	3	1	0	4	30	70	3 Hrs
BTCS403PCT	Professional Core Courses	Operating Systems	3	1	0	4	30	70	3 Hrs
BTCS405PCT	Professional Core Courses	Object Oriented Programming	3	1	0	4	30	70	3 Hrs
BTCS406PCT	Professional Core Courses	Software Engineering	3	1	0	4	30	70	3 Hrs
BTCS407PCT	Professional Core Courses	Discrete Mathematics	3	1	0	4	30	70	3 Hrs
BTCS451PCP	Professional Core Courses	Database Management Systems LAB	0	0	4	2	50	50	3 Hrs
BTCS452PCP	Professional Core Courses	Operating Systems LAB	0	0	4	2	50	50	3 Hrs
BTCS453PCP	Professional Core Courses	Object Oriented Programming LAB	0	0	4	2	50	50	3 Hrs
		Total				**26**	**800**		

PROGRAM		YEAR				SEMESTER			
B.Tech. (CS)		III				V			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS511PCT	Professional Core Courses	Computer Organization	3	1	0	4	30	70	3 Hrs
BTCS512PCT	Professional Core Courses	Formal Language & Automata Theory	3	1	0	4	30	70	3 Hrs
BTCS513PCT	Professional Core Courses	Design & Analysis of Algorithms	3	1	0	4	30	70	3 Hrs
BTCS511HST	Humanities & Social Sciences including	Organizational Behaviour	2	0	0	2	15	35	2 Hrs

	Management								
BTCS512HST	Humanities & Social Sciences including Management	History of Sciences & Technology in India	2	0	0	2	15	35	2 Hrs
BTCS51XPET	Professional Elective Courses	Elective-I	3	1	0	4	3	70	3 Hrs
BTCS560PCP	Professional Core Courses	Design & Analysis of Algorithms LAB	0	0	4	2	50	50	3 Hrs
BTCS511NCT	Mandatory Courses	Constitution of India	2	0	0	-	15	35	2 Hrs
		Total				**22**	**650**		

PROGRAM		**YEAR**				**SEMESTER**			
B.Tech. (CS)		III				VI			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS611PCT	Professional Core Courses	Compiler Design	3	1	0	4	30	70	3 Hrs
BTCS612PCT	Professional Core Courses	Computer Networks	3	1	0	4	30	70	3 Hrs
BTCS61XPET	Professional Elective Courses	Elective-II	3	1	0	4	30	70	3 Hrs
BTCS61XPET	Professional Elective Courses	Elective-III	3	1	0	4	30	70	3 Hrs
UGCS61XGET	Open Elective Courses	Open Elective-I	3	0	0	3	30	70	3 Hrs
BTCS660PCP	Professional Core Courses	Compiler Design LAB	0	0	4	2	50	50	3 Hrs
BTCS661PCP	Professional Core Courses	Computer Networks LAB	0	0	4	2	50	50	3 Hrs
BTCS662PCP	Project	Project-1	0	0	6	3	50	50	Viva-voce & Demonstration
		Total				**26**	**800**		

PROGRAM		YEAR				SEMESTER			
B.Tech. (CS)		IV				VII			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS71XPET	Professional Elective Courses	Elective-IV	3	1	0	4	30	70	3 Hrs
BTCS71XPET	Professional Elective Courses	Elective-V	3	1	0	4	30	70	3 Hrs
UGCS71XGET	Open Elective Courses	Open Elective-II	3	0	0	3	30	70	3 Hrs
BTCS760PCP	Project	Project-II	0	0	12	6	100	100	Viva-voce & Demonstration
		Total				**17**	**500**		

PROGRAM		YEAR				SEMESTER			
B.Tech. (CS)		IV				VIII			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
BTCS83XPET	Professional Elective Courses	Elective-VI	3	1	0	4	30	70	3 Hrs
BTCS83XPET	Professional Elective Courses	Elective-VII	3	1	0	4	30	70	3 Hrs
BTCS83XPET	Professional Elective Courses	Elective-VIII	3	1	0	4	30	70	3 Hrs
BTCS860PCP	Project	Project-III	0	0	12	6	100	100	Viva-voce & Demonstration
		Total				**18**	**500**		

PROFESSIONAL COURSES –ELECTIVE-I IN FIFTH SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
BTCS511PET	Principles of Programming Languages	3	1	0	4	30	70	3 Hrs
BTCS512PET	Parallel and Distributed Algorithms	3	1	0	4	30	70	3 Hrs
BTCS513PET	Signal and Systems	3	1	0	4	30	70	3 Hrs
BTCS514PET	Data Science	3	1	0	4	30	70	3 Hrs

PROFESSIONAL COURSES –ELECTIVE-II & ELECTIVE-III FOR SIXTH SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
BTCS611PET	Data Mining and Data Warehousing	3	1	0	4	30	70	3 Hrs
BTCS612PET	Python Programming	3	1	0	4	30	70	3 Hrs
BTCS613PET	Advanced Computer Architecture	3	1	0	4	30	70	3 Hrs
BTCS614PET	Distributed Systems	3	1	0	4	30	70	3 Hrs
BTCS615PET	Computer Graphics	3	1	0	4	30	70	3 Hrs
BTCS616PET	Advanced Operating Systems	3	1	0	4	30	70	3 Hrs
BTCS617PET	Embedded Systems	3	1	0	4	30	70	3 Hrs
BTCS618PET	Data Visualization using R programming	3	1	0	4	30	70	3 Hrs
Elective-II BTCS611PET **Data Mining and Data Warehousing** BTCS612PET **Python Programming** BTCS613PET **Advanced Computer Architecture** BTCS614PET **Distributed Systems**					**Elective-III** BTCS615PET **Computer Graphics** BTCS616PET **Advanced Operating Systems** BTCS617PET **Embedded Systems** BTCS618PET **Data Visualization using R programming**			

PROFESSIONAL COURSES -ELECTIVE-IV & ELECTIVE-V FOR SEVENTH SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
BTCS711PET	Artificial Intelligence	3	1	0	4	30	70	3 Hrs
BTCS712PET	Block Chain Technology	3	1	0	4	30	70	3 Hrs
BTCS713PET	Real Time System	3	1	0	4	30	70	3 Hrs
BTCS714PET	Ad-Hoc and Sensor Network	3	1	0	4	30	70	3 Hrs
BTCS715PET	Internet-of-Things	3	1	0	4	30	70	3 Hrs
BTCS716PET	Machine Learning	3	1	0	4	30	70	3 Hrs
Elective-IV BTCS711PET **Artificial Intelligence** BTCS712PET **Block Chain Technology** BTCS713PET **Real Time System**					**Elective-V** BTCS714PET **Ad-Hoc and Sensor Network** BTCS715PET **Internet-of-Things** BTCS716PET **Machine Learning**			

PROFESSIONAL COURSES -ELECTIVE-VI, VII FOR EIGTH SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
BTCS831PET	Image Processing	3	1	0	4	30	70	3 Hrs
BTCS832PET	Data Analytics	3	1	0	4	30	70	3 Hrs
BTCS833PET	Neural Networks and Deep Learning	3	1	0	4	30	70	3 Hrs
BTCS834PET	Cloud Computing	3	1	0	4	30	70	3 Hrs
BTCS835PET	Human Computer Interaction	3	1	0	4	30	70	3 Hrs
BTCS836PET	Web and Internet Technology	3	1	0	4	30	70	3 Hrs
BTCS837PET	Cryptography and Network Security	3	1	0	4	30	70	3 Hrs
BTCS838PET	Soft Computing	3	1	0	4	30	70	3 Hrs
BTCS839PET	Speech and Natural Language Processing	3	1	0	4	30	70	3 Hrs

Elective-VI	**Elective-VII**	**Elective-VII**
BTCS831PET **Image Processing** BTCS832PET **Data Analytics** BTCS835PET **Human Computer Interaction**	BTCS834PET **Cloud Computing** BTCS836PET **Web and Internet Technology** BTCS837PET **Cryptography and Network Security**	BTCS833PET **Neural Networks and Deep Learning** BTCS838PET **Soft Computing** BTCS839PET **Speech and Natural Language Processing**

OPEN ELECTIVE-I:

A Student need to opt any one subject from the following open electives to be offered by the other Departments

Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
UGCS611GET	Soft Skill and Interpersonal Communication	3	0	0	3	30	70	3 Hrs
UGCS612GET	Human Resource Development and Organizational Behavior	3	0	0	3	30	70	3 Hrs
UGCS613GET	Cyber Law and Cyber Security	3	0	0	3	30	70	3 Hrs
UGCS614GET	Comparative Study of Modern Indian Languages	3	0	0	3	30	70	3 Hrs
UGCS615GET	Biology (Basic Science Course)	3	0	0	3	30	70	3 Hrs

OPEN ELECTIVE-II:

A Student need to opt any one subject from the following open electives to be offered by the other Departments

Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
UGCS711GET	Intellectual Property Rights	3	0	0	3	30	70	3 Hrs
UGCS712GET	History of Science	3	0	0	3	30	70	3 Hrs
UGCS713GET	Values & Ethics	3	0	0	3	30	70	3 Hrs
UGCS714GET	Economic Policies in India	3	0	0	3	30	70	3 Hrs

Course Code	Course Title	Lecture			
BTCS101BST	Engineering Mathematics-I	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics

Course Objectives:

1. To understand the concept of the matrix and applying to various engineering problems.
2. To provide the concept of Eigen values and eigenvectors.
3. To acquire the concept of mean value theorems and successive differentiation.
4. To impart the concept of partial derivatives of first and higher orders in the field of engineering and technology.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Apply differential and integral calculus to notions of curvature to improper integrals and various engineering problems.	PO_1, PO_2
CO_2	Find the rank of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.	PO_3, PO_5
CO_3	Evaluate the partial derivatives of first and higher orders.	PO_4
CO_4	Demonstrate various applications with basic understanding of Beta and Gamma functions.	PO_3, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	3										
CO_2			2		2							
CO_3				2								
CO_4			2									2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Matrices:** Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination. Cayley-Hamilton's theorem (without proof) and its applications
Unit: 2	**Vector spaces:** Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.
Unit: 3	**Vector spaces:** Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.
Unit: 4	**Calculus- I: Mean value theorems:** Rolle's mean value theorem, Lagrange's mean value theorem and Cauchy's mean value theorem (All Theorems without proof); problems on it. **Successive differentiation**: standard results; Leibnitz's theorem; Expansions of functions: , Taylor's and Maclaurin's series with remainders (All Theorems without proof); Maxima and minima for function of one variable.
Unit: 5	**Calculus-II:** **Partial Differentiation:** Partial derivatives of first and higher orders, Homogeneous functions, Euler's Theorem; Total derivative; Change of variables.

	Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. **Multiple Integrals and Their Applications:** Double integrals and their evaluation; Change of order for integration; Double integrals in polar coordinates; Triple integrals; Application of multiple integrals to find area, volume, surface area
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2	Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3	D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
Reference Books:	
1	H. Anton, C. Rorres, Elementary Linear Algebra with Supplemental Applications, 11th Edition, Wiley Student Edition, New Delhi (2011)
2	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3	M. D. Weir, J. Hass, Thomas' Calculus,12th Edition, Pearson India Education Services Pvt Ltd., New Delhi (2016).
4	V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Code	Course Title	Lecture			
BTCS102BST	Engineering Physics	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Physics

Course Objectives:

1. To acquire competency in the field of engineering with adaptability to new development in science and technology.
2. To demonstrate various scientific principles, engineering methods and technological development.
3. To learning basic properties and characteristics of light, double slit and triple slit interference, Newton's rings, interference in thin films.
4. To understand the concept of elementary particles and conservation laws.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the Bragg's Law and the principles of lasers, types of lasers and applications.	**PO_1**
CO_2	Apply various terms related to properties of materials such as, permeability, polarization, etc.	**PO_1, PO_2**
CO_3	Analyze some of the basic laws related to quantum mechanics as well as magnetic and dielectric properties of materials.	**PO_2, PO_3, PO_4**
CO_4	Analyze and evaluate and simple quantum mechanics calculations.	**PO_2, PO_3**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3											
CO_2	2	1										
CO_3		1	2	2								
CO_4		2	2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications. Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.
Unit: 2	Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres. Lasers: Introduction to interaction of radiation with matter, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, types of laser: solid state, semiconductor, gas; application of lasers.
Unit: 3	Electromagnetism : Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics.
Unit: 4	Magnetic Properties of Materials :Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications. Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect.

Unit: 5	Quantum Mechanics: de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Beiser : Modern Physics
2	Mani and Damask : Modern Physics
Reference Books:	
1	Resnick and Halliday : Physics
2	M. Ratner & D. Ratner (Pearson Ed.): Nanotechnology
3	A.J. Decker (Macmillan): Solid State Physics

Course Code	Course Title	Lecture			
BTCS101EST	Basic Electrical Engineering	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics and Physics

Course Objectives:

1. To introduce fundamental concepts and analysis techniques in electrical engineering.
2. To provide knowledge about the basic DC and AC electric circuits and magnetic circuits.
3. To impart the concepts of generators, motors, transformers and their applications.
4. To gain knowledge about the fundamentals of wiring and earthling.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understanding of the basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global.	**PO_1, PO_2, PO_3**
CO_2	Illustrate an understanding of basic concepts of analysis of simple DC and AC circuits used in electrical and electronic devices	**PO_2, PO_3, PO_6**
CO_3	Demonstrate an understanding of selection skill to identify the type of motors required for particular application.	**PO_2, PO_3**
CO_4	Analyze and evaluate the effects of electric shock and precautionary measures.	**PO_1, PO_4, PO_7**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	2	1									
CO_2		2	2			1						
CO_3		2	2									
CO_4	3			1			2					

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.
Unit: 2	**AC Circuits:** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three-phase balanced circuits, voltage and current relations in star and delta connections.
Unit: 3	**Transformers:** Magnetic materials, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.
Unit: 4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.
Unit: 5	**Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries,

	Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
Reference Books:	
1	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Code	Course Title	Lecture			
BTCS111EST	Engineering Graphics & Design	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	1	1	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Theory & Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics and Physics

Course Objectives:

1. To understand the concept of imagination skills.
2. To acquire the knowledge of developing basic graphic skills.
3. To develop skills in reading and interpretation of engineering Drawings.
4. To impart the knowledge of principles of Isometric Projection, Isometric scale, Isometric Views- Conventions Plane Figures, Simple and Compound Solids.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Get acquainted with the knowledge of various lines, geometrical constructions and construction of various kinds of scales, and Ellipse.	**PO_1, PO_3, PO_9**
CO_2	Improve their imagination skills by gaining knowledge about points, lines and planes.	**PO_2, PO_3, PO_5, PO_9**
CO_3	Become proficient in drawing the projections of various solids	**PO_2, PO_5, PO_6, PO_9**
CO_4	Gain knowledge about orthographic and isometric projections.	**PO_2, PO_4, PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2						1			
CO_2		1	1		2				1			
CO_3		2			2	3			1			
CO_4		2		1	2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Engineering Drawing** covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.
Unit: 2	**Projections of Points and Straight Line**: Point placed in different quadrants. Projections of straight lines - Parallel, perpendicular, inclined to one plan and inclined to planes. True lengths and true angle of a line. Traces of a line. **Projections of Planes:** Projections of regular planes parallel, perpendicular and inclined to one reference plane. Plane inclined to both the reference plane.
Unit: 3	**Projections of Solids**: Projections of regular solids, cube, prism, pyramids, tetrahedran, cylinder and cone, axis inclined to one and both the references plane
Unit: 4	**Sections and Sectional Views:** True shape of section, Right Regular Solids- Prism, Cylinder, Pyramid, Cone.
Unit: 5	**Isometric Projections**: Principles of Isometric Projection, Isometric scale, Isometric views- Conventions Plane Figures, Simple and Compound Solids. **Customisation & CAD Drawing** consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
Reference Books:	
1	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
2	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
3	(Corresponding set of) CAD Software Theory and User Manuals

Course Code	Course Title	Lecture			
BTCS150BSP	Engineering Physics Lab.	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Physics

Course Objectives:

1. To acquire competency in the field of engineering.
2. To demonstrate to new development in physics laboratory by successfully completing the experiments.
3. To understand and learn basic theory and principles of science.
4. To experiment Thermo electric effect – Seebeck effect and Peltier effect.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Learn basic properties and characteristics of light, Double slit and triple slit interference, Newton's rings, interference in thin films.	PO_1, PO_6
CO_2	Apply the working principle of LASER, laser action, population inversion, Einstein coefficients, elementary laser types and applications of LASER.	PO_3, PO_5
CO_3	Analyze magnetic field and forces, electric field and usage of quantum theory.	PO_2, PO_4
CO_4	Evaluate Thermo electric effect – Seebeck effect and Peltier effect	PO_3, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2					2						
CO_2			2		1							
CO_3		1		1								
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Determine the radius of Curvature of Plano convex lens by forming Newton's rings.
2. Determine the Numerical aperture of the given optical fibre by using Laser diode.
3. Draw the current Voltage (V-I) Characteristics of the given P-N-Junction diode.
4. Determine the plank's constant using photocell (Frequency of Blue- 7.406x1014 Hz, Green- 6x1014, Orange 5.26x1014 , Red- 4.68x 1014).
5. Determine the Physical Characteristics of the given Thermistor.
6. Determine the specific rotation of liquid by using polarimeter.
7. Determine the Energy gap of given semiconductor.
8. Determine the wavelength of a given laser source using diffraction grating

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Beiser : Modern Physics
2	Mani and Damask : Modern Physics

Reference Books:

1	Resnick and Halliday : Physics
2	C. Kittel (Wiley Eastern): Introduction to Solid Stat

Course Code	Course Title	Lecture			
BTCS150ESP	Basic Electrical Engineering Lab	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:**	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic Electrical Engineering

Course Objectives:

1. To experiment the basics of Single and Three Phase transformers.
2. To acquire the concepts of D.C. Machines, construction, armature reaction and characteristics.
3. To understand the basic concept of a Three-phase induction motor and its torque slip characteristics.
4. To evaluate the efficiency of the different machines by analyzing their test results.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Explain the concept of circuit laws and network theorems and apply them to laboratory measurements.	**PO_1, PO_2, PO_6**
CO_2	Understand to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both DC Machines and single-phase transformer.	**PO_3, PO_6**
CO_3	Analyze the principles of operation and the main features of electric machines and their applications	**PO_9**
CO_4	Evaluate the skills in using electrical measuring devices.	**PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	1	1				1						
CO_2			1			1						
CO_3									1			
CO_4				1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Verification of Thevenin's and Norton Theorems.
3. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
5. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
6. To Determine the Performance Characteristics of a Series Motor.
7. To Determine the Performance Characteristics of a Shunt Motor.
8. To Determine the Performance Characteristics of a Compound Motor.
9. Speed Control of DC Shunt Motor.
10. To Determine the Load Characteristics of a Shunt Generator.
11. To Determine the Load Characteristics of a Single Phase Induction Motor.

12. To Determine the Performance Characteristics of a Three Phase Induction Motor. 13. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement). 14. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed. 15. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation. 16. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Basic Electrical Engineering, S.N. Singh, PHI, Learning Private Limited.
2	Electrical Machines M. N. Bandyopadhya, PHI, Learning Private Limited.
Reference Books:	
1	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
2	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
3	(Corresponding set of) CAD Software Theory and User Manuals

Course Code	Course Title	Lecture			
BTCS201BST	Engineering Mathematics-II	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics

Course Objectives:

1. To familiarize the students with statistical techniques.
2. To equip the students with standard concepts and tools.
3. To impart the concept of Measures of Central tendency.
4. To acquire the knowledge of Chi-square test for goodness of fit and independence of attributes.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the ideas of probability and random variables and various discrete	**PO_1**
CO_2	Apply continuous probability distributions and their properties.	**PO_2, PO_3**
CO_3	Analyze the basic ideas of statistics including measures of central tendency, correlation and regression.	**PO_3, PO_4**
CO_4	Evaluate the statistical methods of studying data samples.	**PO_5, PO_6, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2	2									
CO_3			2	2								
CO_4					1	1						2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Basic Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.
Unit: 2	**Continuous Probability Distributions:** Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. **Bivariate Distributions:** Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.
Unit: 3	**Basic Statistics:** Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.
Unit: 4	**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.
Unit: 5	**Small samples:** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2	P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.
3	S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4	W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
Reference Books:	
1	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
3	Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Code	Course Title	Lecture			
BTCS211BST	Engineering Chemistry	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Chemistry

Course Objectives:

1. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To impart the knowledge of synthetic aspects useful for understanding reaction pathways.
4. To acquire the skills pertaining to spectroscopy and to apply them for medical and other field.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the knowledge of atomic, molecular and electronic changes, band theory related to conductivity.	PO_1, PO_2
CO_2	Apply the required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.	PO_3
CO_3	Analyze the knowledge of configurational and conformational analysis of molecules and reaction mechanisms.	PO_2, PO_4
CO_4	Evaluate the required skills to get clear concepts on basic spectroscopy and application to medical and other fields.	PO_4, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1										
CO_2			1									
CO_3		2		1								
CO_4				1	1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Molecular structure and Theories of Bonding:** Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N2, O2 and F2 molecules. π molecular orbitals of butadiene and benzene. Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance
Unit: 2	**Water Treatment:** Hardness of water, types of hardness, unites of hardness of water, determination of hardness of water by EDTA method. Boiler troubles - scale and sludge formation in boilers, caustic embrittlement, priming and foaming, Softening of water- Lime soda, permutit and ion exchange process. Problems
Unit: 3	**Electrochemistry and corrosion:** Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

	Causes and Theories of corrosion – Chemical and electrochemical corrosion, Water line and pitting corrosion; Factors affecting rate of corrosion – Nature of metal and Nature of environment. Corrosion control Methods: using pure metal and alloys, modifying the environment, cathodic protection (sacrificial anodic and impressed current cathodic). Surface coatings: Metallic coatings & methods of application of metallic coatings – hot dipping (galvanization & tinning), electroplating
Unit: 4	**Reactivity of Organic Molecules & Types of Reaction and Mechanism :** Inductive effect, Resonance or Mesomeric effect, Electromeric effect, Hyper conjugation, Carbocation, Carbanion & Free radical. Substitution, Addition and Elimination reaction.;Mechanism of the following reactions Aldol condensation, Cannizzaro reaction, Hoffmann reaction & Diels-Alder reaction
Unit: 5	**Spectroscopic techniques and applications**: Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
2	Engineering Chemistry by P.C Jain & Monica Jain, Dhanpatrai Publishing Company (2008)
Reference Books:	
1	Fundamentals of Molecular Spectroscopy, by C. N. Banwell
2	Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.
3	Engineering Chemistry by S.S. Dara & Mukkati S. Chand & Co,New Delhi(2006)
4	Engineering Chemistry – Shasi Chawla, Dhantpat Rai publishing Company, NewDelhi (2008).
5	Engineering Chemistry – R. Gopalan, D. Venkatappayya, D.V. Sulochana Nagarajan – Vikas Publishers (2008)
6	Engineering Chemistry J.C. Kuriacase & J. Rajaram, Tata McGraw Hills co., New Delhi (2004).

