Dr. Babasaheb Ambedkar Technological University (Established a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad, Pin 402 103,

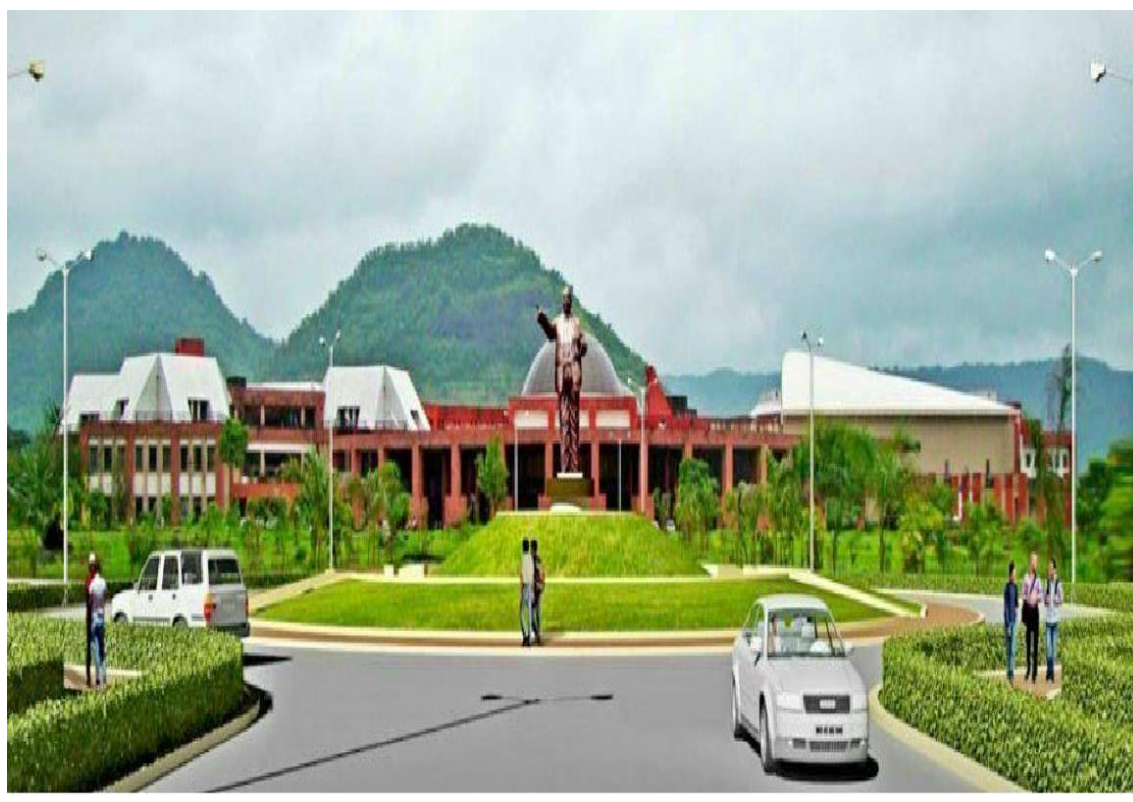**Maharashtra Telephone and Fax. 02140 - 275142 www.dbatu.ac.in**

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CURRICULUM UNDER GRADUATE PROGRAMME FOR

B. TECH

Computer Science and Design

WITH EFFECT FROM THE ACADEMIC YEAR

S.Y. B.Tech 2022-23
T.Y. B.Tech 2023-24

Rules and Regulations

1. The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from mid- July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maxi- mum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.

4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

COURSE PRE-REQUISITES:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specifiedcourses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:
   (a) Satisfied all the Academic Requirements to continue with the programme ofStudies without termination
   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   (c) Paid all required advance payments of the Institute and hostel for the current semester;
   (d) Not been debarred from registering on any specific ground by the Institute**.**

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2019-20, starting from I year B.Tech.

Percentage of Marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. *Class is awarded based on CGPA of all eighth semester of B.Tech Program.*

CGPA for pass is minimum 5.0	
CGPA upto < 5.50	Pass Class
CGPA ≥ 5.50 & < 6.00	Second Class
CGPA ≥ 6.00 & < 7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks = CGPA*10.0]	

3. **A total of 100 Marks for each theory course are distributed as follows:**

1	Mid Semester Exam (MSE) Marks	20
2	Continuous Assessment Marks	20
3	End Semester Examination (ESE)Marks	60

4. *A total of 100 Marks for each practical course are distributed as follows:*

1	Continuous Assessment Marks	60
2	End Semester Examination (ESE) Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, <u>with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.</u>

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20.

5. *Description of Grades:*

EX Grade: An 'EX' grade stands for outstandingachievement.
EE Grade: The 'EE' grade stands for minimum passinggrade.

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.

If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance. The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. *Evaluation of Performance:*

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA): The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where

'n' is the number of subjects for the semester,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.

-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall per- formance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the

grade points obtained in all the courses registered by the student since she entered theInstitute. CGPA is also calculated at the end of every semester (up to two decimal places). Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\left[\sum_{i=1}^{m} c_i g_i\right]}{\left[\sum_{i=1}^{m} c_i\right]}$$

Where

'm' is the total number of subjects from the first semester onwards up to and including the semester S,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

AWARD OF DEGREE OF HONOURS (MAJOR) DEGREE

The concept of Major and Minors at B.Tech level is introduced, to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors
1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for majors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL / SWAYAMcourses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors
1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for minors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL / SWAYAM platform. (if the credits of NPTEL / SWAYAM courses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded with B.Tech Degree in

-------Engineering with Minor in ------------Engineering.

(For e. g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (e.g. Representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

   The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

   In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University / Institutions / Colleges /Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

(a) 20% of the total credit will be considered for respective calculations.
(b) Credits transferred will be considered for overall credits requirements of the programme.
(c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.
(d) A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor / project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.
(e) A student has to get minimum passing grades / marks for such courses for which the credits transfers are to be made.
(f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.
(g) In exceptional cases, the students may opt for higher credits than the prescribed.

Category – wise total number of credits

Sr. No.	Category of courses	Minimum credits to be Earned
1	Basic Science Course (BSC)	25
2	Engineering Science Course (ESC)	20
3	Humanities and Social Science including Management Courses (HSSMC)	12
4	Professional Core Course (PCC)	44
5	Professional Elective Course (PEC)	09
6	Open Elective Course (OEC)	06
7	Seminar / Mini Project / Internship / Major Project	22
8	Emerging Courses	22
	TOTAL	**160**

Programme Educational Objectives (PEO)

Name of Programme: Bachelor of Technology (Computer Engineering)

A graduate in the discipline of Computer Engineering is generally expected to have three kinds of knowledge. First, the graduate should have conceptual knowledge of the core topics of Computer Science. Second, she/he should have knowledge of mathematical formalism underlying various programming concepts. Third, graduates in the discipline of Computer Engineering should have the knowledge of the state of the technologies and tools so that he/she can apply the principles of Computer Science to solve real-life problems from diverse application domains. The programme of B.Tech in Computer Engineering at Dr. Babasaheb Ambedkar Technological University (DBATU) essentially aims to meet these broad expectations. At the same time, the program intends to comply with the courses and syllabus available at National Program on Technology Enhanced Learning (NPTEL) and SWAYAM. The following specific educational objective aims to achieve these global and regional expectations.

Objective Identifier	Objectives
PEO1	To provide knowledge of sound mathematical principles underlying various programming concepts.
PEO2	To develop an ability to understand complex issues in the analysis, design, implementation and operation of information systems.
PEO3	To provide knowledge of mechanisms for building large-scale computer-based systems.
PEO4	To develop an ability to provide computer-based solutions to the problems from other disciplines of science and engineering.
PEO5	To impart skills necessary for adapting rapid changes taking place in the field of information and communication technologies.
PEO6	To provide knowledge of ethical issues arising due to deployment of information and communication technologies in the society on large scale.

Programme Outcomes (PO)

After undergoing the learning process of four years, students of B.Tech. (Computer Engineering) at Dr. Babasaheb Ambedkar Technological University will have an ability to build information systems and provide computer based solutions to real life problems. The graduates of this programme will demonstrate following abilities and skill sets.

Outcome Identifier	Outcomes
PO1	The graduates will possess the knowledge of various discrete mathematical structures, Logic and numerical techniques.
PO2	The graduates will have an ability to apply mathematical formalism of Finite Automata and Probability in modeling and analysis of systems.
PO3	The graduates will have knowledge of core programming paradigms such as database orientation, object orientation, and agent orientation and concepts essential to implement software based system.
PO4	The graduates will have an ability to analyze problem, specify algorithmic solutions to them and to evaluate alternative solutions.
PO5	The graduate will have broad understanding of the impact of a computer based solutions in economic, environmental and social context and will demonstrate use of analytical tools in gathering requirements and distilling relevant information to provide computer based solutions.
PO6	The graduates will demonstrate the ability to build human centric interfaces to computers.
PO7	The graduates will posses the knowledge of advanced and emerging topics in the fields of operating systems, databases and computer networks.
PO8	The graduates will posses skills necessary to communicate design engineering ideas. The skills set include verbal, written and listening skills.
PO9	The graduates will understand ethical issues in providing computer based solutions also they will have an ability and attitude to address the ethical issues.
PO10	The graduates will understand the role of system software such as operating systems, database management systems, compilers, middle-ware and internet protocols in realizing distributed information environment

Graduate Attributes / ABET's Criteria

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

(a) Engineering knowledge: An ability to apply knowledge of mathematics, science and engineering.

(b) Problem analysis: An ability to design and conduct experiments as well as to analyze and interpret data.

(c) Design / development of solutions: An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(d) Individual and team work: An ability to function on multidisciplinary teams.

(e) Problem Solving: An ability to identify, formulate and solve engineering problems.

(f) Ethics: An understanding of professional and ethical responsibility.

(g) Communication: An ability to communicate effectively.

(h) Environment and sustainability: The broad education necessary to understand the impact of engineering solutions in a global, economical, environmental and social context.

(i) Life-long learning: Recognition of the need for and an ability to engage in life-longlearning.

(j) A knowledge of technology: Aknowledge of contemporary issues, and state of art technology

(k) Modern tool usage: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(l) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply in multidisciplinary environments.