Course Code	Course Title	Lecture			
BTCS211EST	Programming for Problem Solving	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific requisites

Course Objectives:

1. To understand the various steps in program development.
2. To impart the basic concepts in C programming language.
3. To acquire how to write modular and readable C programs.
4. To learn to write programs (using structured programming approach) in C to solve problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand various problem-solving techniques and implement them in 'C' language.	**PO_1, PO_2**
CO_2	Apply the basic terminology used in computer programming and write, compile and debug programs in C language.	**PO_3,**
CO_3	Develop programs involving decision structures, loops and functions using different data types and data structures.	**PO_3, PO_4**
CO_4	Apply and analyze logical skills to program in C language.	**PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	2										
CO_2			2									
CO_3			2	1								
CO_4				1	1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Introduction to programming – definitions and developing Algorithms and flowcharts for simple programs. Introduction to C Programming: Origin and history of c programming character set, Identifiers and keywords data types, constants, variables operators, symbolic constants, Expressions, compound statements, structure of C program, Input and output function.
Unit: 2	C Statements – selection statements – if nested if's, the if-else –if ladder the conditional expressions, switch statement nested switch statements, iteration statements – the for loop, for loop variations, the while loop, the do-while loop, declaring variable with in selection and iteration statements, jump statement, the return statement, the go to submit, break statement, exit( ) function, the continue statement, expression statement. Block statements.
Unit: 3	Arrays – Array what is an array? – Array Declaration, Array Initialization – Accessing individual elements of an array – Two Dimensional Arrays – Passing an array element to a function – Rules of using an array. What are strings? String I/O, string Manipulation Functions – The General Form of a Function, elements of function, function categories, types of functions, Function Arguments Call by value, Call by Reference, return statement. Uses of functions. C pre – processor, storage classes – Automatic – Register, Static and external.

Unit: 4	Pointers – definition, pointer variables, pointer expressions, arithmetic pointers, pointers and arrays, initializing pointers and functions and problems with pointers. Structures – definition, accessing structure members, structure assignments, array of structures, passing structures, structure pointers, uses of structures Unions – definitions, difference between structure and union, type def. Files – introduction to streams and files, basics of files – file pointer, opening and closing files, writing and reading character, file functions.
Unit: 5	Principles of OOP: Programming paradigms, basic concepts, benefits of OOP, applications of OOP Introduction to C++: History of C++, structure of C++, basic data types, type casting, type modifiers, operators and control structures, input and output statements in C++. Classes and objects: class specification, member function specification, scope resolution operator, access qualifiers, instance creation.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Let Us C by Yashwanth Kanethar.
2	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

Reference Books:

1	Object Oriented Programming with C++ By E.Balaguruswamy.
2	Programming in C, 2nd Edition, Oxford by Pradip Dey, Mannas Ghosh.

Course Code	Course Title	Lecture			
BTCS211HST	English Communication	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	4	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	2 Hrs.

Prerequisite(s): No specific prerequisites.

Course Objectives:

1. To understand the concept of enhancement of the soft and communication skills.
2. To acquire the phonetics & developing vocabulary.
3. To impart the writing applications, letters formal and non-formal, technical writing.
4. To learn the concept of portfolio writing and resume writing.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Read and write paragraphs in English confidently	**PO_6, PO_{10}**
CO_2	Differentiate among homonyms, homophones, synonyms and antonyms.	**PO_6, PO_{10}**
CO_3	Read and write the specific details and information such as writing applications, formal letters, CVs, technical reports and project reports.	**PO_{12}**
CO_4	Communicate with more confident among students, teachers & other stakeholders of the society.	**PO_8, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2				3		
CO_2						2				3		
CO_3												3
CO_4								1				3

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Oral Communication: 1.1. Communication: Verbal and Non-Verbal 1.2. Conversations and Dialogues 1.3. JAM Sessions and Group Discussions 1.4. Presentation Skills and Interview Skills
Unit: 2	Writing Communication: 2.1. Subject-verb agreement 2.2. Précis Writing and Essay Writing 2.3. Letter Writing and Cover Letters 2.4. Portfolio Writing and Resume Writing

Examination and Evaluation Pattern: It include both internal evaluation (15 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (35 marks) which is mainly end semester examination.

Text Books:

1	Habeeb,G. (2013) *English for Speakers of Urdu: A Proficiency Course*: Orient Black swan
2	Koneru, A. (2015) *Professional Speaking Skills*.OUP.
3	Kumar, S. & P. Lata (2015). *Communication Skills*. New Delhi: OUP.

Reference Books:

1	O'Brien, T. (2011). *Modern Writing Skills*. New Delhi: Rupa
2	Raymond, M. (2013). *English Grammar in Use*. Cambridge: CUP.
3	Taylor, G. (2009). *English Conversation Practice*. Tata McGraw-Hill.

Course Code	Course Title	Lecture			
BTCS212EST	Engineering Mechanics	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Mathematics & Engineering Physics

Course Objectives:

1. To understand distributed force systems, centroid/ center of gravity and method of finding centroids of composite figures and bodies
2. To acquire the moment of inertia and method of finding moment of inertia of areas and bodies.
3. To interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc.
4. To learn the kinetics of the rigid bodies and solve simple problems using work-energy method.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify the significance of centroid/ centre of gravity and find centroids of composite figures and bodies.	**PO_1, PO_2, PO_9**
CO_2	Understand the moment of inertia and method of finding moment of inertia of areas and bodies	**PO_3, PO_6**
CO_3	Interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc.,	**PO_6**
CO_4	Understand the kinetics of the rigid bodies and solve simple problems using work-energy method.	**PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2							1			
CO_2			2			2						
CO_3						2						
CO_4									1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Engineering Mechanics covering**- Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.
Unit: 2	**Friction covering-** Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.
Unit: 3	**Centroid and Centre of Gravity Covering**-Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere.
Unit: 4	**Review of Particle Dynamics-** Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates).

	Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular).
Unit: 5	**Introduction to Kinetics of Rigid Bodies Covering-**Basic terms, general principles in dynamics; Types of motion, Instantaneous center of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill.
2	R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
Reference Books:	
1	Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications.
2	Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

Course Code	Course Title	Lecture			
BTCS260BSP	Engineering Chemistry Lab.	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Chemistry

Course Objectives:

1. To acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
2. To impart practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.
3. To develop the experimental skills both manually and by instrumentation of "qualitative and quantitative analysis" of solutions.
4. To impart with basic titration set up and methodologies for determining strength, hardness and alkalinity of various unknown solutions and water samples.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.	**PO_1, PO_3, PO_4**
CO_2	Conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.	**PO_3**
CO_3	Gain acquaintance in the determination the amount of hardness and chloride in the various samples of water for general purpose and their use its industries involving boilers.	**PO_4, PO_6, PO_7**
CO_4	Skills in estimating acidity/alkalinity in given water samples.	**PO_7, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2	1								
CO_2			2									
CO_3				1		1	2					
CO_4							2		1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

List of experiments/demonstrations:

1. Determination of carbonate and bicarbonate in a given mixture
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution
3. Determination of copper using standard sodium thiosulphate
4. Determination of chloride content in bleaching powder
5. Determination of iron content in the given water sample by Mohr's methods
6. pH- metric titration of acid and base
7. Conductometric titration of acid and base
8. Titration of acid and base by Potentiommetry
9. Recording of Cu +2 Spectrum, absorptivity (demo only) determination of λmax and molar concentration by Spectrophotometer
10. Preparation of organic compound benzoic acid
11. Determination of surface tension and viscosity
12. Ion exchange column for removal of hardness of water
13. Synthesis of a polymer/drug

14. adsorption of acetic acid by charcoal	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Practical Engineering Chemistry by K. Mukkanti, etal, B.S. Publications, Hyderabad.
2	Inorganic quantitative analysis, Vogel.
Reference Books:	
1	Text Book of engineering chemistry by R. N. Goyal and Harrmendra Goel.
2	A text book on experiments and calculation Engg. S.S. Dara.
3	Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications.

Course Code	Course Title	Lecture			
BTCS260ESP	Basic Programming Lab	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To provide the basic knowledge of programming languages.
2. To learn the syntax and semantics of 'C' language with the help of control structures, iterative control structures.
3. To develop programs using 'C' language with the help of functions, array, pointer and structures.
4. To impart the basic terminology used in computer programming for writing and debugging programs for problem solving.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand various problem-solving techniques and will be able to implement them in 'C' language.	**PO_1, PO_2**
CO_2	Apply the basic terminology used in computer programming and write, compile and debug programs in C language.	**PO_3, PO_5**
CO_3	Develop programs involving decision structures, loops and functions using different data types and data structures.	**PO_4, PO_9**
CO_4	Analyze and evaluate difference between call by value and call by reference.	**PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	3										
CO_2			2		2							
CO_3				1					1			
CO_4				1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

List of Experiments:

1. Write C program to input and output the text message.
2. Write C Program to perform all arithmetic operations.
3. Write C Program to utilize the math function.
4. Write C Program to perform the mathematical expressions.
5. Write C Program for Local and Global Variables.
6. Write C Program for internal static and external static variables.
7. Write C Program to find the roots of a Quadratic equation.
8. Write C Programs for all the Operators. (Arithmetical, Logical, Relational, Bitwise).
9. Write C Programs for Increment and Decrement Operators.
10. Write C Programs to implement the Ternary Operator.
11. Write C Programs for special Operators.
12. Write C Programs for all the Control Structures. (Sequential Control Structures, Conditional Control Structures, Iterative Control Structures).
13. Write C Programs to display the different types of patterns using nested for loop.
14. Write C Program for Statements. (Switch, break, goto, continue etc.,).
15. Write C Program to print biggest number from n numbers.
16. Write a C Program to find the given integer number is even or odd number.
17. Write a C Program to calculate the factorial of a given number.

18. Write a C Program to swap the two numbers using temp variable and without using temp variable.
19. Reading and printing a single dimensional array of elements.
20. Ascending and descending of an array.
21. Sum of all odd numbers and sum of all even numbers in a single dimensional array.
22. Mathematical operations on single dimensional arrays.
23. Reading and Printing a multi-dimensional array of elements.
24. Mathematical operations on multi-dimensional array of elements.
25. Passing an array element to a function.
26. Reading and Printing a string.
27. C Programs on String functions.
28. Write a C program to calculate string length by writing the user-define function.
29. Function declaration and initialization.
30. C Program to differentiate the parameters and arguments in functions.
31. Programs for different types of inbuilt functions.
32. Call by value and Call by reference programs in functions.
33. Write a program to swap the given 2 number using passing by reference.
34. Write C Programs to perform all valid arithmetic operations using pointers.
35. C programs on Structures and accessing of members of the structures.
36. Write a C program to print a book information (Book name, Book no, author name) by writing a structure.
37. Write a C program by passing structure elements to a function and display employee Information (emp no, emp name, emp salary, and emp address).
38. C Programs on Reading a file from the secondary storage device.
39. C Program on writing and appending a file on the secondary storage device.
40. C Program on Opening and closing a file.
41. Programs on Classes using C++.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
2	Object Oriented Programming with C++ By E.Balaguruswamy

Reference Books:

1	Programming in C, 2nd Edition, Oxford by Pradip Dey, Mannas Ghosh
2	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Code	Course Title	Lecture			Semester:
BTCS251ESP	Engineering Workshop	L	T	P	II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	6	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	6	Internal Evaluation	:	50
Credits	:	3	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Mechanics

Course Objectives:

1. To provide hands on experience about use of different engineering materials, tools, equipment.
2. To develop a skill of carpentry, fitting and plumbing with safety at work place and team work.
3. To explains the construction, function, use and application of different working tools, equipment and machines.
4. To Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiselling.	PO_1, PO_3, PO_5
CO_2	Apply to fabricate components with their own hands	PO_3, PO_6, PO_9
CO_3	Analyze practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	PO_1, PO_3, PO_6
CO_4	Ability to design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.	PO_3, PO_5, PO_6, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2		2							
CO_2			2			2			1			
CO_3	2		2			2						
CO_4			2		2	2			1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. **Carpentry:** Study of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints. Practice in planning, chiselling, marking and sawing. Joints –Cross joint, T joint, Dove tail joint.
2. **Fitting:** Study of different fitting tools. Use and setting of fitting tools for marking, center punching, chipping, cutting, filing, drilling, their use, different measuring tools, Files – Material and Classification. Practice in filing, cutting, drilling and tapping. Male and female joints, Stepped joints.
3. **Plumbing:** Study of different plumbing tools. Details of plumbing work in domestic and industrial applications. Study of pipe joints, cutting, threading and laying of pipes different fittings using PVC pipes. Use of special tools in plumbing work. Practice of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.

TRADES FOR DEMONSTRATION & EXPOSURE:

1. **House Wiring:** Study of wiring tools, industrial wiring, accessories, earthling, and safety precaution. Practice to make parallel and series connection of three bulbs, stair case wiring, florescent lamp fitting.
2. **Machine Tools:** Study and demonstration on working of machine tools. Specification and block diagram of lathe, Drilling machine and grinder. Common lathe operations such as turning, parting, chamfering and facing. Difference between drilling and boring.

3. **Casting:** Study of Moulding Sands, Pattern, Core Prints, Role of Gate runner, riser, core, casting defects like blow holes & cavities. Practical Work: Mould of any pattern Casting of simple pattern, Solid pattern, Split pattern, multi- piece pattern.	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech Publishers.
2	Elements of Workshop Technology (Volume - 1): Hajra Choudhury.
3	Workshop Manual / Venkat Reddy/ BS Publications/Sixth Edition.
Reference Books:	
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Code	Course Title	Lecture			
BTCS260HSP	English Communication LAB	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	2	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	2	Internal Evaluation	:	50
Credits	:	1	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): English Communication

Course Objectives:

1. To communicate and achieve the perfection of understanding in English language.
2. To understand the spoken English.
3. To understand the written English.
4. To learn business communications in professional English language.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Student will be able to understand, comprehend.	PO_6, PO_{10}
CO_2	Analyze the professional and soft communication skills	PO_2
CO_3	Learn the perfection of understanding in English language.	PO_9, PO_{10}
CO_4	Can read, write and communicate effectively in English.	PO_{10}, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						1				3		
CO_2		2										
CO_3									1	3		
CO_4										3		2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Phonetics – Speech Sounds – Vowels & Consonants
Unit: 2	Structure of Syllables – weak forms & strong forms
Unit: 3	Minimal pairs – word accent and stress shifts
Unit: 4	Intonation and common errors in pronunciation
Unit: 5	Conversation practice – oral presentation skills a. Greeting and leave taking, introducing oneself and others b. Apologizing, interrupting, requesting and making polite conversation c. Giving instructions and directions: speaking of hypothetical situations d. Narrating, expressing opinions and telephone interactions

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	"Enjoying Every day English", Published by Sangam Books, Hyderabad
2	Innovate with English: A Course in English for Engineering Students, edited by T Samson, Foundation Books.

Reference Books:

1	English Grammar Practice, Raj N Bakshi, Orient Longman
2	Technical Communication by Daniel Riordan. 2011. Cengage Publications. New Delhi
3	Effective English, edited by E Suresh Kumar, A RamaKrishna Rao, P Sreehari, Published by Pearson
4	Handbook of English Grammar& Usage, Mark Lester and Larry Beason, Tata Mc Graw –Hill.
5	Spoken English, R.K. Bansal & JB Harrison, Orient Longman
6	Technical Communication, Meenakshi Raman, Oxford University Press
7	Objective English Edgar Thorpe & Showick Thorpe, Pearson Education

Course Code	Course Title	Lecture			Semester:
BTCS311EST	Analog Electronic Circuits	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Physics

Course Objectives:

1. To learn and explore the techniques of circuit analysis and design.
2. To impart the knowledge of signals, Laplace transformation, frequency response.
3. To experiment with analog electronic circuits and signal processing.
4. To provide the knowledge of instrumentation amplifier and conversion.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the characteristics of transistors.	PO_1
CO_2	Design and analyze various rectifier and amplifier circuits.	PO_2, PO_3
CO_3	Analyze the sinusoidal and non-sinusoidal oscillators.	PO_2, PO_5
CO_4	Evaluate the functioning of OP-AMP and design OP-AMP based circuits.	PO_4

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	1											
CO_2		2	2									
CO_3		2			1							
CO_4				1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave Rectifiers, Zener diodes, clamping and clipping circuits. Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits
Unit: 2	MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans conductance, high frequency equivalent circuit..
Unit: 3	Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)
Unit: 4	Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.
Unit: 5	Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Robert Boylested, Louis Nashelky, “Electronic Devices and Circuit Theory”, Pearson Education, New Delhi, India.
2	A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
3	Jacob Millman, Christor C. Halkias, “ Electronic Devices and Circuits” , McGraw Hill Book company, New Delhi, India.
Reference Books:	
1	E. Norman lurch, “Fundamental of Electronics” , John Wiley and Sons, New York, USA.
2	Donald L. Schilling, Charles Belove, “Electronic Circuits: Discrete and Integrated,” McGraw Hill Book company, Singapore.
3	P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.
4	J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.

Course Code	Course Title	Lecture			Semester:
BTCS311PCT	Data Structure & Algorithms	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable to write algorithms for solving problems with the help of fundamental data structures.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Analyze the algorithms to determine the time and computation complexity and justify the correctness.	PO_1, PO_2
CO_2	Implement search problems such as Linear Search and Binary Search	PO_1, PO_2, PO_3
CO_3	Develop given problem of Stacks, Queues and linked list and analyze the same to determine the time and computation complexity.	PO_3, PO_4, PO_{12}
CO_4	To write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.	PO_3, PO_4, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2	2	2	2									
CO_3			2	2								2
CO_4			2	2	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to data structures and objectives, basic concepts Arrays: one dimensional, multi-dimensional, Elementary Operations. Analysis of Algorithm: Time Complexity and Space Complexity, Big-O Notation, Omega Notation, Theta Notation.
Unit: 2	Stacks: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching Queues: Simple queue, circular queue, dequeue, elementary operations and applications. Recursion Technique, Tower of Honoi Problem.
Unit: 3	Linked lists: Linear, circular and doubly linked lists, elementary operations and applications such as polynomial manipulation. Sorting: what is sorting, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Merging, Merge Sort, Radix Sort, Quick Sort, Heap Sort, Binary Tree Sort, Address Calculation Sort, Binary Search.
Unit: 4	Trees: Binary tree representation, tree traversal, complete binary tree, heap, binary search tree, height balanced trees like AVL tree, Huffman Tree, B Tree, B+ Tree and other operations and applications of trees.
Unit: 5	Graph: Undirected Graph, Directed Graph, Representation of Graph, Operation on Graph, Traversal in Graph, BFS (Breadth First Search), DFS (Depth First Search), Spanning Tree. Algorithm: Warshall's Algorithm, Shortest Path Algorithm (Dijkstra), Prim's Algorithm, Kruskal's Algorithm.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2	Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.
Reference Books:	
1	Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition
2	Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson
3	Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
4	Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.

Course Code	Course Title	Lecture			Semester:
BTCS312PCT	Digital Electronics	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Physics

Course Objectives:

1. To impart the basic concepts of digital electronics.
2. To understand concepts about various logical gates.
3. To understand basic concepts about Boolean Algebra.
4. To enable to design the digital logic.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Implement working of logic families and logic gates.	PO_1, PO_2
CO_2	Design and implement Combinational and Sequential logic circuits.	PO_3, PO_9
CO_3	Understand the process of Analog to Digital conversion and Digital to Analog conversion.	PO_1, PO_3,
CO_4	Implement the given logical problem using PLDs.	PO_3, PO_4

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1										
CO_2			3						2			
CO_3	2		3									
CO_4			3	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Fundamentals of Digital Systems and logic families** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.
Unit: 2	**Combinational Digital Circuits** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.
Unit: 3	**Sequential circuits and systems** A 1-bit memory, the circuit properties of Bi stable latch, the clocked SR flip flop, J-K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers , serial to parallel converter, parallel to serial converter, ring counter, sequence generator ,ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.
Unit: 4	**A/D and D/A Converters**

	Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs , sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter ,A/D converter using voltage to frequency and voltage to time conversion ,specifications of A/D converters, example of A/D converter ICs
Unit: 5	Semiconductor memories and Programmable logic devices. Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
2	Mansaf Alam, Bashir Alam, “Digital Logic Design”, PHI,2016
Reference Books:	
1	A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2	Anil K.Maini,”Digital Electronics”, Wiley,2016.