Mapping of Programme Outcomes with Graduate Attributes / ABET's Criteria

	A	B	C	D	E	F	G	H	I	J	K	L
PO1	X											
PO2	X								X			
PO3		X	X									
PO4			X		X							
PO5			X					X				X
PO6					X							
PO7										X		
PO8							X					
PO9						X						
PO10											X	

Semester –III (Second Year)

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
	BTCOC302	Discrete Mathematics	3	1	-	20	20	60	100	4
	BTCOC303	Data Structures	3	1	-	20	20	60	100	4
	BTCOC304	Computer Architecture & Organization	3	1	-	20	20	60	100	4
	BTCOC305	Elective –I (a) Object - oriented Programming in C++ (b) Object Oriented Programming in Java	3	1	-	20	20	60	100	4
	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
	BTCOS307	Seminar – I	-		4	60	-	40	100	2
	BTES211P	Field Training / Internship / Industrial Training –I Evaluation	-	-	-	-	-	-	-	Audit
TOTAL			**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

Semester –IV (Second Year)

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC401	Design & Analysis of Algorithms	3	1	-	20	20	60	100	4
	BTCOC402	Operating Systems	3	1	-	20	20	60	100	4
	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
	BTBSC404	Probability and Statistics	3	-	-	20	20	60	100	3
	BTES405	Digital Logic Design & Microprocessors	3	1	-	20	20	60	100	4
	BTCOL406	Operating Systems & Python Programming Lab	1*	-	4	60	-	40	100	3
	BTCOS407	Seminar – II			4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training –II						-	-	Audit to be evaluated in V Sem.
		TOTAL	**16**	**3**	**8**	**220**	**100**	**380**	**700**	**23**

*Note: Lecture should be conducted only for Python Programming

Proposed Scheme for B. Tech. Computer Science and Design
Semester - V (Third Year)

Sr. No	Course Category	Course Code	Course Title	Weekly Teaching Hrs.			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1		BTCSD 501	Theory of Computation	3	1	--	20	20	60	100	4
2		BTCSD 502	Database System Design	3	1	--	20	20	60	100	4
3		BTCSD 503	Computer Networks	3	1	--	20	20	60	100	4
4		BTCSD 504(a) 504(b)	**Elective-II** Data Mining and Warehousing Cyber Security and Forensics	3	--	--	20	20	60	100	3
5		BTCSD 505(a) 505(b)	**Elective-III** Management Information System Business Communication	3	--	--	20	20	60	100	3
6		BTCSDL 506	Database System Design and Predictive Analytics Lab	1*	--	2	30	--	20	50	1
7		BTCSDM507	Mini Project-I	--	--	4	60	--	40	100	2
8		BTCOF408	Field Training / Internship /Industrial Training – II(Evaluation)	--	--	--	--	--	--	--	Audit
Total				**16**	**3**	**6**	**190**	**100**	**360**	**650**	**21**

Note: * Lecture should be conducted only for Predictive Analytics Lab.

Proposed Scheme for B. Tech. Computer Science and Design
Semester - VI (Third Year)

Sr. No	Course Category	Course Code	Course Title	Weekly Teaching Hrs.			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1		BTCSD 601	Software Engineering & Testing	3	1	--	20	20	60	100	4
2		BTCSD 602	Data Visualization	3	1	--	20	20	60	100	4
3		BTCSD 603	Machine Learning	3	1	--	20	20	60	100	4
4		BTCSD 604 (a) 604 (b) 604 (c)	**Elective-IV** Internet of Things Augmented & Virtual Reality Soft Computing	3	--	--	20	20	60	100	3
5		BTCSD 605 (a) 605 (b) 605 (c)	**Elective-V** Development Engineering Employability and Skill Development Consumer Behaviour	3	--	--	20	20	60	100	3
6		BTCSDL606	Machine Learning Lab and R Programming Lab	1*	--	2	30	--	20	50	2
7		BTCSDM607	Mini Project-II	--	--	4	60	--	40	100	2
8		BTCSDF608	Field Training / Internship/ Industrial Training-III	--	--	--	--	--	--	--	Audit to be Evaluated in VII Sem.
Total				**16**	**3**	**6**	**190**	**100**	**360**	**650**	**22**

Note: * Lecture should be conducted only for R Programming

BTBS 301: Engineering Mathematics-III

Unit 1: **Laplace Transform**
Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives
; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform
Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applicationsto find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform
Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval'sidentity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications
Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable bydirect integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation ($\partial u \partial t = c2 \partial 2 u \partial x2$), and one dimensionalwave equation (i.e. $\partial 2 y \partial t2 = c2 \partial 2 y \partial x2$).

Unit 5: Functions of Complex Variables
Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form;Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs)

Text Books
1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books
1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing CompanyLtd.,New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy. Knowledge ware,Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

General Instructions:
1. The tutorial classes in Engineering Mathematics-III are to be conducted batch wise. Each class should bedivided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes,innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

BTCOC302: Discrete Mathematics

[UNIT 1] Fundamental Structures and Basic Logic   *[7 Hours]*

Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic, Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

[UNIT 2] Functions and Relations   *[7 Hours]*

Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.

Combinatorics: Counting, Recurrence relations, generating functions.

[UNIT 3] Graph   *[7 Hours]*

Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graph, Isomorphic graphs, Planar graphs, Connectivity, Matching Colouring.

[UNIT 4] Trees   *[7 Hours]*

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

[UNIT 5] Algebraic Structures and Morphism   *[7 Hours]*

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
5. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

BTCOC303: Data Structures

[UNIT 1] Introduction   *[7 Hours]*

Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. Arrays and Hash Tables Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

[UNIT 2] Stacks and Queues   *[7 Hours]*

Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

[UNIT 3] Linked list   *[7 Hours]*

Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

[UNIT 4] Trees and Graphs   *[7 Hours]*

Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.

[UNIT 5] Searching and Sorting   *[7 Hours]*

Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations– insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Text Book:

1. Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition,2013

Reference Books:
1. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
2. Y. Langsm, M. Augenstin, A. Tanenbaum , Data Structure using C and C++, Prentice Hall India Learning Private Limited,2nd edition,1998.
3. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition,2008.
4. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition,2002.
5. Venkatesan& Rose, Data Structures, Wiley Publication, 1st Edition,2015.
6. Goodrich &Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition,2011.
7. R. G. Dromey, How to Solve it by Computer, 2nd Impression, PearsonEducation.
8. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition,1999.

BTCOC 304: Computer Architecture and Organization

[UNIT 1] Introduction *[7 Hours]*

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function

[Unit 2] Instruction Sets *[7 Hours]*

Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

[Unit 3] Computer Arithmetic *[7 Hours]*

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

[Unit 4] Memory Organization *[7 Hours]*

Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

[Unit 5] Control Unit and Input / Output Organization *[7 Hours]*

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming. **Input/output Organization:** External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface.Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Book:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition,2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Elective –I
(A) BTCOC 305: Object Oriented Programming in C++

[Unit 1] Introduction to Object Oriented Programming and Objects and Classes   *[7 Hours]*

Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages, class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

[Unit 2] Operator Overloading, Inheritance and Polymorphism   **[7 Hours]**
Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

[Unit 3] Polymorphism   *[7 Hours]*

Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

[Unit 4] Streams and Files   *[7 Hours]*

Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

[Unit 5] Templates, Exception Handling and STL   **[7 Hours]**
Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.

Reference Books:
1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001.
2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.
3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1stEditio,2008
4. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
5. P.J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.
6. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
7. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.

Elective –I
(B) BTCOC 305: Object Oriented Programming in JAVA

[Unit 1] Introduction to Java Applications   *[7 Hours]*

Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Introduction to Classes and Objects: Introduction, Classes, Objects, Methods and Instance Variables, Declaring a Class witha Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, *set* Methods and *get* Methods, Primitive Types vs. Reference type double Types ,Initializing Objects with Constructors, floating point numbers.

[Unit 2] Control Statements   *[7 Hours]*

Control structures *if* single-selection statement, *if….else* double-selection statement, *while* repetition statement, *do….while* repetition statement, *switch* multi-selection statement, *break* and *continue* statements, logical operators. Methods :Introduction, Program modules in Java, *static* methods, *static* Fields and *Class Math*, declaring methods with multiple parameters, scope of declaration, method overloading and Java API packages.

[Unit3]Arrays   *[7 Hours]*

Arrays,declaring and creating arrays in java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

[Unit 4] Inheritance and Polymorphism in Java   [7 Hours]

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, objectclass. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples and Interfaces.

[Unit 5] Exception-handling and Java script   [7 Hours]

Exception-handling overview, handling *Arithmetic Exceptions* and *Input Mismatch Exceptions*, when to use exception handling, java exception hierarchy, *finally* block. Introduction to Java Applets. Java script: Introduction to client side scripting, Syntax basics, Operators, Comparisons, Statements, Loops, Events,Objects, and User defined functions, Validations using object functions, Validations using regular expressions,JS document object model, popovers, windows

Text Book:

1. Paul Deitel and Harvey Detail, *Java: How to Program*, Pearson's Publication, 9thEdition.

Reference Books:

1. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016. Doug Lowe, *Java All-in-One For Dummies*, Wiley Publication, 4th Edition,2014.
2. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Publication, 9thEdition.
3. Patrick Niemeyer, Daniel Leuck, *Learning Java,* O'Reilly Media, 4th Edition,2013.
4. "JavaScript: The Good Parts", Douglas Crockford, O'Reilly, ISBN: 9782744055973. "Microsoft® .NET: Architecting Applications for the Enterprise", Microsoft Press; 1st edition, ISBN:978-0735626096

BTCOL306: Data Structure Laboratory

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list (b)Double linked list.
10. Write a program to implement a stack using a linked list such that the push and pop operations of stack still take O(1)time.
11. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b) Maximum key (c) Search for a given key (d) Find predecessor of a node (e) Find successor of a node (f) delete a node with given key.
12. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
13. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
14. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort.
15. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.

BTCOL306: Object Oriented Programming Lab

(a) Object Oriented Programming in C++

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on dealing with Arrays.
3. Programs on Classes: String and Math.
4. Programs on Inheritance and Polymorphism.
5. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
6. Programs on Interfaces block initializers, final Modifier, as well as static and dynamic binding.
7. Programs on file handling and stream manipulation.
8. Programs on Dynamic Polymorphism.
9. Programs on Dynamic Memory Management.
10. Programs on Exception Handling.
11. Programs on generic programming using templates.
12. Programs on STL-containers and iterators

(b) Object Oriented Programming in JAVA

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate following Function concepts
    i) Function overloading
    ii) Constructors of all types
    iii) Default parameters, returning by reference
4. Programs on dealing with Arrays.
5. Programs on Classes: String and Math.
6. Programs on Inheritance and Polymorphism.
7. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
8. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
9. Programs on Exception Handling.
10. Write a Java program that illustrates the following
        a) Creation of simple package.
        b) Accessing a package.
        c) Implementing interfaces.
11. Programs on Java script client side scripting.
12. Programs on Java script Operators, Comparisons, Statements, Loops, Events, Objects.
13. Programs on Java script User defined functions.
14. Programs on Java script Validations using object functions.
15. Programs on Java script Validations using regular expressions.
16. Programs on Java script JS document object model, Popovers, Windows.

BTCOC401: Design and Analysis of Algorithms

[Unit 1] Introduction to Algorithms   *[7 Hours]*

Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem, Changing Variable, Heap Sort.

[Unit 2] Divide and Conquer   *[7 Hours]*

Introduction, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

[Unit 3] Backtracking   *[7 Hours]*

Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Colouring Problem, Branch and Bound: Introduction, Travelling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

[Unit 4] Greedy Algorithms   *[7 Hours]*

Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm

.