Course Code	Course Title	Lecture			Semester:
BTCS311BST	Engineering Mathematics-III	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Mathematics-II

Course Objectives:

1. To introduce the basic concepts of differential equations, partial differential equations, Laplace transformation and numerical analysis.
2. To explore a variety of various mathematical structures by focusing on mathematical objects, operations, and resulting properties.
3. To understand and learn uses and applications of Ordinary and Partial differential equations, Laplace transformation and Numerical analysis in the field of engineering and technology.
4. To impart the knowledge of numerical integration and Euler's method.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the ability to solve problems using Ordinary and Partial differential equations, Laplace transformation and Numerical analysis	PO_1, PO_2
CO_2	Learn the overview of differential equations.	PO_1, PO_{12}
CO_3	Use of equations reducible to exact form using Integrating factors - Linear, Bernoulli 's equations.	PO_3
CO_4	Learn the applications to Newton's Law of Cooling – Law of natural growth and decay.	PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2	2											2
CO_3			2									
CO_4				2					2			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Differential Equations I**- Differential Equations an overview –Exact Differential Equations, Equations reducible to Exact Differential Equations using Integrating factors, Linear, Bernoulli`s Equations, Applications to Newton's Law of Cooling Law of Natural Growth and Decay, Orthogonal Trajectories in Cartesian and Polar form
Unit: 2	**Differential Equations II**- Linear Differential Equations of Higher Order with Constant Coefficients, Complementary Function and Particular Integral, General form of Particular Integral and Special types such as e^{ax} , $\cos(ax)$, $\sin(ax)$, x^m , e^{ax}. **V**, x.**V**, Method of Variation of Parameters for a Second Order Differential Equation, Applications to Bending of Beams, Electrical Circuits and Simple Harmonic Motion
Unit: 3	**Partial Differential Equations-** Formation of Partial Differential Equations by eliminating the arbitrary constants and arbitrary functions, Solution of Partial Differential Equations (Lagrange's method), Nonlinear Differential Equations of order one (Special forms), Method of Separation of Variables for Solving One Dimensional Wave Equation and Heat Equation and Problems.
Unit: 4	**Laplace Transforms-** Laplace Transform of Standard Functions, Inverse Transform, First Shifting Theorem, Transform of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Dirac-delta Function, Convolution Theorem, Periodic

	Function, Differentiation and Integration of Transforms, Application of Laplace Transform to Ordinary Differential Equations.
Unit: 5	**Numerical Analysis-** Numerical Integration, Trapezoidal rule, Simpson's One-Third rule, Simpson's Three-Eighth rule and Weddle's rule, Numerical Differentiation, Numerical Solution of Ordinary Differential Equations by Euler's Method, Euler's Modified Method and Runge-Kutta Method.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Differential Calculus by shantinarayana
2	Partial Differential Equation by Sneddon
3	Laplace Transform by Schaum's series
Reference Books:	
1	Numerical Analysis by Shastry
2	Engineering Mathematics by B.V Ramana

Course Code	Course Title	Lecture			Semester:
BTCS311HST	Technology and Society	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	2	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	2 Hrs.

Prerequisite(s): No specific requisite.

Course Objectives:

1. To impart the scientific and technological developments affect society and the environment.
2. To understand the applications of science and technology in societal context.
3. To address science and technology to real-world problems.
4. To learn contributions, governance and ethical issues in the context of emerging technologies.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the scientific debates and ethical concerns of such issues as global warming, biotechnology, GMO foods, healthcare, innovation, and economic competitiveness.	PO_1, PO_2
CO_2	Articulate ways in which society is transformed by science and technology.	PO_3, PO_6
CO_3	Able to integrate, synthesize, and apply knowledge of the relationship between science and technology and societal issues in both focused and broad interdisciplinary contexts.	PO_1, PO_2, PO_3,
CO_4	Apply science and technology to real-world problems	PO_7, PO_8, PO_9, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2			2						
CO_3	2	2										
CO_4							2	2	2			2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Technology and Society**: Relationship between technology and society, Role of Technology in Society, social structure and practice, technologies impact society.
Unit: 2	**Social media and civic engagement:** Internet and cause social isolation, Social Construction of Technology (SCOT) perspective.
Unit: 3	**Technology and Risk**: Automation in the workplace: Role of human skill? Socially constructing automation in the workplace, Technology and inequality, ethics and implications of GMOs and potential future impacts, the major impacts of nanotechnology on society
Unit: 4	**Interrelatedness of society, environment, and health** Gene therapy and its various forms, Assess the issue's potential benefits and detriments to global health, Identify the causes of climate change, Assess the various impacts of climate change including economic, geopolitical, biological, meteorological, etc.
Unit: 5	**Gender and Technology**: Gender influences technologies and social organization of scientific and technical workspaces, technologies as both 'liberating' and 'limiting' women. **Public Engagement with Technology**:

	Contributions, governance and ethical issues in the context of emerging technologies, constructing risk, role of State, civil society organizations and industry
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Science Technology And Society – 2014,By K Siddhartha, Publisher: Kisalaya Publication; 1 Edition
2	Impact of Science and Technology on Society – 2012,by Ishwar Singh , Publisher: S.K. Kataria & Sons; Reprint 2012 edition
Reference Books:	
1	Technology and Society – 2010,by R.V.G Menon, Publisher: Pearson Education India; First edition (2010)
2	Book: "The Future: Six Drivers of Global Change"

Course Code	Course Title	Lecture			Semester:
BTCS312HST	Environmental Sciences	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	2	Internal Evaluation	:	15
Credits	:	-	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific requisite.

Course Objectives:

1. To impart the knowledge of importance of Natural resources: Water resources; use and over utilization of surface and ground water.
2. To study energy resources, growing energy needs, renewable and non – renewable energy sources.
3. To learn causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management.
4. To learn Water conservation and environmental ethics: Climate change, global warming, acid rain, ozone layer depletion and Disaster Management.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the importance of Natural resources.	**PO_1, PO_2**
CO_2	Explain renewable and non – renewable energy sources.	**PO_3, PO_5, PO_7**
CO_3	Understand the mechanism to control and measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management.	**PO_4, PO_8, PO_9**
CO_4	Develop the working principles of disaster mitigation, disaster management cycle. Analyze disaster management with causes, effects and control measures.	**PO_3, PO_4, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	1	1										
CO_2			1		1		2					
CO_3				2				1	1			
CO_4			1	2								2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Environmental Studies:** Definition, scope and importance, need for public awareness. **Natural resources:** Water resources; use and over utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems, water logging, salinity. Energy resources, growing energy needs, renewable and non – renewable energy sources.
Unit: 2	**Environmental Pollution:** Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. **Environment Protection Act:** Air, water, forest and wild life acts, issues involved in enforcement of environmental legislation.
Unit: 3	**Social Aspects and the Environment:** Water conservation and environmental ethics: Climate change, global warming, acid rain, ozone layer depletion. **Disaster Management:** Types of disasters, impact of disasters on environment, infrastructure and development. Basic principles of disaster mitigation. disaster management cycle and disaster management in India.

Examination and Evaluation Pattern: It include both internal evaluation (15 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (35 marks) which is mainly end semester examination.	
Text Books:	
1	A.K. De, Environmental Chemistry, New Age Publications, 2002.
2	E.P. Odum, Fundamentals of Ecology, W.B. Sunders Co., U.S.A.
Reference Books:	
1	G.L. Karia and R.A. Christain, Waste Water Treatment, Concepts and Design Approach, Prentice Hall of India, 2005.
2	Benny Joseph, Environmental Studies, Tata McGraw – Hill, 2005.
3	V.K. Sharna, Disaster Management, National Centre for Disaster Management, IIPE, Delhi, 1999.

Course Code	Course Title	Lecture			Semester:
BTCS360ESP	Analog Electronic Circuits LAB	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Analog Electronic Circuits

Course Objectives:

1. To understand the design procedure of various electronic circuit configurations.
2. To design and control the frequency response of amplifiers.
3. To identify and understanding of operation of oscillators and power supplies.
4. To acquire the knowledge of Monostable Multivariate, Bistable Multivibrator and Arduino and Raspberry Pi based experiments.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Design and conduct experiments on amplifiers, oscillators and multivibrators.	PO_3
CO_2	Apply the techniques, skills and modern engineering tools of electronic circuits for engineering practice.	PO_3
CO_3	Analyze the operation of oscillators and power supplies	PO_2, PO_4
CO_4	Evaluate the knowledge of Monostable Multivariate, Bistable Multivibrator and Arduino and Raspberry Pi based experiments.	PO_5, PO_6, PO_9

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2									
CO_2			2									
CO_3		2		2								
CO_4					1	2			1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Diode Characteristics.
2. Transistor characteristics.
3. Series and Shunt feedback amplifiers
4. Design of Wein bridge oscillator
5. Design of transistor RC phase shift oscillator
6. Integrators and Differentiators
7. Clippers and Clampers
8. Darlington Emitter follower
9. Complementary Symmetry Push-pull amplifier
10. Design of Monostable Multivibrato
11. Design of Bistable Multivibrator.
12. Arduino and Raspberry Pi based experiments.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Analog Electronic circuits Laboratory Manual 2.

Reference Books:

1	David A. Bell, "Electronic Devices and Circuits", 5thEdition, Oxford University Press, 2008
2	Microelectronics circuits, Sedra and Smith, Oxford University Press, 1998.

Course Code	Course Title	Lecture			Semester:
BTCS360PCP	Data structure & Algorithms LAB	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Data structure & Algorithms

Course Objectives:

1. To understand the linear and non-linear data structures and algorithms.
2. To identify the suitable data structure and algorithm for the given real-world problem.
3. To gain knowledge in practical applications of data structures and algorithms.
4. To experiments the various applications of Searching and sorting.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Design and analyze the time and space efficiency of the data structure and algorithms.	PO_3
CO_2	Implement the appropriate data structure for given problem and algorithms.	PO_3, PO_4, PO_5
CO_3	Design and analyze data structure and algorithms.	PO_2, PO_3
CO_4	Conceptualize and build data structure based on application needs.	PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2									
CO_2			2	2	2							
CO_3		2	2									
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Implementation of array operations, Structures & Unions.
2. Stacks, Queues, Circular Queues, Priority Queues, Multiple stacks and queues.
3. Infix to postfix expression using stack
4. Implementation of linked lists: stacks, queues, single linked lists.
5. Implementation of polynomial operations. Doubly linked lists
6. Tree traversal: AVL tree implementation, application of trees.
7. Implementation of Hash Table.
8. Searching and sorting
9. Traversal of graph

Note: Students can write the more programs based on prescribed syllabus.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Data structures, Algorithms and Applications in C++, S. Sahni, University Press (India) Pvt. Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd
2	Data structures and Algorithms in C++, Michael T. Goodrich, R. Tamassia and .Mount, Wiley student edition, John Wiley and Sons.

Reference Books:

1	Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition
2	Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson
3	Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.

Course Code	Course Title	Lecture			Semester:
BTCS361PCP	Digital Electronics LAB	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Digital Electronics

Course Objectives:

1. To impart the basic knowledge of various logic gates.
2. To understand combinational circuits and sequential circuits.
3. To acquire the knowledge of Flip-Flop.
4. To design Counters and shift registers.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Able to identify, configure and use off-the-shelf digital ICs	PO_1, PO_2
CO_2	Able to realize and troubleshoot combinational and sequential digital circuits.	PO_2
CO_3	Able to employ MSI ICs of appropriate configuration for realizing a digital system.	PO_3, PO_4
CO_4	Able to design and implement simple digital system for a real-life problem.	PO_3, PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1										
CO_2		2										
CO_3			2	2								
CO_4			2	2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Bread Board Implementation of various logic gates.
2. Bread Board Implementation of various logic gates using NAND gate.
3. Bread Board Implementation of various logic gates using NOR gate.
4. Bread Board implementation of Binary Adder (Half and Full) using general gates.
5. Bread Board implementation of Combinational Circuits.
6. Bread Board implementation of Adder/Subtractor.
7. Bread Board Implementation of Flip-Flops.
8. Experiments with clocked Flip-Flop.
9. Design of Counters.
10. Bread Board implementation of counters & shift registers.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
2	Mansaf Alam, Bashir Alam, “Digital Logic Design”, PHI,2016

Reference Books:

1	A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2	Anil K.Maini,”Digital Electronics”, Wiley,2016.

Course Code	Course Title	Lecture			Semester:
BTCS362PCP	IT Workshop with Python	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Any computer programming course

Course Objectives:

1. To learn the fundamentals of writing Python programming.
2. To understand core Python scripting elements such as variables and flow control structures.
3. To read and write Python files.
4. To impart the knowledge of Python standard library and Explore Python's object-oriented features.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Implement scripting and the contributions of scripting languages.	**PO_1**
CO_2	Apply Python especially the object-oriented concepts.	**PO_3**
CO_3	Analyze and apply built-in objects of Python.	**PO_3**
CO_4	Apply Python standard library and Explore Python's object-oriented features	**PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2			3									
CO_3			3									
CO_4					2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** History, Features, setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, Input-Output, Printing on screen, Functions, If, If- else, Nested if-else, Looping, For, While, Nested loops, Control Statements, Break, Continue, Pass
Unit: 2	**String Manipulation and Lists:** **Strings:** Accessing Strings, Basic Operations, String slices, Function and Methods **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods
Unit: 3	**Functions and modules:** Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Importing module, Math module, Random module, Packages, Composition
Unit: 4	**Regular expressions:** Match function, Search function, Matching VS Searching, Modifiers, Patterns
Unit: 5	Reading data from keyboard, Opening and closing file, Reading and writing files, **Database:** Introduction, Connections, Executing queries, Transactions, Handling error

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Sheetal Taneja and Naveen Kumar, "Python Programming - A Modular Approach", Pearson education.
2	Cay S. Horstmann and Rance D. Necaise, "Python for Everyone", Wiley.

Reference Books:

1	Allen Downe, "Learning With Python", Wiley.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly' Publisher

Course Code	Course Title	Lecture			Semester:
BTCS402PCT	Database Management Systems	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure and Algorithm

Course Objectives:

1. To understand the concept of data planning and database design for serving different types of users with varying skill levels.
2. To handle different user views of the same stored data, combining interrelated data, setting standards, controlling concurrent updates so as to maintain data integrity.
3. To manage, plan and coordinate restart and recovery operations across multiple users for a large complex system.
4. To acquire the concept of file organization and indexing.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand relational database theory, and be able to write relational algebra expressions for queries, logical design of databases, including the E-R method and normalization approach.	**PO_3**
CO_2	Apply and analyze the database storage structures and access techniques like file and page organizations.	**PO_2, PO_3**
CO_3	Analyze and apply indexing methods including B-tree, hashing, query evaluation techniques and query optimization.	**PO_3, PO_5**
CO_4	Evaluate various issues of transaction processing and concurrency control by designing and development of a database application system as part of a team.	**PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2									
CO_2		2	3									
CO_3			3		2							
CO_4				1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Data base System Applications, data base System VS file System – 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 System Structure – Storage Manager – the Query Processor. History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.
Unit: 2	Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views. Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

Unit: 3	Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases. Schema refinement – Problems Caused by redundancy Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.
Unit: 4	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- Base 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.
Unit: 5	Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2	Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition

Reference Books:

1	Fundamentals of Database Systems, Elmasri Navrate Pearson Education
2	Introduction to Database Systems, C.J.Date Pearson Education

Course Code	Course Title	Lecture			Semester:
BTCS403PCT	Operating Systems	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Analog Electronic Circuits/ Digital Electronics

Course Objectives:

1. To understand fundamental operating system abstractions such as processes, threads, files, semaphores, IPC abstractions, shared memory regions, etc.,
2. To learn how the operating system abstractions can be used in the development of application programs, or to build higher level abstractions,
3. To acquire the principles of concurrency and synchronization, and apply them to write correct concurrent programs/software.
4. To impart the knowledge of various kinds of design principle of operating systems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate how to manage multiple tasks that execute at the same time and share resources including processes and threads, context switching, synchronization, schedule CPU time, and deadlock.	**PO_1, PO_2, PO_4**
CO_2	Design, implement and evaluate a computer-based system, process, components, or program to meet desired needs in context of operating system.	**PO_3**
CO_3	Identify the System calls, protection, interrupts and know Input/output, disk access, file systems facilities.	**PO_4**
CO_4	Apply semaphores and monitors for classical and real-world synchronization scenarios	**PO_3, PO_4, PO_6**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1		1								
CO_2			2									
CO_3				1								
CO_4			2	1		2						

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**System Software:** Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers. **Basics of Operating Systems:** Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; System Boot.
Unit: 2	**CPU Scheduling:** Scheduling Criteria and Algorithms; Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling. **Deadlocks:** Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.
Unit: 3	**Memory Management:** Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files. **Disk Management:** Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.
Unit: 4	**File and Input/Output Systems:** Access Methods, Directory and Disk Structure; File-System Mounting, File Sharing, File-System Structure and Implementation;

	Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance; Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.
Unit: 5	**Security:** Protection, Access Matrix, Access Control, Revocation of Access Rights, Program Threats, System and Network Threats; Cryptography as a Security Tool, User Authentication, Implementing Security Defenses. **Windows and Linux Operating Systems:** Design Principles, File Systems, Input and Output; Inter-process Communication, Network Structure.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley
2	SibsankarHalder and Alex A Aravind, "Operating Systems", Pearson Education
Reference Books:	
1	Harvey M Dietel, "An Introduction to Operating System", Pearson Education
2	D M Dhamdhere, "Operating Systems: A Concept based Approach", McGraw Hill
3	Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education".
4	Stuart E. Madnick & John J. Donovan. Operating Systems. McGraw Hill

Course Code	Course Title	Lecture			Semester:
BTCS405PCT	Object Oriented Programming	L	T	P	IV
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To understand the concept of object-oriented programming principle using JAVA programming language.
2. To elaborate variable scopes, memory management, and reference versus value types in relation to parameters and arguments in function calls.
3. To demonstrate the principles of object-oriented features of Java programming language with security features.
4. To acquire the knowledge of error and exception handling.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the principles of object-oriented programming paradigm specifically including abstraction, encapsulation, inheritance and polymorphism.	**PO_1, PO_2,**
CO_2	Demonstrate best practices in designing classes and class hierarchies from problem statements using sub-classing, abstract classes, and interfaces to achieve polymorphism in object-oriented software.	**PO_3**
CO_3	Demonstrate informed use of encapsulation within and across software components and packages.	**PO_4, PO_5**
CO_4	Apply exception handling, generation and escalation mechanisms and practices in writing Java programs.	**PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			3									
CO_3				2	2							
CO_4					2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Java Basics** - Review of OOP concepts, History of Java, Java buzzwords, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow-block scope, conditional statements, loops, break and continue statements, simple java program, arrays, recursion.
Unit: 2	**Classes and Objects:** Abstraction, encapsulation, classes, objects, constructors, methods, parameter passing, access control, this keyword, overloading methods and constructors, static fields and methods, garbage collection, String Handling, Enumerations, Object class and its methods.
Unit: 3	**Inheritance & Polymorphism** – Inheritance concept, benefits of inheritance, Super classes and Sub classes, Member access rules, super keyword, final classes, methods and variables, Polymorphism - dynamic binding, method overriding, dynamic method dispatch, abstract classes and methods, Interfaces – Interfaces vs. abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface, Packages- Defining, Creating and Accessing a Package.

Unit: 4	**Exception handling & Multi-threading**– Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, built in exceptions, creating own exception sub classes. Multi-threading - Differences between multiple processes and multiple threads, creating threads, interrupting threads, thread priorities, daemon threads, thread lifecycle.
Unit: 5	**Database Connectivity** –Types of Drivers, Processing SQL statements, DriverManager class, Connection, Statement, ResultSet, PreparedStatement, ResultSetMetaData interfaces, Developing CRUDS application using JDBC.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Herbert schildt, Java: the complete reference, 12th edition, 2022, McGraw Hill.
2	Nick Samoylov, Learn Java 17 Programming, 2nd edition, Packt Publishing Limited.
Reference Books:	
1	Kathy Sierra, Bert Bates, Trisha Gee, Head First Java, 3rd Edition, 2022, O'Reilly
2	Mahmoud Parsian, JDBC Recipes: A Problem-Solution Approach, Apress

Course Code	Course Title	Lecture			Semester:
BTCS406PCT	Software Engineering	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure & Algorithm

Course Objectives:

1. To understand the fundamentals of software engineering including analysis, design, construction, maintenance, quality assurance and project management.
2. To learn appropriate computer science and mathematics principles in the development of software systems.
3. To acquire software requirement elicitation, methods of coding and testing software products.
4. To impart the concept of the measurement techniques, quality control aspects.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand software engineering theory, principles, tools and processes, as well as the theory and principles of computer science.	**PO_1, PO_2**
CO_2	Apply mathematics to the development and maintenance of complex software systems.	**PO_3**
CO_3	Design and test specific software requirements through a productive working relationship with project stakeholders.	**PO_3, PO_5**
CO_4	Verify and validate various software prototypes and to develop quality software metrics.	**PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2		2							
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Software Engineering Fundamentals:** Definition of software product and process, Software Characteristics, Components, Applications, Layered Technologies, Processes and Product, Methods and Tools, Generic View of Software Engineering, Software Crisis, Software development paradigms, Techniques of Process Modelling, Software Process and lifecycle models
Unit: 2	**Software Requirements Analysis & Specification:** System specification, Software requirements specification (SRS) standards, Analysis and Design Modelling: ER Diagram, Dataflow Model, Control Flow Model, Control and Process Specification, Data Dictionary.
Unit: 3	**Software Design:** Software architecture, Modular Design-cohesion and coupling, Process-oriented design, Process and Optimization, Data-oriented design, User-interface design, Real-time software design, Architectural Designing, Interface Design, Procedural Design, Object Oriented Design. **CASE Tools:** Computer-aided software engineering, Introduction to CASE, Building Blocks of CASE, Relevance of CASE tools, High-end and low-end CASE tools, automated support for data dictionaries, DFD, ER diagrams, Integrated Case Environment, CASE workbenches.