[Unit 5] Dynamic Programming   *[7 Hours]*

Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Sub-sequence, matrix multiplication, shortest paths: Bellman Ford, Floyd Warshall, Application of Dynamic Programming. NP Completeness: Introduction, the Complexity Class P, the Complexity Class NP, Polynomial-Time Reduction, the Complexity Class NP-Complete.

Text Book:

1. T. Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.

Reference Books:

1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition,1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition,2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.
4. Ellise Horowitz, SartajSahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988

BTCOC402: Operating Systems

[Unit 1]   *[7 Hours]*

Introduction and Operating system structures: Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.

[Unit 2]   *[7 Hours]*

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.

[Unit 3]   *[7 Hours]*

Process Synchronization: The critical-section problem, Critical regions, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

[Unit 4]   *[7 Hours]*

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing,Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

[Unit 5]   *[7 Hours]*

File Management: File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text Book:
1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.

Reference Books:
1. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
2. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
3. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
4. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
5. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

BTHM403: Basic Human Rights

[Unit 1] *[6 Hours]*

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people.

[Unit 2] *[6 Hours]*

Fundamental rights and economic programme, Society, religion, culture, and their inter relationship, Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

[Unit 3] *[6 Hours]*

Migrant workers and human rights violations, human rights of mentally and physically challenged, State, Individual liberty, Freedom and democracy, NGOs and human rights in India: - Land, Water, Forest issues.

[Unit 4] *[6 Hours]*

Human rights in Indian constitution and law: - i) the constitution of India: Preamble ii) Fundamental rights iii) Directive principles of state policy vi) Fundamental duties v) some other provisions.

[Unit 5] *[6 Hours]*

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

Text Book:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

Reference books:

1. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India

BTBSC404: Probability and Statistics

[Unit 1] Probability Theory   [7 Hours]

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

[Unit 2] Random Variable and Mathematical Expectation   [7 Hours]

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

[Unit 3] Correlation   [7 Hours]

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.

[Unit 4] Linear Regression Analysis   [7 Hours]

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

[Unit 5] Estimation and Hypothesis   [7 Hours]

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Book:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.

Reference Books:

1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Wiley

Publication, 2nd Edition, 2001.

8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition, Thomson Books/Cole.

9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics for engineers & scientists, 9th edition, Prentice Hall.

BTES405: Digital Logic Design & Microprocessor

[Unit1] Introduction *[7 Hours]*

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.

[Unit 2] Combinational Digital Circuits *[7 Hours]*

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, parity checker / generator.

[Unit 3] Sequential circuits and systems *[7 Hours]*

1- bit memory, the circuit properties of Bistable 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] Fundamentals of Microprocessors **[7 Hours]**

Fundamentals of Microprocessor, Comparison of 8-bit, (8085) 16-bit (8086), and 32-bit microprocessors (80386), The 8086 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

[Unit 5] 8086 Instruction Set and Programming **[7 Hours]**

Memory Interfacing, I/O Interfacing, Direct Memory Access (DMA), Interrupts in 8086, 8086 Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs, C language programs, Assemblers and compilers, Programming and debugging tools.

Text Book:

1. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

Reference Books:

1. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
2. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
3. Douglas Hall, Microprocessors and Interfacing, McGraw-Hill Publication, Revised 2nd Edition, 2006.

BTCOL406: Python Programming

One hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

[Unit 1]   *[2 Hours]*

Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.

[Unit 2]   *[2 Hours]*

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.

[Unit 3]   *[2 Hours]*

Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.

[Unit 4]   *[2 Hours]*

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

[Unit 5]   *[4 Hours]*

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.

*Programming assignments are mandatory.

Text Book:

1. Michael Urban and Joel Murach, Murach's Python Programming, Murach's Publication, 2016.

Reference Books:

1. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
2. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
3. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
4. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
5. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
6. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

BTCOL406: Python Programming

BTCOL406: Operating Systems Laboratory

BTCOS407: Seminar – II

Web Site development Essentials: Overview of Web Design Concepts, Web Project Management Fundamentals, Web Site Development Process, HTML and the Evolution of Markup languages, HTML basic tags, Web Page Layout and Elements, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

Cascading Style Sheets: Cascading Style Sheets for Web page design, Creating CSS rules, Format Text with CSS, Use of CSS Selectors, Embed Style Sheets, and Attach External Style Sheets. Using CSS with Tables: Insert and Styling Tables, Import Table Data, Style Tables with CSS, Sort Data in Table.

Introduction to JavaScript, Variables, Basic in JavaScript — Numbers and operators, Handling text — Strings in JavaScript, Useful string methods, Arrays, Troubleshooting JavaScript;

Programming fundamentals: If...Else Statements, Else...If Statements, For Loops, While Loops, Breaking Out Of Loops, Switch Statements, Functions; JavaScript Events, Selecting HTML elements using get Element ById().

PHP: Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Handling Html Form with PHP: Capturing Form Data, Dealing with Multi-value filed, redirecting a form after submission, PHP Session.

JQuery: Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples

AJAX: Introduction to AJAX, PHP with AJAX Introduction to RDBMS: Connection with MySQL Database, Performing basic database operation (DML)(Insert, Delete, Update, Select)

Suggestive List of Experiments:

1. Design an html form for displaying information using interactive css including images, tables.
2. Create a webpage with HTML describing your department with following specification:
   a. Change the background color of the page. At the bottom create a link to take user to the top of the page.
   b. Insert an image and create a link such that clicking on image takes user to other page.
   c. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.
3. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
4. Write a JavaScript to validate the following fields of employee on html form: email, name, mobile no., address, salary.
5. Develop and demonstrate a HTML file that includes JavaScript script that uses functions for the following problems:
   a. Parameter: A string
      Output: Length of the String

   b. Parameter: A number
      Output: The number with its digits in the reverse order

6. Develop and demonstrate a HTML file that includes JavaScript for the following problems:
   a. Input: A starting and ending number
   b. Output: find all the prime numbers between starting and ending number.
7. Write a PHP program to display a digital clock which displays the current time of the server.