Unit: 4	**Coding and Testing:** Choice of Programming languages, Coding standards for Software. User Interface Design: Concepts of Ui, Interface Design Model, Internal and External Design, Evaluation, Interaction and Information Display Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing.
Unit: 5	**Configuration Management:** Concepts in Configuration Management, The Configuration Management Process: Planning and Setting up Configuration Management, Perform Configuration Control, Status Monitoring and Audits. **Software Maintenance:** What is software maintenance, Maintenance Process & Models, Reverse Engineering, Software re-engineering, Configuration Management issues and concept, Configuration planning & techniques, Software versions and change control process, Documentation.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	R. Pressman, "Software Engineering", 7th Edition, 2010, McGraw-Hill.
2	Yogesh Singh "Software Engineering" , 3rd Edition, 2007, New Age Publications, Delhi.
Reference Books:	
1	W.S. Jawadekar, "Software Engineering", 2008, A Primer, TMH.
2	Shari Pfleeger, "Software Engineering", 2010, Pearson Education.
3	Stephen Schach, "Software Engineering", 2007, TMH.

Course Code	Course Title	Lecture			Semester:
BTCS407PCT	Discrete Mathematics	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Mathematics-III

Course Objectives:

1. To understand variety of various mathematical structures by focusing on set theory, mathematical objects, operations, and resulting properties.
2. To develop formal logical reasoning techniques and notation and demonstrate the application of logic to analyzing and writing proofs, techniques for counting, permutations and combinations
3. To impart the concept of relation through various representations of Graphs, DFS, BFS, Spanning Trees, and Planar Graphs.
4. To acquire the knowledge of graph theory and applications, isomorphism and sub graphs, multi graphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand Well-formed formulas, Truth Tables, tautology, equivalence implication, Normal forms, Quantifiers, universal quantifiers.	PO_1, PO_2
CO_2	Analyze operations on set theory, mathematical objects, operations, and resulting properties.	PO_2, PO_3
CO_3	Evaluate the application of logic to analyzing and writing proofs, techniques for counting, permutations and combinations	PO_3
CO_4	Apply the concepts of Graphs, DFS, BFS, Spanning Trees, and Planar Graphs. Graph Theory and other engineering applications	PO_3, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1										
CO_2		1	2									
CO_3			2									
CO_4			2		1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Mathematical Logic:** Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, equivalence implication, Normal forms, Quantifiers, universal quantifiers. Predicates: Predicative logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction, Automatic Theorem Proving.
Unit: 2	**Relations:** Properties of binary Relations, equivalence, transitive closure, compatibility and partial ordering relations, Lattices, Hasse diagram. Functions: Inverse Function, Composition of functions, recursive Functions, Lattice and its Properties, Pigeon hole principles and its application.
Unit: 3	**Elementary Combinatorics:** Basics of counting, Combinations & Permutations, with repetitions, Constrained repetitions, Binomial Coefficients, Binomial and Multinomial theorem, the principles of Inclusion – Exclusion.
Unit: 4	**Recurrence Relations:** Generating Functions, Function of Sequences, Calculating Coefficients of generating functions, Recurrence relations, solving recurrence relation by substitution and Generating functions, the method of Characteristic roots, solution of Inhomogeneous Recurrence Relations.

Unit: 5	**Graph Theory:** Representation of Graphs, DFS, BFS, Spanning Trees, Planar Graphs. Graph Theory and Applications, Basic Concepts, Isomorphism and Sub graphs, Multi graphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Mathematical Foundation of Computer Science – Shahnaz Bathul, PHI.
2	Elements of Discrete Mathematics- A Computer Oriented Approach,C.L.Liu, D.P. Mohapatra,3edition,TMH.
3	Discrete Mathematics for Computer Scientists & Mathematicians, second edition, J.L.Mott, A. Kandel, T.P. Baker, PHI
4	Discrete and Combinatorial Mathematics- An Applied Introduction-5th Edition– Ralph. P.Grimaldi, Pearson Education
Reference Books:	
1	Discrete Mathematics and its applications, 6th edition, K.H. Rosen, TMH.
2	Discrete Mathematical Structures, Mallik and Sen, Cengage Learning
3	Discrete Mathematical Structures, Bernand Kolman, Robert C. Busby, Sharon Cutler Ross, PHI/ Pearson Education
4	Discrete Mathematics with Applications, Thomas Koshy, Elsevier.
5	Logic and Discrete Mathematics, Grass Man and Tremblay, Pearson Education

Course Code	Course Title	Lecture			Semester:
BTCS451PCP	Database Management Systems LAB	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Database Management Systems

Course Objectives:

1. To acquire the knowledge of DBMS, in terms of use and implementations.
2. To understand the concept of data planning and database design for serving different types of users with varying skill levels.
3. To handle different user views of the same stored data, combining interrelated data, setting standards, controlling concurrent updates so as to maintain data integrity.
4. To write programme by the use of PL/SQL.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the relational database theory, and be able to write relational algebra expressions for queries, logical design of databases, including the E-R method and normalization approach.	PO_3
CO_2	Illustrate commercial relational database system by writing SQL.	PO_3, PO_5
CO_3	Analyze the database storage structures.	PO_2, PO_6, PO_9
CO_4	Build Access techniques like file and page organizations, indexing methods including B-tree, hashing, query evaluation techniques and query optimization.	PO_3, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2									
CO_2			2		2							
CO_3		2				2			1			
CO_4			3		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Write the queries for Data Definition and Data Manipulation Language
2. Write SQL queries using logical operations (=, <,>, etc.)
3. Write SQL queries using SQL operators
4. Write SQL query using character, number, date and group functions
5. Write SQL queries for relational algebra
6. Write SQL queries for extracting data from more than one table
7. Write SQL queries for sub queries, nested queries
8. Write programme by the use of PL/SQL
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS
10. Create VIEWS, CURSORS and TRIGGERS & write ASSERTIONS
11. Create FORMS and REPORTS

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Fundamentals of Database Systems, Elmasri Navrate Pearson Education
2	Introduction to Database Systems, C.J.Date Pearson Education

Reference Books:

1	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2	Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition

Course Code	Course Title	Lecture			Semester:
BTCS452PCP	Operating Systems LAB	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Operating Systems

Course Objectives:

1. To write programs in Linux environment using system calls.
2. To implement the scheduling algorithms.
3. To develop solutions for synchronization problems using semaphores.
4. To impart the knowledge of file organization techniques.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of Linux environment.	**PO_1**
CO_2	Develop application programs using system calls in UNIX.	**PO_3, PO_5**
CO_3	Implement inter-process communication between two processes.	**PO_5**
CO_4	Design and solve synchronization problems.	**PO_3, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2			2		2							
CO_3					2							
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Basics of UNIX commands
2. Shell programming
3. Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d) Priority
4. Implement all file allocation strategies
5. Implement Semaphores
6. Implement all File Organization Techniques
7. Implement Bankers algorithm for Dead Lock Avoidance
8. Implement an Algorithm for Dead Lock Detection
9. Implement the all-page replacement algorithms a) FIFO b) LRU c) LFU
10. Implement Shared memory and IPC
11. Implement Paging Technique memory management
12. Implement Threading & Synchronization Applications

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	An Introduction to Operating Systems, P.C.P Bhatt, 2nd edition, PHI.

Reference Books:

1	Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2	Unix System Programming Using C++, Terrence Chan, PHI/Pearson.

Course Code	Course Title	Lecture			Semester:
BTCS453PCP	Object Oriented Programming LAB	L	T	P	IV
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Object Oriented Programming

Course Objectives:

1. To understand the concept of object-oriented programming principle using JAVA programming language
2. To Apply the concept of classes, Java, JDK Components and develop Simple Java Programs and Develop Simple Java Programs using inheritance and Exception handling
3. To introduce the principles of inheritance, polymorphism and exception handling
4. To demonstrate the concept of Packages, exception & Threads.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the principles of object-oriented programming paradigm specifically including abstraction, encapsulation, inheritance and polymorphism.	**PO_1, PO_2**
CO_2	Demonstrate best practices in designing classes and class hierarchies from problem statements using sub-classing, abstract classes, and interfaces to achieve polymorphism in object-oriented software.	**PO_3**
CO_3	Demonstrate informed use of encapsulation within and across software components and packages.	**PO_4, PO_5**
CO_4	Apply exception handling, generation and escalation mechanisms and practices in writing Java programs.	**PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2			3									
CO_3			2		2				1			
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Write a java program to perform following operations using recursion:
   - I. Factorial.
   - II. LCM of the three numbers.
2. Write a java program to find the square root of its own number.
3. Write a java program to perform:
   - I. Switch case
   - II. Call by value
   - III. Call by reference
4. Warte a java program to perform operation of Matrix Multiplication.
5. Write a JAVA program to implement class mechanism.
   - Create a class
   - Create methods and
   - invoke them inside main method
6. Write a java program to demonstrate the following Class:
   - I. Scanner class.
   - II. Static class.
7. Write Java program to demonstrate the concept of following:

- dynamic binding,
- differentiating method,
- overloading method and,
- overriding method.

8. Write a java program to perform the following inheritance:
   I. Single
   II. Multi-level
   III. Hierarchical
9. Write the following java programs:
   I. Write a java program to operate super keyword in java.
   II. Write a java program to demonstrate the final method.

10. Write the following java programs:
   I. Write a java program to define and implement an interface
   II. Write a java program to implement Interface using extends keyword
11. Write a java program to demonstrate this keyword
   - Write a java program to demonstrate this () method.
12. Write a java program to create user defined package.
13. Write a java program to demonstrate.
   I. Constructor
   II. Default constructor
   III. Copy constructor

Q 14. Write the following java programs:
   i. Method overloading
   ii. Constructor overloading

15 a.) Develop a Java application to generate Electricity bill. Create a class with the following members:
- Consumer no.
- consumer name
- previous month reading
- current month reading
- type of EB connection (domestic or commercial).

b.) Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
- First 100 units - Rs. 1 per unit
- 101-200 units - Rs. 2.50 per unit
- 201 -500 units - Rs. 4 per unit
- >= 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:
- First 100 units - Rs. 2 per unit
- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- >= 501 units - Rs. 7 per unit

16. I.) Develop a java application with a class Employee which consist:
- Emp Name
- Em Id
- Address
- E-Mail id
- Mobile no. as members.

ii.) Inherit the classes Programmer
- Assistant Professor,
- Associate Professor and
- Professor from employee class.

iii.) Add Basic Pay (BP) as the member of all the inherited classes with
- 97% of BP as DA,
- 10 % of BP as HRA,
- 12% of BP as PF,
- 0.1% of BP for staff club fund.

Generate pay slips for the employees with their gross and net salary.

17. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area ().

- Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape.
- Each one of the classes contains only the method print Area () that prints the area of the given shape.

18. Write the following java programs:
    I. Write a Java Program to describe about try and catch blocks for handling exceptions
    II. Write a Java Program to demonstrate about throw and throws keywords
    III. Write a Java program to implement user defined exception handling

19. Write a Java Program to demonstrate String Buffer Class and String Builder Class
20. Write a Java Program to perform the following operations:
    I. To create threads in java by extending Thread Class
    II. To create threads in java by implementing Runnable Interface
21. Write a java program that connects to a database using JDBC and perform the following:
    i. add record.
    ii. delete record.
    iii. modify record.
    iv. Retrieve record.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Java; the complete reference, 9th editon, Herbert schildt, TMH.
2	Understanding OOP with Java, updated edition, T. Budd, Pearson education.

Reference Books:

1	Programming with java , E Balagurusamy, McGraw-Hill; Sixth edition (25 March 2019);
2	Introduction to OOP, second edition, T. Budd, pearson education.

Course Code	Course Title	Lecture			Semester: V
BTCS511PCT	Computer Organization	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Digital Electronics

Course Objectives:

1. To understand the organization of the classical von Neumann machine and its major functional Modules.
2. To learn system organization and structure through instruction cycles.
3. To provide basic concepts of interrupts and how interrupts are used to implement I/O control and data transfers.
4. To identify various types of buses in a computer system and illustrate how data transfers are performed.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Apply and analyze computer organization, computer arithmetic, and CPU design.	**PO_2, PO_3**
CO_2	Understand I/O system and interconnection structures of computer.	**PO_2, PO_6**
CO_3	Design and analyze different interrupts, I/O techniques, PLDs and memory organization.	**PO_3**
CO_4	Implement learning skills and be able to develop different hardware for computer organization.	**PO_3, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		1	2									
CO_2		2				1						
CO_3			2									
CO_4			2	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction: Function and structure of computer Functional components of a computer, Interconnection of components, Performance of a computer. Computer Organization and Architecture Basic structure of General purpose Computer with instruction set, Basic Computer and registers, Hardware Organization.
Unit: 2	Registers Microoperations and Arithmetic Logic Structure: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Adder-Subtractor, Arithmetic Logic Shift Unit.
Unit: 3	CPU Organization: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control Organization of a control unit-Operations of a control unit, Hardwired control unit, Microprogrammed control unit.
Unit: 4	Input Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA controlled I/O, Direct Memory Access, Input-Output Processor

Unit: 5	Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI
2	Computer Organization and Architecture–William Stallings Sixth Edition, Pearson/PHI
Reference Books:	
1	Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill
2	Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI/Pearson
3	Fundamentals of Computer Organization and Design, -Sivaraama Dandamudi Springer Int. Edition.
4	Computer Architecture a quantitative approach, John L. Hennessy and David A. Patterson, Fourth Edition Elsevier
5	Computer Architecture: Fundamentals and principles of Computer Design, Joseph D. Dumas II, BS Publication

Course Code	Course Title	Lecture			Semester: V
BTCS512PCT	Formal Language & Automata Theory	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Discrete Mathematics

Course Objectives:

1. To understand the fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton and Turing machine.
2. To explain the basic models of computation including the foundation of many branches of computer science, e.g., compilers, software engineering, concurrent systems, etc.
3. To acquire insights into the relationship among formal languages, formal grammars, and automata.
4. To impart the knowledge of Chomsky hierarchy of languages.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the understanding of abstract models of computing, including deterministic (DFA), non-deterministic (NFA), and Turing (TM) machine models.	**PO_1, PO_2**
CO_2	Demonstrate an understanding of regular expressions and grammars, including context-free and context-sensitive grammars.	**PO_2, PO_3**
CO_3	Design and find the relationships between language classes, including regular, context-free, context-sensitive, recursive, and recursively enumerable languages.	**PO_3, PO_4**
CO_4	Gain proficiency with mathematical tools and formal methods	**PO_3, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2									
CO_3			3	2								
CO_4			2	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction; Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata.
Unit: 2	Regular expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine.
Unit: 3	Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

Unit: 4	Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA.
Unit: 5	Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, Universal TM, Church's Thesis, Chomsky hierarchy of languages, Recursive and recursively enumerable languages, Halting problem, Undecidable problems about TMs. Post correspondence problem (PCP).
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Introduction to Automata Theory Languages and Computation". Hopcroft H.E. and Ullman J. D. Pearson Education
2	Theory of Computer Science: Automata, Languages and Computation, K.L.P.Mishra, N.Chandrasekaran
Reference Books:	
1	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley
2	Introduction to languages and the Theory of Computation ,John C Martin, TMH
3	Elements of Theory of Computation", Lewis H.P. & Papadimition C.H. Pearson /PHI.

Course Code	Course Title	Lecture			Semester:
BTCS513PCT	Design & Analysis of Algorithms	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure & Algorithm

Course Objectives:

1. To understand the concepts and skills of algorithm design, implemental some well-known algorithms and analyze the performance of algorithms
2. To define the complexity of algorithms, Reasoning about the correctness of the algorithm
3. To impart the concept of behaviors of algorithms and the notion of tractable and intractable problems.
4. To provide the knowledge of problem solving such as travelling sales person problem.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Analyze a given algorithm and express its time and space complexities in asymptotic notations and Solve recurrence equations using Iteration Method, Recurrence Tree Method and Master's Theorem.	**PO_1, PO_2, PO_3**
CO_2	Design algorithms using Divide and Conquer Strategy and Compare Dynamic Programming and Divide and Conquer Strategies.	**PO_3, PO_4**
CO_3	Solve Optimization problems using Greedy strategy and Design efficient algorithms using Back Tracking and Branch Bound Techniques for solving problems.	**PO_4, PO_9**
CO_4	Classify computational problems into P, NP, NP-Hard and NP-Complete and to understanding about writing algorithms and step by step approach in solving problems with the help of data structures.	**PO_2, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	3									
CO_2			3	2								
CO_3				2					1			
CO_4		2		2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- O notation, Omega notation, Theta notation **Divide and Conquer:** Structure of divide-and-conquer algorithms; Binary search; Merge Sort; Quick sort.
Unit: 2	**Greedy Method:** General method- Knapsack problem – job sequencing with deadlines– minimum-cost spanning trees: Prim's and Kruskal's algorithms – Single source shortest paths: Dijkstra's algorithm.
Unit: 3	**Dynamic Programming:** General method – Multistage Graphs – All pairs shortest paths, Single source shortest paths – optimal binary search trees – 0/1 Knapsack problem traveling sales person problem
Unit: 4	**Back Tracking:** General method – n-queen problem – sum of subsets problem – graph colouring – Hamiltonian cycles – Knapsack problem.
Unit: 5	**Branch and Bound:** Least Cost (LC) search, bounding – LC branch and bound – FIFO branch and bound – Travelling sales person problem, Computability classes – P, NP, NP-complete and NP-hard.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2	Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson Education, 2007.
Reference Books:	
1	RCT Lee, SS Tseng, RC Chang and YT Tsai, "Introduction to the Design and Analysis of Algorithms", Mc Graw Hill, 2005.
2	E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms", Berman, Paul," Algorithms", Cengage Learning.
3	Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.

Course Code	Course Title	Lecture			Semester:
BTCS511HST	Organizational Behaviour	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	2	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	2 Hrs.

Prerequisite(s): No specific requisites.

Course Objectives:

1. To develop cognizance of the importance of human behaviour.
2. To describe how people behave under different conditions.
3. To analyses specific strategic human resources demands for future action.
4. To synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the applicability of the concept of organizational behaviour	**PO_1, PO_2, PO_6**
CO_2	Demonstrate the applicability of analyzing the complexities associated with management of individual behaviour in the organization.	**PO_9, PO_{10}, PO_{11}**
CO_3	Analyze the complexities associated with management of the group behaviour in the organization.	**PO_8, PO_9**
CO_4	Evaluate how the organizational behaviour can integrate in understanding the motivation (why) behind behaviour of people in the organization.	**PO_8, PO_9, PO_{10}, PO_{11}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2				1						
CO_2									2	3	3	
CO_3								2	2			
CO_4								2	2	3	3	

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Meaning, Fundamental concepts, Definition, Approaches to OB, Characteristics and limitations of OB, Challenges and Opportunities of OB, Models of OB.
Unit: 2	**Personality:** Definition, Features, Big five model, MBTI, Johari Window, Managerial Implications of Personality. Perceptions and Attributions: Definition, Features, factors affecting perception, Process. Attribution, perceptual and attribution errors, Managerial Implications of Perception.
Unit: 3	Learning: Definition, Features, Classical and operant conditioning, social learning theory, Behavioural modification. Attitude: Definition, Features, ABC model of Attitude, Managerial Implications of Attitude.
Unit: 4	**Motivation:** Concept, Definition, Features, Types of Motivation, Process, Managerial Implications of Motivation. Leadership: Concept, Definition, Leadership Styles, Transactional and Transformational Leadership, Leadership development.
Unit: 5	**Groups and Teams:** Definition, Features, Group development stages, Group vs. Teams, Managing and developing effective teams. Conflict Management: Definition, Features, Types of Conflict, Conflict Resolution Strategies, Relationship between Conflict and Performance. Organizational Culture:

	Elements and dimensions of organizational culture, Importance of organizational culture in shaping the behaviour of people.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Robbins, S. P., & Judge, T. (2013). Organizational behavior (15th ed.). Boston: Pearson.
2	Newstrom J. W., & Davis, K. (2011). Human behavior at work (12th ed.). Tata McGraw Hill
3	Nelson, D , Quick, J.C., & Khandelwal, P., (2011). ORGB . Cengage Learning.
4	Udai Pareek, Understanding Organisational Behaviour, 2nd Edition, Oxford Higher Education, 2004.
Reference Books:	
1	Pareek. U. (2010). Understanding Organizational Behavior (2nd ed.). Oxford University Press
2	Schermerhorn, J. R., Osborn, R.N., Hunt, M.U.J (2016). Organizational Behavior (12th ed.). Wiley

Course Code	Course Title	Lecture			Semester:
BTCS512HST	History of Sciences & Technology in India	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	2	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	2 Hrs.