8. Write a PHP program to implement sign-In and Sign-out functionality.
9. Write a PHP program to keep track of the number of visitors visiting the Web page and to display this count of visitors, with proper headings.
10. Write a PHP code to implement AJAX functionality.
11. Write a PHP program to perform search operation on the student records using AJAX.
12. Write a PHP program to sort the student records which are stored in the database using ascending/descending order.

Text Book:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, Ajax, PHP and jQuery, 2ed (English, Paperback, DT Editorial Services).

Reference Books:

1. Robin Nixon, Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5 Paperback by Orielly Pub.
2. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, 2nd Edition, 2012.

Guidelines for Seminar:

1. Each candidate shall deliver a seminar as per the Scheme of Teaching and Examination for a minimum 35 minutes including questions and answers.
2. Students can choose/propose any topic for web application development.
3. Students can use HTML, CSS, Java Script, AJAX, PHP or any other front-end tool for web application development.
4. Applications developed must be demonstrated on desktop/laptop as a web based application in the seminar.
5. A seminar report must be submitted at the end of semester on the base of application developed and technology used.

Field Training / Internship/ Industrial Training Evaluation

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.

2. Student can also apply through online platforms such as Internshala for industrial training.

3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).

4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.

5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.

6. Evaluation of the students' performance should be done in the next upcoming semester.

7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

BTCSD 501 Theory of Computation

Course Objectives:
1. To study Finite State Machine, Finite Automata, and its language.
2. To learn Regular Expressions and Regular Languages.
3. To understand Context Free Grammars and Context Free Languages.
4. To study Pushdown Automata and its language.
5. To learn and understand Turing Machine and its language.

Course Outcomes:
1. Analyse and design Finite Automata for regular languages.
2. Build regular expressions for a regular language and to prove theorems and properties of regular languages.
3. Write context free grammar for context free languages and to prove properties of CFL.
4. Analyse and design Pushdown Automata for context free language.
5. Analyse and design Turing Machines for unrestricted languages.

UNIT I: Formal Language Theory and Finite Automata   (7 Hours)

Basic Mathematical Objects: Sets, Logic, Functions, Relations Introduction to Formal language, Alphabets and languages, Finite representation of language, Finite Automata (FA): An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA, FA with output: Moore and Mealy machines -Definition, models, inter-conversion. Application of FA: Text Search.

UNIT II: Regular Expressions (RE) and Languages   (7 Hours)

Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Conversions: NFA to DFA, RE to DFA, DFA to RE, State/loop elimination, Arden's theorem, Properties of Regular Languages: Pumping Lemma for Regular languages, Closure and Decision properties, Applications of RE: Regular Expressions in UNIX, Lexical analysis, Finding patterns in text.

UNIT III: Context Free Grammars (CFG) and Languages   (7 Hours)

Introduction, Regular Grammar, Context Free Grammar Definition, Derivations, Language of a grammar, sentential forms, Parse trees- inference, derivations, parse trees, Ambiguity in grammar and Languages- ambiguous Grammar, Simplification of CFG, Normal Forms- Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL's, Chomsky Hierarchy, Application of CFG: Parsers, The YACC Parser-Generator, Markup languages, XML and Document Type Definitions.

UNIT IV: Pushdown Automata (PDA) & Linear Bounded Automata (LBA)   (7 Hours)

Definition of the PDA, Languages of a PDA, Equivalence of Acceptance by Final State & Empty stack, Equivalence of PDA's and CFG's, Deterministic PDA, PDA and Context Free Language, Definition of Linear Bounded Automata, Language of LBA, LBA and Context Sensitive Language.

UNIT V: Turing Machines (TM)   (7 Hours)

Problems that computers cannot solve, Turing Machine: Notation for the TM, Instantaneous description for TM, Transition diagrams for TM, The Language of Turing Machine, TM and Halting, Programming techniques for TM's, Extensions to the basic TM, Turing Machines and Computers, Church-Turing Thesis, Universal Turing Machines.

Textbooks:
1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1.
2. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787

Reference Books:
1. John Martin, "Introduction to Languages of The Theory of Computation", 2nd Edition, Mc Graw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
2. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Pre ss, ISBN:0521424267 9780521424264
3. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454.
4. J. Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-4
5. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN10 8126533110
6. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 9781133187813
7. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

BTCSD 502 Database System Design

Course Objective:
1. To understand the fundamental concepts of database management (Database design, database languages, and database-system implementation).
2. To provide a strong formal foundation in database concepts, technology, and practice.
3. To give systematic database design approaches covering conceptual design, logical design, and an overview of physical design.
4. Be familiar with the basic issues of transaction processing and concurrency control.
5. To learn and understand various Database Architectures and Applications.

Course Outcomes:
1. Create E-R diagram for given requirements and convert the same into database tables.
2. Use database techniques such as SQL & PL/SQL.
3. Implement good database design using normalization.
4. Use transaction Management and query processing in relational database System.
5. Compare different database architecture and use of appropriate architecture in real time application.

UNIT I: Introduction to DBMS   **(7 Hours)**
Introduction to Database Management Systems, File system verses database system, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database users, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.

UNIT II: SQL and PL/SQL   **(7 Hours)**
SQL: Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries. PL/SQL: concept of Stored Procedures & Functions, Cursors, Triggers, Assertions, roles and privileges, Embedded SQL, Dynamic SQL.