Prerequisite(s): Basic knowledge of science

Course Objectives:

1. To acquire the knowledge the origin and development of astronomy in ancient India.
2. To understand the origin and growth of mathematics in ancient India.
3. To identify the origin and development of copper, gold, Iron and other metal in ancient India.
4. To know the prominent scientist of India since beginning and their achievement.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Recognize the development of Science Beginning and their achievement	PO_6, PO_7, PO_8
CO_2	Assess the growth of engineering in ancient India.	PO_9
CO_3	Find the significance of metallurgy in ancient India.	PO_7, PO_9
CO_4	Gain the knowledge of history from ancient India to modern India	PO_8, PO_{10}, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2	2					
CO_2									2			
CO_3							2		2			
CO_4								2		2		2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Science and Technology- The Beginning Development in different branches of Science in Ancient India: Astronomy, Mathematics, Engineering and Medicine. Developments in metallurgy: Use of Copper, Bronze and Iron in Ancient India. Development of Geography: Geography in Ancient Indian Literature.
Unit: 2	Developments in Science and Technology in Medieval India Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of maktabs, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc.
Unit: 3	Developments in Science and Technology in Colonial India Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the Company's Service.
Unit: 4	Indian Response to new Scientific Knowledge, Science and Technology in Modern India: Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites
Unit: 5	Prominent scientist of India since beginning and their achievement Mathematics and Astronomy: Baudhayan, Aryabhtatta, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna. Medical Science of Ancient India (Ayurveda & Yoga): Susruta, Charak, Yoga & Patanjali. Scientists of Modern India: Srinivas Ramanujan, C.V. Raman, Jagdish Chandra Bose, Homi Jehangir Bhabha and Dr. Vikram Sarabhai.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	George G Joseph, Crest of the Peacock, Non-European roots of mathematics, Third edition, Princeton University Press, Princeton, NJ, 2011.
2	Agrawal, D.P., Ancient Metal Technology and Archaeology of South Asia (A Pan-Asian Perspective), Aryan Books International, New Delhi, 2000
Reference Books:	
1	Cunningham , Alexander , The Ancient Geography of India. Indological Book House, Varanasi, 1963.
2	Dey, N. L., The Geographical Dictionary of Ancient and Medieval India. Luzac and Co., London, 1927.

Course Code	Course Title	Lecture			Semester:
BTCS560PCP	Design & Analysis of Algorithms LAB	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	2 Hrs.

Prerequisite(s): Design & Analysis of Algorithms

Course Objectives:

1. To write programs to solve problems using divide and conquer strategy.
2. To develop programs to solve problems using backtracking strategy.
3. To experiment programs to solve problems using greedy and dynamic programming techniques.
4. To implement various problems of searching and sorting.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Implement various data structures (viz. Stacks, Queues, Linked Lists, Trees, Graphs) and algorithms like Greedy, Dynamic, Divide & Conquer etc.	**PO_2, PO_3, PO_5**
CO_2	Analyze step by step and develop algorithms to solve real world problems.	**PO_2, PO_3, PO_5, PO_9**
CO_3	Use and implement appropriate algorithms for the required problems using a programming language.	**PO_2, PO_3, PO_4**
CO_4	Analyze the space and time complexity of a given problem	**PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2		2							
CO_2		2	2		2				1			
CO_3		2	2	2								
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Sort a given set of elements using the quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the 1st to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2. Implement merge sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3. Implement 0/1 Knapsack problem using Dynamic Programming.
4. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
5. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
6. Find a subset of a given set $S = \{s_1, s_2, ..., s_n\}$ of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1, 2, 6} and {1, 8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.
7. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
8. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
9. Implement N Queen's problem using Back Tracking.
10. Implement the travelling salesperson problem (TSP) using dynamic programming.

Note: Students can implement more algorithms based on prescribed syllabus.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Data structures, Algorithms and Applications in java, 2nd Edition, S. Sahani, Universities Press.
2	Data structures and Algorithms in java, 3rd edition, A. Drozdek, Cengage Learning.
Reference Books:	
1	Data structures with Java, J. R. Hubbard, 2nd edition, Schaum's Outlines, TMH.
2	Data Structures using Java, D. S. Malik and P.S. Nair, Cengage Learning

Course Code	Course Title	Lecture			Semester:
BTCS511NCT	Constitution of India	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	2	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	50
Periods/ Week	:	2	Internal Evaluation	:	15
Credits	:	-	End Semester	:	35
Instruction Mode	:	Lecture	Exam Duration	:	2 Hrs.

Prerequisite(s): No specific pre-requisite.

Course Objectives:

1. To understand the salient features of the Indian Constitution.
2. To learn different ways of acquiring Indian Citizenship.
3. To impart the knowledge of the fundamental rights and fundamental duties of Indian citizens.
4. TO describe the directive principles of state policy and their significance.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Practice the moral values that ought to guide the Engineering profession.	**PO_6, PO_8**
CO_2	Know the definitions of risk and safety also discover different factors that affect the perception of risk.	**PO_6, PO_8**
CO_3	Appreciate the Ethical issues and know the code of ethics adopted in various professional bodies and industries.	**PO_6, PO_7, PO_8**
CO_4	Justify the need for protection of human rights and to know about concept of women empowerment.	**PO_6, PO_8, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2		2				
CO_2						2		2				
CO_3						2	2	2				
CO_4						2		2				2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction: Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy
Unit: 2	Union Government and its Administration: Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha
Unit: 3	State Government and its Administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions
Unit: 4	Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy
Unit: 5	Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Examination and Evaluation Pattern: It include both internal evaluation (15 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (35 marks) which is mainly end semester examination.

Text Books:

1	'Indian Polity' by Laxmikanth
2	'Indian Administration' by Subhash Kashyap
Reference Books:	
1	'Indian Constitution' by D.D. Basu
2	'Indian Administration' by Avasti and Avasti

Course Code	Course Title	Lecture			Semester: VI
BTCS611PCT	Compiler Design	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Formal Language & Automata Theory

Course Objectives:

1. To understand and list the different stages in the process of compilation and identify different methods of lexical analysis.
2. To design top-down and bottom-up parsers.
3. To identify synthesized and inherited attributes and develop syntax directed translation schemes
4. To develop algorithms to generate code for a target machine.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Analyze given grammar specification develop the lexical analyzer.	**PO_1, PO_3,**
CO_2	Apply given parser specification design top-down and bottom-up parsers.	**PO_3, PO_4, PO_5**
CO_3	Develop syntax directed translation schemes.	**PO_3, PO_4**
CO_4	Implement algorithms to generate code for a target machine.	**PO_3, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2									
CO_2			2	2	2							
CO_3			2	2								
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (lex, flex).
Unit: 2	**Syntax Analysis (Parser):** Context-free languages and grammars, push-down automata, LL(1) gram-mars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).
Unit: 3	**Semantic Analysis:** Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope.
Unit: 4	**Intermediate Code Generation:** Translation of different language features, different types of intermediate forms. Code Improvement (optimization): Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc.
Unit: 5	**Architecture dependent code improvement:** instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation **Advanced topics:** Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Principles of compiler design -A.V. Aho .J.D.Ullman; Pearson Education.
2	Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.
Reference Books:	
1	lex&yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly
2	Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech. 3.
3	Engineering a Compiler-Cooper & Linda, Elsevier
4	Compiler Construction, Louden, Thomson.

Course Code	Course Title	Lecture			Semester: VI
BTCS612PCT	Computer Networks	L	T	P	
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Operating System

Course Objectives:

1. To understand the fundamental concepts of data communications and computer Networks s.
2. To identify the basic components/instrument/equipment and their respective roles in data communication system
3. To incorporate networks skills in various capacities like Networks administrators, Networks designers.
4. To provide the concept of world wide web and their generations.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the different protocols layers of the OSI model & TCP/IP.	**PO_1, PO_6**
CO_2	Implement and configure the different types of Networks topologies and protocols.	**PO_2, PO_3, PO_8**
CO_3	Understand the importance of network security in data communication	**PO_6**
CO_4	Apply the different Networking sub-systems and their functions in a telecommunication system.	**PO_2, PO_3, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2					2						
CO_2		1	2					2				
CO_3						2						
CO_4		2	2	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Data Communication: Data and Information; Components of Data communication system, Data Flow: Simplex, Half-Duplex, Duplex; Components of Computer Network; Data Communication Medium; Digital and Analog Transmission. Classification of Computer Networks: Networks, LAN, MAN, WAN, PAN; Network and its Devices; Network Topology; ARPANET; Internet; Bitrate; Baud Rate; Bandwidth; Throughput and Latency
Unit: 2	Computer Networks: Network hardware (Machine, Node, Device); Network software; Network Application; Signal and Type; Layered Architecture, OSI Reference Model; Network port and Adress. Physical Layer: Transmission media; Nodes: End, Intermediate; Switching; Circuitswitched Network, Packet-Switch;
Unit: 3	Data Link Layer: Link-layer addressing; Services; Sub-layers; Framing; Error and Types; Error Detection and Correction Technique; Elementary Data link protocol; Sliding Window Protocol; Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA; Link layer Network Devices, Virtual LANs; IEEE Standards 802.11
Unit: 4	Network Layer: Routing algorithms TCP, UDP and SCTP Protocols; Congestion Control Algorithms; Quality of Service; Internetworking; Network layer in the

	internet (IPv4 and IPv6); IPv6 Packet Format, Mapping Logical to Physical Address (ARP); Flow Control, Error Control and Congestion Control in TCP and SCTP.
Unit: 5	**World Wide Web (WWW):** Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP. **Network Security**: Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Forouzen, "Data Communication and Networks ing", TMH
2	A.S. Tanenbaum, “Computer Networks s”, 3rd Edition, Prentice Hall India, 1997.
Reference Books:	
1	S. Keshav, “An Engineering Approach on Computer Networks ing”, Addison Wesley, 1997
2	W. Stallings, “Data and Computer Communication”, Macmillan Press, 1989

Course Code	Course Title	Lecture			Semester:
BTCS660PCP	Compiler Design LAB	L	T	P	VI
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Compiler Design

Course Objectives:

1. To identify tokens by lexical analysis.
2. To design LL parsers and LR parser.
3. To develop syntax directed translation schemes.
4. To develop algorithms to generate code for a target machine.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Apply given grammar specification develop the program for lexical analyzer	**PO_3, PO_4, PO_5**
CO_2	Implement given parser specification develop the program for top-down and bottom-up parsers	**PO_3, PO_4,**
CO_3	Develop program for syntax directed translation scheme	**PO_3, PO_4**
CO_4	Develop algorithms to generate code for a target machine	**PO_3, PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2	2	2							
CO_2			2	2								
CO_3			2	2								
CO_4			2	2	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Section A List of Experiments using Lex and YACC tools:

1. Write a Lex program to find Keyword, Identifier, Constant, Special Characters, Whitespace.
2. Write a Lex program to find and count Vowels and Consonants.
3. Write a Lex program to find and count Upper Case and Lower Case.
4. Write a Lex program to find and count Capital Words and Small Words.
5. Write a Lex program to count the number of Lines, Words, Spaces and Characters.
6. Write a Lex program to recognize given statement is Simple or Compound.
7. Write a Lex and YACC program to recognize valid arithmetic expression (+, -, *, / operators).
8. Write a Lex and YACC program to recognize valid relational expression.
9. Write a Lex and YACC program to recognize declarative statements.
10. Write a Lex and YACC program to implement basic calculator.

Section B List of Experiments using C Programming:

11. Write a C program to read a file and display Number of characters, Number of digits, Number of spaces, Number of lines, Number of special characters, Number of letters.
12. Write a C program display whether the given input is keyword or not.
13. Write a C program to check whether the given string is accepted by given DFA or not.
14. Write a C program to implement Lexical Analyzer.
15. Write a C program to remove left recursion from a given grammar.
16. Write a C program to remove left factoring from given grammar.
17. Write a C program to find FIRST() sets and FOLLOW() sets of as given grammar.
18. Write a C program to derive the predictive parse table.
19. Write a C program to check whether a given string belongs to operator grammar or not.

20. Write a C program to check whether a given string belongs to grammar or not by using predictive parse	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Principles of compiler design -A.V. Aho .J.D.Ullman; Pearson Education.
2	Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.
Reference Books:	
1	lex&yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly
2	Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech. 3.
3	Engineering a Compiler-Cooper & Linda, Elsevier
4	Compiler Construction, Louden, Thomson.

Course Code	Course Title	Lecture			Semester:
BTCS661PCP	Computer Networks LAB	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Networks

Course Objectives:

1. To understand the functionalities of various layers of OSI model.
2. To understand the operating System functionalities.
3. To implement Dijkstra 's algorithm to compute the shortest path through a graph.
4. To write a program to break the above DES coding.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Apply the encryption and decryption concepts in Linux environment.	**PO_2, PO_3, PO_4,**
CO_2	Ability to apply appropriate algorithm for the finding of shortest route.	**PO_3, PO_4, PO_5**
CO_3	Ability to configure the routing table.	**PO_4, PO_5**
CO_4	Able to apply essential protocols in network design and implementation	**PO_3, PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2	2								
CO_2			2	2	2							
CO_3				2	2							
CO_4			2		2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Implement the data link layer framing methods such as character, character stuffing, and bit stuffing.
2. Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP .
3. Implement Dijkstra's algorithm to compute the Shortest path thru a graph.
4. Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm
5. Take an example subnet of hosts. Obtain broadcast tree for it.
6. Take a 64 bit playing text and encrypt the same using DES algorithm.
7. Write a program to break the above DES coding
8. Using RSA algorithm encrypts a text data and Decrypt the same

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Forouzen, "Data Communication and Networks ing", TMH
2	A.S. Tanenbaum, "Computer Networks s", 3rd Edition, Prentice Hall India, 1997.

Reference Books:

1	S. Keshav, "An Engineering Approach on Computer Networks ing", Addison Wesley, 1997
2	W. Stallings, "Data and Computer Communication", Macmillan Press, 1989

Course Code	Course Title	Lecture			Semester:
BTCS662PCP	Project-I	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	6	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Lab Hours/ Week	:	6	Internal Evaluation	:	50
Credits	:	3	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	-

Prerequisite(s): Programming for Problem Solving & Design and Analysis of Algorithm

Course Objectives:

1. To understand Software requirement specification and designing methodology.
2. To familiarize of the syntax, semantics, data-types and library functions of any programming languages.
3. To apply ER Diagram, DFD, UML for designing the software application.
4. To implement the specified problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Applying SRS, techniques	**PO_2, PO_3, PO_8, PO_9, PO_{11}**
CO_2	Apply Design methods for given SRS	**PO_3, PO_5, PO_9, PO_{11}**
CO_3	Write the codes as per SRS and designed Framework	**PO_3, PO_5**
CO_4	Able to implement real world problem into software solution	**PO_3, PO_5, PO_9, PO_{11}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2					2	2		2	
CO_2			2		2				2		2	
CO_3			2		2							
CO_4			2		2				2		2	

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

- Based on real-time/ in-house/ problem specific

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Course Code	Course Title	Lecture			Semester:
BTCS760PCP	Project-II	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	6	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	200
Lab Hours/ Week	:	6	Internal Evaluation	:	100
Credits	:	6	End Semester	:	100
Instruction Mode	:	Practical	Exam Duration	:	-

Prerequisite(s): Project-I

Course Objectives:

1. To understand Software requirement specification and designing methodology.
2. Familiarization of the syntax, semantics, data-types and library functions of any programming languages.
3. To apply ER Diagram, DFD, UML for designing the software application.
4. To implement the specified problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Applying SRS, techniques	PO_2, PO_3, PO_8, PO_9, PO_{11}
CO_2	Apply Design methods for given SRS	PO_3, PO_5, PO_9, PO_{11}
CO_3	Write the codes as per SRS and designed Framework	PO_3, PO_5
CO_4	Able to implement real world problem into software solution	PO_3, PO_5, PO_9, PO_{11}, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2					2	2		2	
CO_2			2		2				2		2	
CO_3			2		2							
CO_4			2		2				2		2	2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

- Based on real-time/ in-house/ problem specific

Examination and Evaluation Pattern: It include both internal evaluation (100 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (100 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Course Code	Course Title	Lecture			Semester:
BTCS860PCP	Project-III	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	6	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	200
Lab Hours / Week	:	6	Internal Evaluation	:	100
Credits	:	6	End Semester	:	100
Instruction Mode	:	Practical	Exam Duration	:	-

Prerequisite(s): Project-I & Project-II

Course Objectives:

1. To understand Software requirement specification and designing methodology.
2. Familiarization of the syntax, semantics, data-types and library functions of any programming languages.
3. To apply ER Diagram, DFD, UML for designing the software application.
4. To implement the specified problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Applying SRS, techniques	PO_2, PO_3, PO_8, PO_9, PO_{11}
CO_2	Apply Design methods for given SRS	PO_3, PO_5, PO_9, PO_{11}
CO_3	Write the codes as per SRS and designed Framework	PO_3, PO_5
CO_4	Able to implement real world problem into software solution	PO_3, PO_5, PO_9, PO_{11}, PO_{12}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2					2	2		2	
CO_2			2		2				2		2	
CO_3			2		2							
CO_4			2		2				2		2	2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

- Based on real-time/ in-house/ problem specific

Examination and Evaluation Pattern: It include both internal evaluation (100 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (100 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

LIST OF PROFESSIONAL ELECTIVES

Course Code	Course Title	Lecture			Semester:
BTCS511PET	Principles of Programming Languages	L	T	P	V
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To study and appreciate different types of languages and the underlying mathematical theories.
2. To introduce important paradigms of programming languages.
3. To provide conceptual understanding of high-level language design and implementation.
4. To provide the concept of syntax and semantics, concurrency, functional, logic programming languages and scripting languages.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand to express syntax and semantics in formal notation.	PO_2, PO_3
CO_2	Apply suitable programming paradigm for the application.	PO_3, PO_4, PO_6
CO_3	Analyze and apply of high-level language design and implementation.	PO_4, PO_5
CO_4	Gain knowledge and comparison of the features programming languages.	PO_3, PO_4

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2									
CO_2			3	2	1							
CO_3				2	1							
CO_4			2		1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Overview of different programming paradigms e.g. imperative, object oriented, functional, logic and concurrent programming. **Syntax and semantics of programming languages:** A quick overview of syntax specification and semiformal semantic specification using attribute grammar.
Unit: 2	**Imperative and OO Languages:** Names, their scope, life and binding. Control-flow, control abstraction; in subprogram and exception handling. Primitive and constructed data types, data abstraction, inheritance, type checking and polymorphism.
Unit: 3	**Functional Languages:** Typed-calculus, higher order functions and types, evaluation strategies, type checking, implementation, case study. **Logic Programming Languages:** Computing with relation, first-order logic, SLD-resolution, unification, sequencing of control, negation, implementation, case study.
Unit: 4	**Concurrency:** Communication and synchronization, shared memory and message passing, safety and liveness properties, multithreaded program.
Unit: 5	**Formal Semantics:** Operational, denotational and axiomatic semantics of toy languages, languages with higher order constructs and types, recursive type, subtype, semantics of nondeterminism and concurrency.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Forouzen, "Data Communication and Networks ing", TMH
2	A.S. Tanenbaum, “Computer Networks s”, 3rd Edition, Prentice Hall India, 1997.

Reference Books:

1	S. Keshav, “An Engineering Approach on Computer Networks ing”, Addison Wesley, 1997
2	W. Stallings, “Data and Computer Communication”, Macmillan Press, 1989

Course Code	Course Title	Lecture			Semester: V
BTCS512PET	Parallel and Distributed Algorithms	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Design & Analysis of Algorithm

Course Objectives:

1. To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
2. To understand the main classes of parallel algorithms.
3. To study the complexity and correctness models for parallel algorithms.
4. To provide the concept of distributed shared memory systems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Learn basic principles of parallel and distributed computing and with parallel and distributed algorithms and their time complexity.	PO_1, PO_2
CO_2	Apply the Message Passing Techniques.	PO_3, PO_4
CO_3	Explore the concepts of pipelining.	PO_2, PO_3
CO_4	Analyze the distributed shared memory techniques.	PO_2, PO_3, PO_4

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	2								
CO_3		2	2									
CO_4		2	2	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Basic Technique, Need for parallel computers, Models of computation, Analyzing parallel algorithms, Expressing parallel algorithms, Parallel, Parallel & Cluster Computing
Unit: 2	Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples
Unit: 3	Pipelining- Techniques computing platform, pipeline programs examples
Unit: 4	Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP
Unit: 5	Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Nicola Santoro, "Design and Analysis of Distributed Algorithms", John Wiley.
2	Barry Wilkinson, Michael Allen, "Parallel Programming", Pearson education.

Reference Books:

1	Joseph Jaja, An Introduction to Parallel Algorithms, Addison Wesley.
2	Selim G. Akl, "The Design and Analysis of Parallel Algorithms", PHI

Course Code	Course Title	Lecture			Semester: V
BTCS513PET	Signals & Systems	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Analog Electronics Circuits and Digital Electronics.

Course Objectives:

1. To familiarize with basic concept of control systems.
2. To study the concepts and techniques of stability for linear and non-linear control systems.
3. To prove the thorough knowledge of Z transform.
4. To provide the concept of power spectral density.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the basic concept of control systems.	PO_1, PO_2
CO_2	Analyze the stability for linear and non-linear systems.	PO_2
CO_3	Design of linear control systems.	PO_3
CO_4	Application of the most powerful technique of state-space.	PO_3

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	1									
CO_3			1									
CO_4			2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Morphology of signals and their classifications. Even and odd functions, orthogonal function, definition of Step, impulse, ramp functions. Other non-sinusoidal signals and wave forms as the sum of standard functions. Fourier series representation of signals.
Unit: 2	Fourier Integral and Fourier transform and its properties. Parsevel's theorem. System representation using differential equations, transfer function, impulse response. Poles and zeros of a system
Unit: 3	Analysis of Linear Time Invariant (LTI) continuous-time system using Laplace Transform. Frequency response of LTI systems, zero input response, forced input response. Stability of LTI system, pole criteria for stability, Routh's stability test.
Unit: 4	Introduction to Z-transform, Inverse Z- transform and their properties, region of convergence. Poles and zeros. Difference equation, transfer function, pulse response. Applications of Z transform for the analysis of discrete-time LTI systems.
Unit: 5	Introduction to probability. Bay's theorem, concept of random variable, probability density and distribution function of a random variable. Introduction to random process. Power spectral density.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Simon Hykin, Barry Van Veen "Signals and System", John Wiley & Sons.
2	Robert A Gabel , "Signal and Linear Systems", John Wiley & Sons.

Reference Books:

1	Henary Stark and John W Woods, "Probability and Random Processes", Pearson Education, New Delhi.
2	Alan V. Oppenheim, "Signals and Systems", Prentice Hall, 2010

Course Code	Course Title	Lecture			Semester: V
BTCS514PET	Data Science	L	T	P	
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Mathematics, Statistics

Course Objectives:

1. To make the students to know about understanding of the data operations.
2. To make the student to learn the concept of simple statistical models and the basics of machine learning techniques of regression.
3. To analyze the capability of regression, classification problem.
4. To apply algorithms on Applications of Data Science & Machine learning.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concepts of data science process, data science toolkit, Types of data, Data collection and management	**PO_1, PO_2**
CO_2	Demonstrate the concept of simple statistical models and the basics of machine learning techniques of regression.	**PO_2**
CO_3	Apply the regression and classification problem and create the Databases	**PO_3**
CO_4	Analyze the data, Applications of Data Science, Technologies for data visualization	**PO_3**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2	1	2							
CO_4			2	1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction, Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.
Unit: 2	Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using pvalue.
Unit: 3	Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples.
Unit: 4	Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study.
Unit: 5	Network Analysis, Graphs, Social Networks, centrality, drawing centrality of Graphs, PageRank, Ego-Networks, community Detection.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Introduction to Data Science a Python approach to concepts, Techniques and Applications, Igual, L;Seghi', S. Springer, ISBN:978-3-319-50016-4
Reference Books:	
1	Python Data Analysis, Second Ed., Armando Fandango, Packt Publishing, ISBN: 9781787127487
2	Data Analysis with Python A Modern Approach, David Taieb, Packt Publishing, ISBN-9781789950069

Course Code	Course Title	Lecture			Semester:
BTCS611PET	Data Mining and Data Warehousing	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Database Management System

Course Objectives:

1. To understand the concept of data mining principles and techniques with data mining as a cutting-edge business intelligence tool.
2. To develop critical thinking, problem solving and decision-making skills in terms of data warehouse and data mining.
3. To learn various schema model and the Star Schema to design a Data Warehouse.
4. To provide the concept of classification and clustering methods.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Analyze and design a data warehouse or data mart to present information needed by the manager and can be utilized for managing clients.	PO_2, PO_3
CO_2	Implement a quality data warehouse or data mart effectively.	PO_3, PO_5
CO_3	Apply the data resources in such a way that it will truly meet management's requirements.	PO_3, PO_4, PO_6
CO_4	Evaluate standards and new technologies to determine their potential impact on your information resource for a large complex data warehouse/data mart.	PO_4, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2									
CO_2			2		2							
CO_3			2	1		1						
CO_4				2	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Fundamentals of Data Mining, Kinds of Patterns can be mined, Technologies Used, Applications and Issues in Data Mining. **Types of Data:** Attribute types, Basic Statistical descriptions of Data, Measuring data Similarity and Dissimilarity. **Data Preprocessing:** Need of Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation.
Unit: 2	**Data Warehouse and OLAP:** Data Warehouse, Data Warehouse Modeling, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-oriented induction
Unit: 3	**Mining Frequent Patterns, Associations and Correlations:** Market Basket Analysis, Association rule mining, Frequent Item set mining methods, Pattern Evaluation methods, Constraint based frequent pattern mining, Mining Multilevel and Multidimensional patterns
Unit: 4	**Classification:** General approach to classification, Classification by Decision Tree Induction, Bayes Classification methods, Bayesian Belief Networks, Classification by Backpropagation, Lazy Learners, Other Classification methods, Classification using Frequent patterns, Model Evaluation and selection

Unit: 5	**Cluster Analysis:** Basic Clustering methods, Partitioning methods, Density – Based Methods, Grid- based methods, and Evaluation of Clustering, Outlier Analysis and Detection methods. **Data Mining Trends and Research Frontiers:** Mining Complex Data Types, Data Mining Applications, Data Mining Trends
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Han J & Kamber M, "Data Mining: Concepts and Techniques", Harcourt India, Elsevier India, Second Edition.
2	Pang-NingTan. MichaelSteinback,VipinKumar, "Introduction to Data Mining", Pearson Education, 2008.
Reference Books:	
1	Margaret H Dunham,S.Sridhar, "Data mining: Introductory and Advanced Topics", Pearson Education, 2008.
2	Humphires,hawkins,Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.
3	Anahory, Murray, "Data Warehousing in the Real World", PearsonEçiucation, 2008.
4	Kargupta,Joshi,etc., "Data Mining: Next Generation Challenges and Future Directions" Prentice Hall of IndiaPvtLtd, 2007.

Course Code	Course Title	Lecture			Semester:
BTCS612PET	Python Programming	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Any programming language

Course Objectives:

1. To learn the fundamentals of writing Python programming and core Python scripting elements such as variables and flow control structures.
2. To impart with concept of lists and sequence data and use of Python to read and write files.
3. To deploy the Python standard library for implementing various standard algorithms.
4. To explore Python's object-oriented features for solving various engineering problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Read and write the python program for various descriptive statistics on a given dataset.	**PO_3, PO_5**
CO_2	Implement the list and sequence data and use of Python to read and write files.	**PO_3, PO_5**
CO_3	Apply Pandas, Matplotlib to visualize the outcomes of given algorithm.	**PO_5**
CO_4	Write the Python program for solving classification and regression problem using any standard repository (UCI ML Repository/ Kaggle)	**PO_3, PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			3		2							
CO_2			3		2							
CO_3					2							
CO_4			3		2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, Input-Output, Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions, If, If- else, Nested if-else, Looping, For, While, Nested loops, Control Statements, Break, Continue, Pass
Unit: 2	**String Manipulation and Lists:** **Strings:** Accessing Strings, Basic Operations, String slices, Function and Methods **Lists:** Introduction, accessing list, Operations, Working with lists, Function and Methods
Unit: 3	**Functions and modules:** Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Importing module, Math module, Random module, Packages, Composition **Exception Handling:** Exception, Exception Handling, Except clause, Try ? finally clause, User Defined Exceptions
Unit: 4	**OOPs concept:** Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding **Regular expressions:** Match function, Search function, Matching VS Searching, Modifiers, Patterns **Database:** Introduction, Connections, Executing queries, Transactions, Handling error

Unit: 5	**Networking:** Socket, Socket Module, Methods, Client and server, Internet modules **Multithreading:** Thread, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue **GUI Programming:** Introduction, Tkinter programming, Tkinter widgets, Sending email
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Sheetal Taneja and Naveen Kumar, "Python Programming - A Modular Approach", Pearson education.
2	Cay S. Horstmann and Rance D. Necaise, "Python for Everyone", Wiley.
Reference Books:	
1	Allen Downe, "Learning With Python", Wiley.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly' Publisher

Course Code	Course Title	Lecture			Semester:
BTCS613PET	Advanced Computer Architecture	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Organization

Course Objectives:

1. To learn the computer design and performance metrics.
2. To understand pipelining, RISC and CISC.
3. To study about parallelism with instruction-Level parallelism.
4. To impart the knowledge of practical issues in interconnecting networks.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the performance of processor and various instruction sets.	PO_3
CO_2	Gain knowledge of RISC, CISC and pipelining hazards.	PO_4
CO_3	Analyze the importance of parallelism and dynamic scheduling.	PO_2, PO_3
CO_4	Design a inter connection and networks for a given scenario.	PO_3, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1			2									
CO_2				2								
CO_3		2	2									
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Fundamentals of Computer Design:Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law. Instruction set principles and examples- Introduction, Classifying instruction set- MEmory addressing- type and size of operands, Operations in the instruction set.
Unit: 2	Pipelines: Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties. Memory Hierarchy Design: Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.
Unit: 3	Instruction Level Parallelism the Hardware Approach: Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation. ILP Software Approach Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.
Unit: 4	Multi Processors and Thread Level Parallelism: Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

Unit: 5	Inter Connection and Networks: Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	John L. Hennessy, David A. Patterson – Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier.
2	John P. Shen and Miikko H. Lipasti – Modern Processor Design : Fundamentals of Super Scalar Processors
Reference Books:	
1	Computer Architecture and Parallel Processing – Kai Hwang, Faye A.Brigs., MC Graw Hill.
2	Advanced Computer Architecture – A Design Space Approach – Dezso Sima, Terence Fountain, Peter Kacsuk , Pearson Ed.

Course Code	Course Title	Lecture			Semester:
BTCS614PET	Distributed Systems	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Database Management System, Operating System & Computer Networks

Course Objectives:

1. To familiarize the students with the basics of distributed computing systems.
2. To understand the concepts of distributed file systems, shared memory and message passing systems, synchronization and resource management.
3. To learn the concept of inter–process Communication, API for the Internet Protocols, External Data Representation and Marshalling – Client –Server Communication – Group Communication – Case Study.
4. To know the concept of distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications – Java RMI – Case Study.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand Map-Reduce Architecture and Map reduce programming.	**PO_1, PO_2**
CO_2	Design and develop various algorithms for different environment like Amoeba, Hadoop, HDFS architecture, setting up the Hadoop environment.	**PO_3, PO_5**
CO_3	Ability to design distributed systems for various real-world applications.	**PO_3, PO_5**
CO_4	Verify and analyze the time complexity of the algorithms related to distributed computing.	**PO_2, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		2							
CO_3			2		3							
CO_4		2		2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Basic Concepts** Characterization of Distributed Systems – Examples – Resource Sharing and the Web Challenges System Models – Architectural and Fundamental Models – Networks ing and InterNetworks ing Types of Networks s – Networks Principles – Internet Protocols – Case Studies.
Unit: 2	**PROCESSES AND DISTRIBUTED OBJECTS** Inter–process Communication – The API for the Internet Protocols – External Data Representation and Marshalling – Client –Server Communication – Group Communication – Case Study – Distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications – Java RMI – Case Study.
Unit: 3	**OPERATING SYSTEM ISSUES** The OS Layer – Protection – Processes and Threads – Communication and Invocation – OS Architecture – Security – Overview – Cryptographic Algorithms – Digital Signatures – Cryptography Pragmatics – Case Studies – Distributed File

	Systems – File Service Architecture – Sun Networks File System – The Andrew File System.
Unit: 4	**OPERATING SYSTEM ISSUES** Name Services – Domain Name System – Directory and Discovery Services – Global Name Service – X.500 Directory Service – Clocks – Events and Process States – Synchronizing Physical Clocks – Logical Time And Logical Clocks – Global States – Distributed Debugging – Distributed Mutual Exclusion – Elections – Multicast Communication Related Problems.
Unit: 5	**DISTRIBUTED TRANSACTION PROCESSING** Transactions – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering – Comparison – Flat and Nested Distributed Transactions – Atomic Commit Protocols – Concurrency Control in Distributed Transactions – Distributed Deadlocks – Transaction Recovery – Overview of Replication And Distributed Multimedia Systems.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", 3rd Edition, Pearson Education, 2002.
2	Andrew S. Tanenbaum, Maartenvan Steen, Distibuted Systems, "Principles and Pardigms", Pearson Education, 2002
3	John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
Reference Books:	
1	Sape Mullender, "Distributed Systems", 2nd Edition, Addison Wesley, 1993.
2	Albert Fleishman, Distributes Systems, "Software Design and Implementation", Springer, Verlag, 1994.
3	M. L. Liu, "Distributed Computing Principles and Applications", Pearson Education, 2004

Course Code	Course Title	Lecture			Semester:
BTCS615PET	Computer Graphics	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure & Algorithm and Engineering Mathematics

Course Objectives:

1. To understand the 2D/ 3D geometrical transformation (translation, rotation, scaling).
2. To understand computer graphics techniques (2-D/3-D), focusing on 3D modelling, image synthesis, and rendering.
3. To provide the concept of geometric transformations, geometric algorithms, software systems.
4. To impart the knowledge of 3D object models (surface, volume and implicit), visible surface algorithms, image synthesis, shading and mapping, ray tracing, radiosity, global illumination, photon mapping, and anti-aliasing.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate geometrical transformations (2-D/3-D) with the relevant mathematics of computer graphics, e.g., 3D rotations using both vector algebra, geometrical transformations and projections using homogeneous co-ordinations system.	PO_1, PO_2
CO_2	Apply principles and techniques of computer graphics, e.g., the graphics pipeline, and Brenham algorithm for speedy line and circle generation.	PO_3, PO_4
CO_3	Apply computer graphics concepts in the development of computer games, information visualization, and business applications.	PO_3, PO_5
CO_4	Gain the knowledge of 3D object models and apply various visible surface algorithm, shading and mapping etc.	PO_3

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	2								
CO_3			2		2							
CO_4			2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction, Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices. **Output primitives**: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms
Unit: 2	**2-D geometrical transforms**: Translation, scaling, rotation, other transformations, matrix representations and homogeneous coordinates, 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.

Unit: 3	**3-D object representation:** Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon rendering methods.
Unit: 4	**3-D Geometric transformations**: Translation, rotation, scaling, reflection and shear transformations, composite transformations. **3-D viewing:** Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.
Unit: 5	**Visible surface detection methods**: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods **Computer animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Computer Graphics C *version*", Donald Hearn and M.Pauline Baker, Pearson Education.
2	Computer Graphics Principles & practice", second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.
Reference Books:	
1	Principles of Computer Graphics, Shalini Govil, Pai, 2005, Springer
2	Computer Graphics, Steven Harrington, TMH

Course Code	Course Title	Lecture			Semester:
BTCS616PET	Advanced Operating Systems	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Operating Systems

Course Objectives:

1. To define, explain, and apply introductory operating systems concepts: process management, inter-process communication, memory management, I/O systems, file systems.
2. To utilize the UNIX operating system interface to implement a user-level shell in the C language.
3. To design and implement a correct concurrent program requiring synchronization.
4. To impart the concept of real time operating system and their classifications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Able to understand Unix kernel and file management	PO_1, PO_2
CO_2	Gain the knowledge of distributed operating systems	PO_2
CO_3	Evaluate the design issues of multiprocessor operating system	PO_6
CO_4	Compare various operating systems such as real time, batch OS etc.	PO_2

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2				2						
CO_3												
CO_4		2										

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction**: Functions of operating systems, Design approaches: layered, kernel based and virtual machine approach, types of advanced operating systems (NOS, DOS, Multiprocessor OS, Mobile OS, RTOS, Cloud OS) **Unix Kernel and File Management**: System Structure, User Perspective, Architecture of Unix Operating System, Buffer cache: Header, Buffer Pool, Retrieving, Reading and Writing Buffer. File Representation: inodes: Structure of file Directories, Path conversion to inode, superblock, inode assignment, allocation of disk blocks
Unit: 2	**Unix Process and Memory management**: Detailed design of Process Structure: Kernel Data structures for process, Structure of Uarea and Process table, Process states and Transitions. Context of a Process: Static and Dynamic area of context, Saving the Context Layout of System Memory, Regions, Mapping regions with Process, page table and mapping virtual address to physical address.
Unit: 3	**Distributed Operating system concepts**: Goals, Distributed Computing Models, Hardware Concepts, Software Concepts, Architecture of DOS. Design Issues: Transparency, Flexibility, Scalability, Reliability, Performance, fault tolerance
Unit: 4	**Multiprocessor Operating System**: Introduction, Basic multiprocessor system architectures, design issues, Threads, Process synchronization: the test and set instruction, the swap instruction, implementation of the process wait. Processor scheduling: Issues, Co-scheduling, Smart scheduling, Affinity Based scheduling
Unit: 5	**Real Time Operating Systems and Mobile OS**: Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Scheduling in RTOS: Clock driven: cyclic, Event driven: EDF and rate monotonic scheduling.

	Mobile OS: Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design issues
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Charles Crowley, "Operating Systems: A Design-Oriented Aproach", Tata McGraw Hill Education".
2	Stuart E. Madnick & John J. Donovan. Operating Systems. McGraw Hill
Reference Books:	
1	Harvey M Dietel, " An Introduction to Operating System", Pearson Education
2	D M Dhamdhere, "Operating Systems :A Concept basedAproach", McGraw Hill

Course Code	Course Title	Lecture			Semester:
BTCS617PET	Embedded Systems	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Digital Electronics

Course Objectives:

1. To understand the concept of embedded computing – characteristics of embedded computing applications – embedded system design challenges.
2. To explain the process of Real time Embedded system – Selection of processor; Memory; database security, mechanism, policy and standards.
3. To learn the concept of RTOS- Inter Process communication, Interrupt driven Input and Output Non-maskable interrupt, Software interrupt;
4. To acquire the knowledge of thread - single, multithread concept; multitasking semaphores.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand characteristics of embedded computing applications, embedded system design challenges.	PO_1, PO_3
CO_2	Demonstrate the process of Selection of processor; Memory; database security, mechanism, policy and standards.	PO_2, PO_3
CO_3	Analyze the mechanism of Inter Process communication, Interrupt driven Input and Output Non- maskable interrupt, Software interrupt.	PO_2, PO_4
CO_4	Implement multithread concept and multitasking semaphores.	PO_3, PO_5

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2									
CO_2		2	2									
CO_3		2		2								
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Embedded System Organization** Embedded computing – characteristics of embedded computing applications – embedded system design challenges; Build process of Real time Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I^2C, CAN, USB buses, 8 bit –ISA, EISA bus.
Unit: 2	**Real-Time Operating System** Introduction to RTOS; RTOS- Inter Process communication, Interrupt driven Input and Output Non- maskable interrupt, Software interrupt; Thread – Single, Multithread concept; Multitasking Semaphores.
Unit: 3	**Interface with Communication Protocol** Design methodologies and tools – design flows – designing hardware and software Interface. system integration; SPI, High speed data acquisition and interface-SPI read/write protocol, RTC interfacing and programming.
Unit: 4	**Design of Software for Embedded Control** Software abstraction using Mealy-Moore FSM controller, Layered software development, Basic concepts of developing device driver – SCI – Software - interfacing & porting using standard C & C++ ; Functional and performance

	Debugging with benchmarking Real-time system software – basics of contemporary RTOS – VXWorks, UC/OS-II
Unit: 5	**Interfacing with Embedded Controller** Programmable interface with A/D & D/A interface; Digital voltmeter, control-Robot system; - PWM motor speed controller, serial communication interface. Standard single purpose processor's peripherals: timers, counters, watchdog timers, UART, LCD controllers, keypad controllers. **Applications:** Digital camera-washing machine-cell phones-home security systems-finger print identifiers-cruise control-printers Automated teller machine
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Steven F. Barrett, Daniel J. Pack, "Embedded Systems – Design and Applications with the 68HC 12 and HCS12", Pearson Education, 2008.
2	Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.
Reference Books:	
1	Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.
2	Jack R Smith "Programming the PIC microcontroller with MBasic" Elsevier, 2007.

Course Code	Course Title	Lecture			Semester: VI
BTCS618PET	Data Visualization using R programming	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Statistics, Data Mining, Data Science

Course Objectives:

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1		PO_1, PO_3
CO_2		PO_2, PO_3
CO_3		PO_2, PO_4
CO_4		PO_3, PO_5

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2									
CO_2		2	2									
CO_3		2		2								
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	
Unit: 2	
Unit: 3	
Unit: 4	
Unit: 5	

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Course Code	Course Title	Lecture			Semester:
BTCS711PET	Artificial Intelligence	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Architecture & Organization

Course Objectives:

1. To understand the concept of intelligent human behaviors on a computer.
2. To learn the concept of Artificial intelligence, include: problem solving, reasoning, planning, natural language understanding, computer vision, automatic programming, and machine learning.
3. To learn and possess a firm grounding in the existing techniques and component areas of Artificial Intelligence.
4. To apply this knowledge to the development of Artificial Intelligent Systems and to the exploration of research problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of intelligent human behaviors on a computer	PO_1, PO_2
CO_2	Be familiar with techniques for computer-based representation and manipulation of complex information, knowledge, and uncertainty.	PO_2, PO_4
CO_3	Gain awareness of several advanced AI applications and concepts	PO_2, PO_9
CO_4	Apply various machine learning algorithms to solve real-life problem.	PO_3, PO_5, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2		2								
CO_3		2							1			
CO_4			2		2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction**: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.
Unit: 2	**Introduction to Search** : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.
Unit: 3	**Knowledge Representation** & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.
Unit: 4	**Machine Learning** : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning.
Unit: 5	**Pattern Recognition** : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education.
2	Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill.
Reference Books:	
1	E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education.
2	Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India.