UNIT III: Relational Database Design   **(7 Hours)**
Relational Model: Basic concepts, Attributes and Domains, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.

UNIT IV: Database Transactions and Query Processing   **(7 Hours)**
Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlocks, Time-stamping Methods, Recovery methods: Shadow-

Paging and Log-Based Recovery, Checkpoints, Query Processing, Query Optimization, Performance Tuning.

UNIT V: Database System Architecture   (7 Hours)
Introduction to Database Architectures: Multi-user DBMS Architectures, Case study-Oracle Architecture. Parallel Databases: Speedup and Scale up, Architectures of Parallel Databases, Distributed Databases: Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database. Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

Textbooks:
1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition.
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4

Reference Books:
1. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, "Database Systems : Concepts, Design and Application", Pearson, Education, ISBN 978-81-317-6092-5
3. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626.
4. Kristina Chodorow, Michael Dirolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-1-449-34468-9.

BTCSD 503 Computer Networks

Course Objectives:
1. To learn and understand the fundamental concepts of computer network.
2. To learn and understand different techniques for framing, error control and flow control.
3. To learn and understand different techniques for channel allocation and IEEE standards.
4. To learn and understand switching and routing techniques used in internet layer.
5. To learn and understand TCP and UDP protocols used in transport layer.

Course Outcomes:
1. Design and implement different computer networks using network technologies.
2. Design and implement different error and flow control algorithms.
3. Demonstrate basic concepts of channel allocation.
4. Demonstrate different switching and routing techniques.
5. Design and implement client server architecture using transport layer protocol.

UNIT I: Introduction to Computer Networks   **(7 Hours)**
Communication System, Introduction of LAN, MAN, WAN, WAN Acceleration, PAN, Ad-hoc Network, Network Architectures: Client-Server Peer to Peer, Topologies: Star and Hierarchical, OSI Model, TCP/IP Model, Design issues for Layers, Network Devices: Bridge, Switch, Router and Access Point, Smart NIC.

UNIT II: Logical Link Control Layer   **(7 Hours)**
Design issues: Services to Network Layer, Framing, Error Control and Flow Control, Error Control: Parity Bits, Hamming Codes (7/8-bits) and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.

UNIT III: Medium Access Control Layer   **(7 Hours)**
Channel allocation: Static and Dynamic, Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, Binary Exponential Back off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.

UNIT IV: Internet Layer   **(7 Hours)**
Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols: Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP, Congestion control and QoS, MPLS, Routing in MANET: AODV, DSR.

UNIT V: Transport Layer and Application Layer   **(7 Hours)**
Services, Berkley Sockets, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP Congestion Control, Quality of Service (QoS), Differentiated services, Protocols: TCP and UDP.
Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).

Textbooks:
1. Andrew S. Tenenbaum, "Computer Networks", PHI, ISBN 81-203-2175-8.

2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw-Hill, Publications, ISBN: 0 – 07 – 058408 – 7.

Reference Books:

1. Kurose, Ross "Computer Networking a Top-Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204.
2. Matthew S. G, "802.11 Wireless Networks", O'Reilly publications, ISBN: 81-7656-992-5
3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, ISBN-10: 8131706885; ISBN-13: 978-8131706886.
4. Holger Karl and Andreas Willing, "Protocols and Architectures for Wireless Sensor Networks", Wiley India, ISBN: 9788126533695.
5. Eldad Perahia, Robert Stacey, "Next Generation Wireless LANs", Cambridge, ISBN-10:1107016762; ISBN-13: 978-1107016767.
6. Efraim Turban, Linda Volonino, Gregory R. Wood "Computer Networking a Top Down.
7. "Approach Featuring the Internet", 10th Edition, Wiley; ISBN13: 978-1-118-96126-1.

Elective II
BTCSD 504(A) Data Mining and Warehousing

Course Objectives:
1. To understand the fundamentals of Data Mining.
2. To identify the appropriateness and need of mining the data.
3. To learn the preprocessing, mining, and post processing of the data.
4. To understand various methods, techniques, and algorithms in data mining.

Course Outcomes:
1. Apply basic, intermediate, and advanced techniques to mine the data.
2. Analyze the output generated by the process of data mining.
3. Explore the hidden patterns in the data.
4. Adapt to new data mining tools.
5. Optimize the mining process by choosing best data mining technique.

UNIT I: Introduction (7 Hours)

Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis.

UNIT II: Data Warehouse [7 Hours]

Data Warehouse, Operational Database Systems and Data Warehouses (OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.

UNIT III: Measuring Data Similarity and Dissimilarity [7 Hours]

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minkowski Distance, Euclidean distance, and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

UNIT IV: Association Rules Mining [7 Hours]

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint-based association rule mining, Meta rule-Guided Mining of Association Rules.

UNIT V: Classification [7 Hours]

Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbour Classifiers, Case-Based Reasoning, Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning.

Textbooks:
1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.
2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making" by Wiley-IEEE Press, ISBN: 978-0-470-91999-6.

Reference Books:
1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More", Shroff Publishers, 2nd Edition, ISBN: 9780596006068
2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462.

Elective II
BTCSD 504 (B) Cyber Security and Forensics

Course Objectives:
1. To offer an understanding of principle concepts and basic approaches in information and cyber security.
2. To know the basics of cryptography.
3. To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity, and authenticity.
4. To learn the Forensics using Computers.
5. To learn Tools used in Computer Forensics and Cyber Applications.