Course Code	Course Title	Lecture			Semester:
BTCS712PET	Block Chain Technology	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Python Programming

Course Objectives:

1. To understand the concept of the function of Blockchains as a method of securing distributed ledgers
2. To acquire the knowledge of cryptocurrency.
3. To impart the concept of Ethereum framework.
4. To provide the knowledge of Ethereum network and Ethereum Virtual Machine.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Familiarize the functional/operational aspects of cryptocurrency ecosystem.	**PO_1, PO_2**
CO_2	Understand emerging abstract models for Blockchain Technology.	**PO_2**
CO_3	Identify major research challenges and technical gaps existing between theory and practice in cryptocurrency.	**PO_4, PO_9**
CO_4	Analyze the Ethereum network and Ethereum Virtual Machine.	**PO_2**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3				2					1			
CO_4		2										

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Blockchain:** Basics of Blockchain, Distributed Ledger Technology, Types of network, Components of Blockchain or DLT, Ledger: Blocks, Blockchain, PKI and Cryptography: Private Keys, Public Keys, Hashing Digital Signature, Digital Token, Cryptocurrency.
Unit: 2	**Consensus Problem** - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS)
Unit: 3	**Blockchain Working:** Block, Hash, Structure of Blockchain, Distributed, Lifecycle of Blockchain, Smart Contract, Consensus Algorithm, Fault Tolerance, Actors of Blockchain, Blockchain developer, Blockchain operator, Blockchain regulator, Blockchain user, Membership service provider, Building A Small Blockchain Application
Unit: 4	**Introduction to Bitcoin:** Bitcoin, Wallet, Blocks, Merkley Tree, hardness of mining, transaction verifiability, anonymity, forks, double spending, mathematical analysis of properties of Bitcoin.

Unit: 5	**Ethereum** - Ethereum network, Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity - Smart Contracts, some attacks on smart contracts, Design and issue Cryptocurrency.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
2	Arshdeep Bahga and Vijay Madisetti, "Blockchain Application: A Hnads-on Approach".
Reference Books:	
1	Xiwei (Sherry) Xu, Ingo Weber and Mark Staples "Architecture for Blockchain Applications", Springer.
2	Andreas Antonopoulos, "Mastering Bitcoin", O'Reilly' Publisher.

Course Code	Course Title	Lecture			
BTCS713PET	Real Time System	L	T	P	**Semester:** VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Embedded System

Course Objectives:

1. To develop an understanding of various Real Time systems Application
2. To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of real-time systems.
3. To acquire the concept of Real time Communication, Soft and Hard RT Communication systems.
4. To understand in-depth hands-on experience in designing and developing a real operational system.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand concepts of Real-Time systems and modelling.	PO_1,
CO_2	Recognize the characteristics of a real-time system.	PO_2
CO_3	Understand and Design document on an architectural design of a real-time system.	PO_3, PO_6
CO_4	Develop a real operational system.	PO_3, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2										
CO_3			2			2						
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction**: Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.
Unit: 2	**Real Time Scheduling**: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.
Unit: 3	**Resources Sharing**: Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources, Controlling Concurrent Accesses to Data Objects.
Unit: 4	**Real Time Communication**: Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for

	Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols.
Unit: 5	**Real Time Operating Systems and Databases:** Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Concurrency Control, Overview of Commercial Real Time databases.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Real Time Systems by Jane W. S. Liu, Pearson Education Publication
Reference Books:	
1	MALL RAJIB, "REAL TIME SYSTEMS", PEARSON EDUCATION
2	Albert M. K. Cheng, "Real-Time Systems: Scheduling, Analysis, and Verification", Wiley.

Course Code	Course Title	Lecture			Semester:
BTCS714PET	Ad-Hoc and Sensor Network	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Python Programming

Course Objectives:

1. To learn Ad-hoc wireless Internet, MAC protocols for Ad hoc Wireless Networks Issues in Designing a MAC Protocol for Ad hoc Wireless Networks.
2. To understand the Basics of Wireless, Sensors and Applications: The Mica Mote, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications Data Retrieval in Sensor Networks.
3. To provide the concept of classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.
4. To acquire the concept of operating system in sensors.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand ad hoc wireless Internet, MAC protocols for Ad hoc Wireless Networks Issues	PO_1
CO_2	Analyze Routing Protocol for Ad hoc Wireless Networks, Classifications of Routing Protocols, Transport Layer for Ad Hoc Wireless Networks	PO_2
CO_3	Demonstrate Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.	PO_3, PO_{10}
CO_4	Design and implement the application of operating system in sensors.	PO_3, PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2										
CO_3			2							2		
CO_4			2	2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Ad Hoc Wireless Networks s:** Introduction, Issues in Ad hoc wireless Networks s, Ad hoc wireless Internet **MAC protocols for Ad hoc Wireless Networks s** Issues in Designing a MAC Protocol for Ad hoc Wireless Networks s, Design Goals for a MAC Protocol for Ad hoc Wireless Networks s, Classifications of the MAC Protocols, Other MAC Protocols.
Unit: 2	**Routing Protocols for Ad Hoc Wireless Networks s** Issues in Designing a Routing Protocol for Ad hoc Wireless Networks s, Classifications of Routing Protocols **Transport Layer for Ad Hoc Wireless Networks s** Issues in Designing a Transport layer protocol for Ad hoc Wireless Networks s, Design goal s of a Transport layer protocol for Ad hoc Wireless Networks s, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks.
Unit: 3	**Security protocols for Ad hoc Wireless Networks s** Security in Ad hoc Wireless Networks s, Networks Security Requirements, Issues and

	Challenges in Security Provisioning, Networks Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks.
Unit: 4	**Basics of Wireless, Sensors and Applications:** The Mica Mote, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications **Data Retrieval in Sensor Networks s:** Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.
Unit: 5	**Sensor Networks Hardware:** Components of Sensor Mote, **Operating System in Sensors–** TinyOS, LA-TinyOS, SOS, RETOS **Imperative Language:** nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor Networks extension, TOSSIM.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Carlos de Morais Cordeiro and Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Applications", Second Edition, World Scientific Publishers, 2011.
Reference Books:	
1	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks s', A John Wiley & Sons Inc. Publication, 2007.
2	Prasant Mohapatra and Sriramamurtyhy, "Ad Hoc Networks s: Technologies and Protocols", Springer International Edition, 2009.

Course Code	Course Title	Lecture			Semester:
BTCS715PET	Internet-of-Things	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): It is expected that the students have done BTCS711ET and BTCS714PET courses.

Course Objectives:

1. To understand the concepts of Internet of Things and can able to build IoT applications
2. To learn the architecture and applications of IoT.
3. To learn the importance of python for the implementation of IoT.
4. To impart the knowledge of challenges in IoT and their possible solutions.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the impact and challenges posed by IoT networks leading to new architectural models	**PO_1, PO_2**
CO_2	Analyze the role of IoT protocols for efficient network communication	**PO_2, PO_5**
CO_3	Elaborate the need for Data Analytics and Security in IoT	**PO_3, PO_5**
CO_4	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.	**PO_3, PO_9, PO_{10}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2			1							
CO_3			2		2							
CO_4			2						1	2		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to IoT:** Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs **IoT & M2M:** Machine to Machine, Difference between IoT and M2M, Software define Network
Unit: 2	**Network & Communication aspects:** Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination
Unit: 3	**Challenges in IoT:** Design challenges, Development challenges, Security challenges, Other challenges
Unit: 4	**Domain specific applications of IoT:** Home automation, Industry applications, Surveillance applications, Other IoT applications
Unit: 5	**Developing IoTs:** Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2	Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

Reference Books:

1	Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice
2	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013

Course Code	Course Title	Lecture			Semester:
BTCS716PET	Machine Learning	L	T	P	VII
Version: 1.2	**Date of Approval:** 18th BoS 27-02-2024	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Mining and Data Ware Housing

Course Objectives:

1. To understand the basic building blocks and general principles that allow one to design machine learning algorithms.
2. To become familiar with specific, widely used machine learning algorithms.
3. To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.
4. To provide the concept of various machine learning modelling paradigms.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the basic concept of machine learning.	PO_1, PO_2
CO_2	Analyze a variety of learning algorithms to data.	PO_2, PO_3, PO_5
CO_3	Apply the Neural Networks and its usage in machine learning application.	PO_4
CO_4	Perform evaluation of learning algorithms and model selection.	PO_4, PO_9

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2		2							
CO_3				2								
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Machine Learning**, Need of Machine Learning, Application of Machine Learning, Types of Machine Learning, Design cycle of Machine Learning. **Machine Learning Statistic:** Data, Dataset, Features, Data formats: Primary, Secondary, Qualitative, Quantitative; Descriptive Statistic, Inferential Statistic, Measure of Central Tendency, Measure of Dispersion.
Unit: 2	**Exploratory Data Analysis:** Data Collection Techniques, Data Cleansing / Preprocessing, Outliers handling, Univariate Analysis, Bi-variate Analysis, **Hypothesis:** Null-hypothesis, Alternate-hypothesis; Bias-Variance tradeoff. ML basic Libraries: Pandas, Numpy, Matplotlib, Seaborn, Scikit-Learn.
Unit: 3	**Supervised-Learning:** Regression – Linear Regression, Support Vector Regression (SVR). Best fit line, Residual, cost function, learning rate. **Gradient Descent:** Global minima, Local minima; Under fitting, Over fitting. Classification - Logistic Regression, Sigmoid function, KNN Algorithm.
Unit: 4	**Decision Tree Learning:** Concept of decision tree, Using ID3 and CART algorithm, Picking the Splitting attribute: Entropy, Information Gain. **Ensemble Learning**: Base leaner (weak learner), Bagging (Bootstrap aggregation), Boosting: Ada-Boost, XGboost, Gradient Boosting;
Unit: 5	**Support Vector Machines:** Hyper plane, Support Vectors, Kernal Function: Linear, Polynomial, RBF; Maximum margin linear separator. **Bayesian Learning:** Bayes rule, Naïve Bayes learning algorithm, Bayes nets and Markov nets.

	Clustering: K-Mean clustering: Centroid, Distance Metric, Elbow method for clustering.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Machine Learning – Tom M. Mitchell, - MGH
2	Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)
Reference Books:	
1	Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
2	Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

Course Code	Course Title	Lecture			Semester:
BTCS831PET	Image Processing	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Graphics

Course Objectives:

1. To imparts knowledge in the area of image and image processing.
2. To understand fundamentals of digital image processing.
3. To provide knowledge of the applications of the theories taught in Digital Image Processing.
4. To learn the concept of various segmentation techniques.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand Basics of Image formation and transformation using sampling and quantization	PO_1, PO_2
CO_2	Analyze different types signal processing techniques used for image sharpening and smoothing.	PO_2
CO_3	Perform and apply compression and coding techniques used for image data.	PO_3, PO_5
CO_4	Apply various segmentation techniques.	PO_3, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2		2							
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Image Processing:** Image formation, image geometry perspective and other transformation, stereo imaging elements of visual perception.Digital Image-sampling and quantization serial & parallel Image processing.
Unit: 2	**Signal Processing:** Signal Processing - Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification, Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour
Unit: 3	**Image Restoration:** Image Restoration-Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.
Unit: 4	**Segmentation Techniques:** Segmentation Techniques-thresh holding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.
Unit: 5	**Shape Analysis:** Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, Skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications –

	Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Gonzalez and Wood, "Digital Image Processing", Addison Wesley, 1993.
2	Anil K.Jain, "Fundamental of Image Processing", Prentice Hall of India.
Reference Books:	
1	Rosenfeld and Kak, "Digital Picture Processing" vol.I&vol.II, Academic,1982
2	Ballard and Brown, "Computer Vision", Prentice Hall, 1982

Course Code	Course Title	Lecture			Semester:
BTCS832PET	Data Analytics	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Engineering Mathematics and Data Mining & Data ware Housing

Course Objectives:

1. To learn the fundamental concepts of data analytics.
2. To provide the principles and methods of statistical analysis.
3. To discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
4. To understand the various search methods and visualization techniques.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Explain the importance of data and data analysis	**PO_1, PO_2**
CO_2	Interpret the probabilistic models for data	**PO_2**
CO_3	Illustrate hypothesis, uncertainty principle	**PO_3**
CO_4	Demonstrate the regression analysis	**PO_3, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2									
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Data Analytics and Decision Making**: Introduction, Overview of the Book, The Methods, The Software, Modeling and Models, Graphical Models, Algebraic Models, Spreadsheet Models, Seven-Step Modeling Process. **Describing the Distribution of a Single Variable**: Introduction, Basic Concepts, Populations and Samples, Data Sets, Variables, and Observations, Types of Data, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Numerical Summary Measures, Numerical Summary Measures with Stat Tools, Charts for Numerical Variables, Time Series Data, Outliers and Missing Values, Outliers, Missing Values, Excel Tables for Filtering, Sorting, and Summarizing. **Finding Relationships among Variables**: Introduction, Relationships among Categorical Variables, Relationships among Categorical Variables and a Numerical Variable.
Unit: 2	**Probability and Probability Distributions**: Introduction, Probability Essentials, Rule of Complements, Addition Rule, Conditional Probability and the Multiplication Rule, Probabilistic Independence, Equally Likely Events, Subjective Versus Objective Probabilities, Probability Distribution of a Single Random Variable, Summary Measures of a Probability Distribution, Conditional Mean and Variance, Introduction to Simulation Normal Random Distribution.
Unit: 3	**Decision Making under Uncertainty**: Introduction, Elements of Decision Analysis, Payoff Tables, Possible Decision Criteria, Expected Monetary Value (EMY), Sensitivity Analysis, Decision Trees, Risk Profiles, The Precision Tree Add-In, Bayes' Rule, Multistage Decision Problems and the Value of Information, The Value of Information, Risk Aversion and Expected Utility,

	utility Functions, Exponential Utility, Certainty Equivalents, Is Expected Utility Maximization Used?
Unit: 4	**Hypothesis Testing using R programming**: Introduction, Concepts in Hypothesis Testing, Null and Alternative Hypothesis, One-Tailed Versus Two-Tailed Tests, Types of Errors, Significance Level and Rejection Region, Significance from p-values, Type II Errors and Power, Hypothesis Tests and Confidence Intervals, Practical versus Statistical Significance, Hypothesis Tests for a Population Mean.
Unit: 5	**Regression Analysis**: Estimating Relationships: Introduction, Scatterplots : Graphing Relationships, Linear versus Nonlinear Relationships, Outliers, Unequal Variance, No Relationship, Correlations: Indications of Linear Relationships, Simple Linear Regression, Least Squares Estimation, Standard Error of Estimate, The Percentage of Variation Explained: R-Square, Multiple Regression, Interpretation of Regression Coefficients, Interpretation of Standard Error of Estimate and R-Square, Modeling Possibilities, Dummy Variables, Interaction Variables, Nonlinear Transformations, Validation of the Fit., Statistical Inference: Introduction, Assumptions, Nonconstant Error Variance, Nonnormality of Residuals, Autocorrelated Residuals, Prediction.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2	Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012
Reference Books:	
1	Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons,2014
2	Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles , David Corrigan, "Harness the Power of Big Data The IBM Big Data Platform", Tata McGraw Hill Publications, 2012

Course Code	Course Title	Lecture			Semester:
BTCS833PET	Neural Networks and Deep Learning	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Artificial Intelligence and Machine Learning

Course Objectives:

1. To understand the major deep learning algorithms, the problem settings, and their applications to solve real world problems.
2. To learn the foundations of artificial neural networks and their various types.
3. To acquire the knowledge on deep learning concepts.
4. To gain knowledge to apply optimization strategies.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	PO_1, PO_2
CO_2	Implement deep learning algorithms and solve real-world problems.	PO_3
CO_3	Ability to use an efficient algorithm for Deep models	PO_2, PO_3
CO_4	Apply optimization strategies for large scale applications	PO_3, PO_9

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3		2	2									
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.
Unit: 2	Feedforward neural network: Artificial Neural Network, activation function, multi-layer neural network. Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.
Unit: 3	Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy. Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.
Unit: 4	Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.
Unit: 5	Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing. Deep Learning Tools: Caffe, Theano, Torch.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2	Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

1	Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2	Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013

Course Code	Course Title	Lecture			Semester:
BTCS834PET	Cloud Computing	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Distributed System

Course Objectives:

1. To understand the concept of cloud computing fundamentals, issues and challenges of cloud computing, Evolution of Cloud Computing, Applications cloud computing.
2. To learn the characterizes of cloud computing services and models, role of Virtualization, Grids and cluster.
3. To explain Cloud Security Challenges and Risks.
4. To learn the concept of Software-as-a-Service Security, Security Governance, Risk Management, Security Monitoring, Security Architecture Design, Data Security.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand fundamentals of Cloud Computing	**PO_1, PO_2**
CO_2	Demonstrate cloud computing services and models and role of Virtualization, Grids and cluster.	**PO_3**
CO_3	Analyze Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance and Risk Management	**PO_3, PO_4**
CO_4	Apply any one Cloud Computing simulation toolkit such as Eucalyptus - Nimbus - Open Nebula, CloudSim for cloud services	**PO_3, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2	2								
CO_4			2		1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Cloud Computing Fundamentals:** Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing, Applications cloud computing, Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.
Unit: 2	**Cloud Services and File System** Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service- Monitoring as a Service – Communication as services. Service providers- Google App Engine, Amazon EC2, Microsoft Azure, Sales force. Introduction to MapReduce, GFS, HDFS, Hadoop Framework
Unit: 3	**Collaborating With Cloud** Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing ,Databases Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks s – Collaborating via Blogs and Wikis.

Unit: 4	**Virtualization** Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation. **Hardware and Infrastructure** Clients, Security, Networks , Services. Accessing the Cloud – Platforms, Web Applications, Web APIs, Web Browsers. Cloud Storage – Overview, Cloud Storage Providers, Standards – Application, Client, Infrastructure, Service.
Unit: 5	**Security in the Cloud** Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009. Kumar Saurabh, "Cloud Computing – insights into New -Era Infrastructure", Wiley India,2011.
2	Cloud Computing "A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
Reference Books:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

Course Code	Course Title	Lecture			Semester:
BTCS835PET	Human Computer Interaction	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Graphics and Image Processing

Course Objectives:

1. To learn the foundations of human computer interaction.
2. To understand the concept of design technologies for individuals and persons with disabilities.
3. To provide the guidelines for user interface.
4. To impart the knowledge of designing web interfaces.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept effective dialog for HCI.	**PO_1, PO_2**
CO_2	Analyze the effective HCI for individuals and persons with disabilities.	**PO_2, PO_3**
CO_3	Assess the importance of user feedback.	**PO_3**
CO_4	Able to apply HCI and principles to interaction design	**PO_3, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2									
CO_3			2									
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	FOUNDATIONS OF HCI The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.
Unit: 2	DESIGN & SOFTWARE PROCESS Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.
Unit: 3	MODELS AND THEORIES Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.
Unit: 4	MOBILE HCI Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.
Unit: 5	WEB INTERFACE DESIGN Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004
Reference Books:	
1	Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009.
2	Brian Fling, "Mobile Design and Development", First Edition , O"Reilly Media Inc., 2009

Course Code	Course Title	Lecture			Semester:
BTCS836PET	Web and Internet Technology	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Networks

Course Objectives:

1. To provide you the conceptual and technological developments in the field of Internet and web designing with the emphasis on comprehensive knowledge of Internet and its applications.
2. To understand the concept of networks and types of networks with Peer-Peer, Clients-Server.
3. To impart the basic concepts of web design with components of web publishing.
4. To acquire the knowledge of basic command with PHP scripting language.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate the ability to create web pages using HTML, DHTML, Java Scripts, and XML.	**PO_1, PO_2**
CO_2	Review the current topics in Web & Internet technologies	**PO_2**
CO_3	Apply server-side scripting with PHP language	**PO_3, PO_5, PO_9**
CO_4	Implement server-side programming with JavaScript	**PO_3, PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2		2				1			
CO_4			2	2	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Internet:** Internet, Internet history of the World Wide Web and ARPANET, Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on Society – Crime on/through the Internet. **Internet Network:** Network definition, Common terminologies: LAN, WAN, Node, Host, Workstation, bandwidth, Interoperability, Network administrator, network security.
Unit: 2	**Network Components:**Client, Server, Communication Media, Types of network: Peer-Peer, Clients-Server **Addressing in Internet:** DNS, Domain Name and their organization, understanding the Internet Protocol Address. Network topologies: Bus, star and ring, Ethernet, FDDI, ATM and Intranet. **Services & Current Trends on Internet:** Services- E-mail, WWW, Telnet, HTTP, FTP, IRC and Search Engine, Current Trends- Languages, Internet Phone, Internet Video, collaborative computing, e-commerce.
Unit: 3	**Web Publishing and Browsing:** Overview, Web hosting, HTML. Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Consideration and Principles. **HTML Programming Basics:** HTML page structure, HTML Text, HTML links, HTML document tables, HTML Frames, HTML Images, multimedia.

	Style Sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS.
Unit: 4	**Interactivity Tools:** ASP, VB Script, JAVA Script, JAVA and Front Page, Flash **Javascript:** Client side scripting, What is Javascript, How to develop Javascript, Simple Javascript, Variables, Functions, Control Statements, Arrays.
Unit: 5	**PHP:** Starting to script on server side, Arrays, function and forms, advance PHP Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", 2006, Pearson Education.
2	Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, 2007, Pearson Education.

Reference Books:

1	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, 2006, Pearson Education.
2	Marty Hall and Larry Brown,"Core Web Programming" Second Edition, Volume I and II, 2001, Pearson Education.

Course Code	Course Title	Lecture			Semester:
BTCS837PET	Cryptography and Network Security	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Network

Course Objectives:

1. To learn the fundamentals of computer Networks security concepts and security challenges.
2. To understand the classical and modern cryptographic techniques, modular arithmetic, key concepts, Fiestal cipher structure.
3. To provide the concept of symmetric and asymmetric key cryptography, factors affecting computer Networks security deployment.
4. To acquire the knowledge of emerging technology in the net-centric security areas and assess their current capabilities, limitations and potential applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the difference between steganography and cryptographic techniques, various public and private key algorithms.	**PO_1, PO_2**
CO_2	Demonstrate Network security issues like confidentiality, integrity, availability, authentication and authorization, DoS.	**PO_2, PO_3**
CO_3	Analyze different Network security protocol, Virus, Worms, Trozen Hoarse, Intrusion detection system, Firewall, Private virtual Networks.	**PO_6**
CO_4	Gain the knowledge of emerging technology in the net-centric security areas and assess their current capabilities, limitations and potential applications.	**PO_{10}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2									
CO_3						2						
CO_4										2		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks.
Unit: 2	Modular arithmetic, prime numbers, relative prime numbers, Euler's function, GCD. Computer-based Symmetric Key Cryptographic Algorithms: Algorithm Types and Modes, An overview of Symmetric Key Cryptography, DES, International Data Encryption Algorithm (IDEA), RC5, Blowfish, AES, Differential and Linear Cryptanalysis.
Unit: 3	Computer-based Asymmetric Key Cryptography: Brief History of Asymmetric Key Cryptography, An overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography, Digital Signatures.

Unit: 4	Public Key Infrastructure: Digital Certificates, Private Key Management, The PKI Model, Public Key Cryptography Standards, PKI and Security. Internet Security Protocols: Basic Concepts, Secure Socket Layer, SHTTP, Time Stamping Protocol, Secure Electronic Transaction, SSL versus SET, 3-D Secure Protocol, Electronic Money, E-mail Security.
Unit: 5	Understanding Session Hijacking, Spoofing vs Hijacking, Steps in Session Hijacking, Types of Session Hijacking, and TCP Concepts Sequence numbers. ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Wireless 802.11 Networks security standards, Sniffing Traffic, Wireless DOS attacks, DDoS, WLAN Scanners, WLAN Sniffers, Securing Wireless Networks.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Cryptography and Networks Security by Behrouz A. Forouzan, 2nd Edition TMH.
2	Cryptography and Networks Security, W. Stallings, Prentice Hall, 5th Edition, 20102.
Reference Books:	
1	Networks Security Essentials, William Stallings, Prentice Hall, 5th Edition, 2013.
2	Firewalls and Internet Security, William R. Cheswick and Steven M. Bellovin, Addison-Wesley Professional, 2ndEdition, 2003.

Course Code	Course Title	Lecture			Semester:
BTCS838PET	Soft Computing	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Mining & Data Ware Housing and Machine Learning

Course Objectives:

1. To familiarize with soft computing techniques and basic concepts.
2. To provide the basic concepts of different methods and tools for processing of uncertainty in intelligent systems, such as, fuzzy models, neural Networks s, probabilistic models, and foundations of it using in real systems.
3. To understand the idea of Neural Networks s, fuzzy logic and use of heuristics based on human experience.
4. To impart the knowledge of biological neurons and their simulation to problem solving.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify and describe soft computing techniques and their roles in building intelligent machines.	**PO_1, PO_2**
CO_2	Recognize the feasibility of applying a soft computing methodology for a particular problem.	**PO_2**
CO_3	Demonstrate fuzzy logic and reasoning to handle uncertainty and solve engineering problems, genetic algorithms to combinatorial optimization problems.	**PO_3, PO_4, PO_9**
CO_4	Apply Artificial Neural Networks to solve various classification and regression problems.	**PO_3, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2	2					1			
CO_4			2	2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Soft Computing, Concept of computing systems, "Soft" compiting versus "Hard" Computing, Characteristics of Soft computing, Some applications of Soft computing techniques
Unit: 2	Fuzzy logic: Introduction to Fuzzy logic.,Fuzzy sets and membership functions., Operations on Fuzzy sets., Fuzzy relations, rules, propositions, implications and inferences., Defuzzification techniques. Fuzzy logic controller design., Some applications of Fuzzy logic.
Unit: 3	Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to proablistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using GAs.
Unit: 4	Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them., Multi-Objective Evolutionary Algorithm (MOEA).,Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.
Unit: 5	Artificila Neural Networks: Biological neurons and its working., Simulation of biolgical neurons to problem soloving., Different ANNs architectures.,

	Trainging techniques for ANNs., Applications of ANNs to solve some real life problems.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2	Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press, 1998.
3	An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
Reference Books:	
1	Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
2	Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.

Course Code	Course Title	Lecture			Semester:
BTCS839PET	Speech and Natural Language Processing	L	T	P	VIII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Machine Learning

Course Objectives:

1. To understand the concept of basic NLP problems, tasks and methods.
2. To learn basic programming tools for NLP.
3. To understand some of the problems and solutions of NLP and their relation to linguistics and statistics.
4. To acquire the concept of language generation and discourse analysis.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate Regular Expressions and Morphology	PO_1, PO_2
CO_2	Understand syntactic analysis and context free grammars	PO_2
CO_3	Apply the methodology for evaluating NLP systems.	PO_3, PO_5
CO_4	Implement a simple NLP system to solve real life problem	PO_3, PO_4, PO_5, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2		2							
CO_4			2	2	2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	OVERVIEW AND MORPHOLOGY Introduction – Models -and Algorithms - -Regular Expressions Basic Regular Expression Patterns – Finite State Automata. Morphology - Inflectional Morphology - Derivational Morphology. Finite-State Morphological Parsing -- Porter Stemmer
Unit: 2	WORD LEVEL AND SYNTACTIC ANALYSIS N-grams Models of Syntax - Counting Words - Unsmoothed N-grams Smoothing- Backoff DeletedInterpolation – Entropy - English Word Classes - Tagsets for English Part of Speech Tagging-Rule Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging
Unit: 3	CONTEXT FREE GRAMMARS Context Free Grammars for English Syntax- ContextFree Rules and Trees. Sentence- Level Constructions– Agreement – Sub Categorization. Parsing – Top-down – Earley Parsing - feature Structures – ProbabilisticContext-Free Grammars
Unit: 4	SEMANTIC ANALYSIS Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus. Representing Linguistically Relevant Concepts -SyntaxDriven Semantic Analysis - Semantic Attachments -SyntaxDriven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Struct ure - Word SenseDisambiguation -Information Retrieval
Unit: 5	LANGUAGE GENERATION AND DISCOURSE ANALYSIS Discourse -Reference Resolution - Text Coherence - Discourse Structure – Coherence. Dialog and Conversational Agents - Dialog Acts – Interpret ation -

	Conversational Agents. Language Generation – Architecture - Surface Realizations - Discourse Planning Machine Translation -Transfer Metaphor–Interlingua – Statistical Approaches
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008
Reference Books:	
1	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999
2	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999

Course Code	Course Title	Lecture			Semester : VI
UGCS611GET	Soft Skill and Interpersonal Communication	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To learn the concept of building interpersonal skills.
2. To apply the conceptual understanding of communication into everyday practice.
3. To understand the importance of teamwork and group discussions skills.
4. To develop time management and stress management.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of building interpersonal skills.	PO_6
CO_2	Apply the conceptual understanding of communication into everyday practice.	PO_6, PO_{10}
CO_3	Demonstrate the importance of teamwork and group discussions skills.	PO_9, PO_{10}
CO_4	Establish time management and stress management.	PO_{10}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2						
CO_2						2				3		
CO_3									2	3		
CO_4										3		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Fundamentals of Communication:** The Importance of Communication; The Basic Forms of Communication; The Process of Communication; Barriers to Communication; Dealing with Communication Barriers. **Nonverbal Communication:** Characteristics of Nonverbal Communication; Components of Nonverbal Communication.
Unit: 2	**Listening:** Importance of Listening; Barriers to Effective Listening; Approaches to Listening; How to be a Better Listener; What Speakers can do to Ensure Better Listening. **Interpersonal Skills:** Building Positive Relationships; Giving Praise; Dealing with Criticism; Managing Conflict.
Unit: 3	**Negotiations:** Approaches to Negotiation; The Major Elements of Negotiation Preparation; The Situation. **Interviewing:** Interview and Types of Business Interviews; Planning an Interview; Conducting an Interview; The Ethics of Interviewing
Unit: 4	**Interpersonal Skills:** Building Positive Relationships; Giving Praise; Dealing with Criticism; Managing Conflict. **Negotiations:** Approaches to Negotiation; The Major Elements of Negotiation Preparation; The Situation.
Unit: 5	**Interviewing:** Interview and Types of Business Interviews; Planning an Interview; Conducting an Interview; The Ethics of Interviewing. Ethics in engineering practice and research, Introduction to ethical reasoning & Engineering.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press.
2	Krishna Mohan, Meera Banerji, "Developing Communication Skill", McMillan India Ltd.
Reference Books:	
1	Simon Sweeney, "English for Business Communication", Cambridge University Press.
2	Caroline & Whitbeck, "Ethics in Engineering Practice and Research", Cambridge University Press.

Course Code	Course Title	Lecture			Semester : VI
UGCS612GET	Human Resource Development and Organizational Behaviour	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To learn best by active participation.
2. To familiarize with the theories, concepts, techniques.
3. To acquire the use of case discussions, exercises, games, psychometric testing.
4. To impart into the collaborative learning that emphasized in the form of group exercises, group projects, role-plays.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand Organizational Behaviour	PO_6
CO_2	Improve Personality	PO_6, PO_{10}
CO_3	Build motivation as an individual as well as a team	PO_6, PO_9, PO_{10}
CO_4	Able to analyze various selection techniques in recruitment	PO_6, PO_{10}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2						
CO_2						2				2		
CO_3						2			2	2		
CO_4						2				2		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to the course What is Organizational Behaviour (OB) and Human Resource Management (HRM) Difference between corporates and development organizations OB and HRM and Sustainable development OB and HRM: contribution and linkages with sustainability Importance of OB and HRM for sustainable development practitioners
Unit: 2	Knowing and Managing Yourself Individual Behaviour: MARS model of individual behaviour Values: Values across cultures (Hofstede's framework); Personality: Big five model; MBTI; Use of personality tests; Personality attributes influencing OB Emotions: Understanding emotions; Emotional labour; Emotional Intelligence Attitudes: Attitudes v/s values; Job Satisfaction; Organizational Commitment Perception: Factors influencing perception; 3 3 Perceptual errors; Self-fulfilling prophecy; Know yourself: Johari window
Unit: 3	Motivation in the workplace What is motivation; Early theories of motivation; Contemporary theories of motivation; Designing motivating jobs: JCM model; motivation of social workers. Work Teams v/s groups; Why teams; A model of Team effectiveness: Context, Composition, Work design, Process; Virtual teams; Turning individuals into team players
Unit: 4	Communication What is communication; Organizational communication: Formal networks and Grapevine; Electronic communications; Barriers to effective communication; non- verbal communication; Improving Interpersonal communication: Empathy and Active listening
Unit: 5	Job Analysis Job description; Job Specification; Job Evaluation 2 1 8 Recruitment, Selection, Orientation Sources of recruitment: Internal and

	external; Steps in selection process; Socialization and Induction; NGO recruitment
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	McShane, S.L. and Von Glinow, M.A., Organizational Behaviour, New Delhi, Tata McGrawHill Publishing company ltd.
2	P. Jyothi, P. and Venkatesh, D.N., Human Resource Management, New Delhi, Oxford University Press
Reference Books:	
1	Denhardt, R.B., Denhardt, J.V., and Aristigueta, M.P. (2009), Managing Human Behaviour in Public and Non-Profit Organizations, Second edition. California, Sage Publications.
2	Pynes, J.E. (2004). Human Resources Management for Public and Nonprofit Organizations, Second Edition. San Francisco, CA: Jossey- Bass Publishers.

Course Code	Course Title	Lecture			Semester:
UGCS613GET	Cyber Law and Cyber Security	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To create the basic clarity and understanding of cyberlaws and cyber security laws to the professionals learning the ethical hacking programme.
2. To emphasize on the activities leading to infringement of individual or organizational privacy.
3. To provide the awareness of vulnerabilities in software.
4. To understand the concept of intrusion detection and prevention.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand of cyberlaws and cyber security laws	PO_1, PO_2
CO_2	Awareness for prevention of cyber crimes	PO_6, PO_8, PO_{12}
CO_3	Demonstrate cyber security vulnerabilities and cyber security safeguards	PO_5, PO_8
CO_4	Able to secure web applications	PO_8, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2						2	3					2
CO_3					2			2				
CO_4								2	2			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Cyber law, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level, Issues of jurisdiction in cyberspace, Types of jurisdiction, The Test evolved - Minimum Contacts Theory - Sliding Scale Theory - Effects Test and International targeting, Jurisdiction under IT Act, 2000.
Unit: 2	**Cyber Crimes& Legal Framework** Cyber Crimes against Individuals, Institution and State , Hacking , Digital Forgery ,Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud , Cyber Terrorism .,Cyber Defamation ,Right to Privacy and Data Protection on Internet - Concept of privacy. Threat to privacy on internet - Self-regulation approach to privacy - Ingredients to decide confidentiality of information - Breach of sensitive personal information and confidentiality under IT Act and penalties for the same. - Right of Interception under IT Act. , Different offences under IT Act, 2000.
Unit: 3	**Overview of Cyber Security, Internet Governance** – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.
Unit: 4	**Cyber Security Vulnerabilities and Cyber Security Safeguards:** vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak

	Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.
Unit: 5	**Securing Web Application, Services and Servers:** Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Intrusion Detection and Prevention, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Karnika Seth, Computers, Internet and New Technology Laws, Lexis NexisButterworthsWadhwa Nagpur.
2	Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
Reference Books:	
1	JonthanRosenoer, Cyber Law, Springer, New York, (1997).
2	SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)
3	S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).

Course Code	Course Title	Lecture			Semester:
UGCS614GET	Comparative Study of Modern Indian Languages	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1		
CO_2		
CO_3		
CO_4		

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1												
CO_2												
CO_3												
CO_4												

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	
Unit: 2	
Unit: 3	
Unit: 4	
Unit: 5	

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Course Code	Course Title	Lecture			Semester:
UGCS615GET	Biology (Basic Science Course)	L	T	P	VI
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To introduce the basics of biology such as cell structure and functions.
2. To learn the concepts of inheritance & evolution.
3. To understand basic concepts of genetics.
4. To introduce microbiology concepts.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the basics of Diversity of life	**PO_7**
CO_2	Gain knowledge of Metabolism and Bioenergetics	**PO_7, PO_{12}**
CO_3	Explore the concept of Genetics and cell Biology	**PO_7, PO_{12}**
CO_4	Analyze biology as a science, outlining the diversity, organization and fundamental principles of living systems.	**PO_7, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1							2					
CO_2							2					2
CO_3							2					2
CO_4							2					2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Basics: Diversity of life, prokaryotes and eukaryotes, basic cell constituents and macromolecules.
Unit: 2	Biochemistry: Metabolism (Catabolism and Anabolism) and Bioenergetics
Unit: 3	Genetics: Basic principles of Mendel, molecular genetics, structure and function of genes and chromosomes, Transcription and Translation, gene expression and regulation
Unit: 4	Cell Biology: Macromolecules, membranes, organelles, cytoskeleton, signaling, cell division, differentiation, motility.
Unit: 5	Microbiology: host-microbe interactions, physiology, ecology, diversity, and virology

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Biology: N. Campbell and J. Reece (2005) 7th edition, Pearson, Benjamin,Cummings
2	The Biological Chemistry of the Elements: J.J.R.F. da Silva, R.J.P. Williams (2001) 2ndedition, Oxford UniversityPress

Reference Books:

1	Biology: P.H. Raven, G.B. Johnson, J.B. Losos and S.R. Singer (2005) 7th edition, McGraw Hill
2	Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2007) 5th edition, GarlandScience.

Course Code	Course Title	Lecture			Semester:
UGCS711GET	Intellectual Property Rights	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites/ awareness of Cyber Law and Cyber Security is desirable.

Course Objectives:

1. To understand the fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To learn all aspects of the IPR Acts with case studies to demonstrate the application of the legal concepts in science, engineering, technology and creative design.
3. To acquire the knowledge of copyright act and rights of trademark.
4. To provide the concept of geographical indication and their protection.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the basic concepts of Intellectual property, laws	PO_6, PO_8
CO_2	Demonstrate about licensing regime associated with each kind of intellectual property	PO_6, PO_8
CO_3	Understand the knowledge of copyright act and rights of trademark.	PO_6, PO_8
CO_4	Analyze all aspects of the IPR Acts with case studies	PO_6, PO_8

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2		2				
CO_2						2		2				
CO_3						2		2				
CO_4						2		2				

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	OVERVIEW OF INTELLECTUAL PROPERTY introduction and the need for intellectual property right (IPR) IPR in India – Genesis and Development IPR in abroad Some important examples of IPR 5 PATENTS: Meaning,Criteria for obtaining patents Novelty Inventive step. Utility Non patentable inventions. Procedure for registration , Term of patent , Rights of patentee. Basic concept of Compulsory license and Government use of patent Infringement of patents and remedies in case of infringement
Unit: 2	COPYRIGHT: What is copyright, Copyright Act; What is covered by copyright? How long does copyright last? Why protect copyright? RELATED RIGHTS What are related rights? Distinction between related rights and copyright? Rights covered by copyright? TRADEMARKS: What is a trademark? Rights of trademark? What kind of signs can be used as trademarks? types of trademark function does a trademark perform How is a trademark protected? How is a trademark registered? How long is a registered trademark protected for ? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate to trademarks?
Unit: 3	GEOGRAPHICAL INDICATIONS: What is a geographical indication? How is a geographical indication protected? Why protect geographical indications?

	INDUSTRIAL DESIGNS:What is an industrial design? How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?
Unit: 4	ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS Infringement of intellectual property rights Enforcement Measures EMERGING ISSUES
Unit: 5	INTELLECTUAL PROPERTY Overview of Biotechnology and Intellectual Property, Biotechnology Research and Intellectual Property Rights Management Licensing and Enforcing Intellectual Property
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	T. M Murray and M.J. Mehlman,Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000
2	Lionel Bently & Brad Sherman, Intellectual Property Law, Oxford. P. Narayanan, Intellectual Property Law, Eastern Law House
Reference Books:	
1	Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2	Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.

Course Code	Course Title	Lecture			Semester:
UGCS712GET	History of Science	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1		
CO_2		
CO_3		
CO_4		

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1												
CO_2												
CO_3												
CO_4												

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	
Unit: 2	
Unit: 3	
Unit: 4	
Unit: 5	

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Course Code	Course Title	Lecture			Semester:
UGCS713GET	Values & Ethics	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To help students to understand values.
2. To introduce the concepts related to values.
3. To understand the problem of Sustenance of value.
4. To facilitate the students to understand the views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Able to understand the importance of values in real life	**PO_6**
CO_2	Demonstrate the concepts related to values	**PO_7,**
CO_3	Analyze the problem of Sustenance of value	**PO_2, PO_8**
CO_4	Explore the views of Pt. Madan Mohan Malviya and Mahatma Gandhi.	**PO_6, PO_8**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2						
CO_2							2					
CO_3		2						3				
CO_4						2		3				

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Definition and classification of values: Extrinsic values, Universal and Situational values, Physical, Environmental, Sensuous, Economic, Social, Aesthetic, Moral and Religious values.
Unit: 2	Concepts related to values: Purusartha, Virtue, Right, duty, justice, Equality, Love and Good
Unit: 3	Egoism, Altruism and universalism. The Ideal of Sarvodaya and Vasudhaiva Kutumbakam
Unit: 4	The Problem of Sustenance of value in the process of Social, Political and Technological changes.
Unit: 5	The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Little, William, An Introduction of Ethics , allied Publisher, Indian Reprint 1955
2	William, K Frankena, Ethics , Prentice Hall of India, 1988

Reference Books:

1	Dr. Awadesh Pradhan , Mahamana ke Vichara. , B.H.U., Vanarasi-2007

Course Code	Course Title	Lecture			Semester:
UGCS714GET	Economic Policies in India	L	T	P	VII
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	45 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No specific pre-requisites.

Course Objectives:

1. To understand the development strategies in India.
2. To acquire the knowledge of Economic reforms since 1991.
3. To learn growth policies.
4. To analyze Indian Economy with other countries.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the development strategies in India	PO_6
CO_2	Gain the knowledge of Economic reforms since 1991	PO_6
CO_3	Demonstrate growth policies	PO_6, PO_9
CO_4	Analyze Indian Economy with other countries	PO_6

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1						2						
CO_2						2						
CO_3						2			1			
CO_4						2						

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Development Strategies in India: Planning in India, Objectives, Strategies and Evaluation.
Unit: 2	Economic reforms since 1991 and its impact.
Unit: 3	Economic Development and Growth Policies.
Unit: 4	Agriculture and Industrial Sectors of the Indian economy.
Unit: 5	Current challenges facing Indian Economy, Development experience of India- a comparison with other countries.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Karl E. Case and Ray C. Fair, Principles of Economics, Pearson Education Inc., 8th Edition, 2007.
2	N. Gregory Mankiw, Economics: Principles and Applications, India edition by South Western, a part of Cengage Learning, Cengage Learning India Private Limited, 4th edition, 2007.

Reference Books:

1	Joseph E. Stiglitz and Carl E. Walsh, Economics, W.W. Norton & Company, Inc., New York, International Student Edition, 4th Edition, 2007.