Course Outcomes:
1. Gauge the security protections and limitations provided by today's technology.
2. Identify information security and cyber security threats.
3. Analyze threats to protect or defend it in cyberspace from cyber-attacks.
4. Be able to develop Computer Forensics Awareness.
5. Ability to use Computer Forensics Tools.

UNIT I: Information Security Concepts (7 Hours)

Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.

UNIT II: Cryptography (7 Hours)

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication and Hash functions, Digital Signatures, Public Key infrastructure.

UNIT III: Tools and Methods used in Cyber Crimes (7 Hours)

Introduction, Proxy Servers anonymizers, Phishing, Password Cracking, Key loggers and Spywares, DOS and DDOS Attacks, SQL injection, Attacks on wireless networks, Identity Theft.

UNIT IV: Understanding Computer Forensics (7 Hours)

Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Relevance of the OSI 7 Layer model to computer forensics, Challenges in Computer Forensics, Special tools, and Techniques.

UNIT V: Crimes and Digital Evidence (7 Hours)

Violent Crime and Digital Evidence, Digital Evidence as Alibi, Computer Intrusions, Computer Basics for Digital Investigators, Applying Forensic Science to Computers, Digital Evidence on Windows Systems, Digital Evidence on UNIX Systems.
Understanding Cell phone working Characteristics, Hand-Held Devices and Forensics, Toolkits for Hand-Held Device Forensics, Techno-Legal Challenges with Evidence from handheld devices, Organizational Guidelines on cell phone forensics.

Textbooks:
1. V. K. Pachghare, "Cryptography and Information Security", PHI Publication India, 2014, ISBN No.:978-81-203-3521-9.
2. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1.
3. Eoghan Casey, "Digital Evidence and Computer Crime", Third Edition, Elsevier Academic Press.

Reference Books:
1. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN: 978-0-07-064823-4
2. William Stallings, "Cryptography and network security principles and practices", Pearson,
   6th Edition, ISBN: 978-93-325-1877-3
3. Guide to Computer Forensics & Investigation, Bill Nelson, Amelia Phillips, Christopher Stewart, Cengage Learning, Fourth Edition, ISBN 13: 978-1435498839, ISBN 10: 1435498836.
4. Evi Nemeth, Garth Snyder, "Unix and Linux Administration Handbook", Pearson Publication.

Elective III
BTCSD 505(A) Management Information System

Course Objectives:
1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

Course Outcomes: Learner will be able to…
1. Explain how information systems Transform Business.
2. Identify the impact information systems have on an organization.
3. Describe IT infrastructure and its components and its current trends.
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making.
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.

UNIT I: Introduction (7 Hours)

Introduction to Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages, and IS.

UNIT II: Data and Knowledge Management (7 Hours)

Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results.

UNIT III: Social Computing (7 Hours)

Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-Business, and E-Commerce – B2B B2C. Mobile commerce.

UNIT IV: Computer Network and Information System (7 Hours)

Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.
Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process.

UNIT V: Security and Applications (7 Hours)

Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls. Acquiring Information Systems and Applications: Various System development life cycle models.

Textbooks:

1. R. Kelly Rainer, Brad Prince, Hugh J. Watson, Management Information Systems, 4th Ed., Wiley, 2018.

Reference Books:
1. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
2. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008.
3. J. O. Brien, & G. M. Marakas, Introduction to Information Systems, 10th Ed. McGraw Hill, 2011.

Elective III
BTCSD 505(B) Business Communication

Course Objectives:
1. Analyse and demonstrate writing and speaking processes through invention, organization, drafting, revision, editing, and presentation.
2. Understand the importance of specifying audience and purpose and to select appropriate communication choices.
3. Interpret and appropriately apply modes of expression, i.e., descriptive, expositive, Narrative, scientific, and self-expressive, in written, visual, and oral communication.
4. Participate effectively in groups with emphasis on listening, critical and reflective thinking, and responding.
5. Develop the ability to research and write a documented paper and/or to give an oral presentation.

Course Outcomes: students will be able to
1. Apply business communication strategies and principles to prepare effective communication for domestic and international business situations.
2. Utilize analytical and problem-solving skills appropriate to business communication.
3. Participate in team activities that lead to the development of collaborative work skills.
4. Select appropriate organizational formats and channels used in developing and presenting business messages.
5. Communicate via electronic mail, Internet, and other technologies and deliver an effective oral business presentation.

UNIT I: Introduction to Business Communication: (7 Hours)
Importance and Objectives of Business communication, Process of communication, Barriers to effective communication, Techniques of effective communication. Forms of communication (Written, Oral, audio-visual communication).

UNIT II: Managing Business Communication: (7 Hours)
Formal and Informal communication, non-verbal communication (Body language, Gestures, Postures, Facial expressions). The cross-cultural dimensions of business communication. Techniques to effective listening, methods, and styles of reading.

UNIT III: Other aspects of communication: (7 Hours)
Vocabulary: Single word substitution, Idioms and phrases, Precis writing, Comprehension. Group Discussions, Extempore, Principles of effective speech and presentations, Roleplaying.

UNIT IV: Introduction to managerial writing: (7 Hours)
Business letters: Inquiries, Circulars, Quotations, Orders, Acknowledgement, Claims & adjustments, Collection letters, Sales letters, drafting of different resumes, covering letters Applying for a job, social correspondence, Invitation to speak. Official Correspondence: Memorandum, Notice, Agenda, Minutes, Circular letters.

UNIT V: Report writing and Technical Proposals: (7 Hours)
Business reports, Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, checklists for reports. Technical proposals, Definitions, types, and format.

TEXTBOOK
1. "Communication Skills", Sanjay Kumar & Pushp Lata, Oxford University Press.
2. "Business Correspondence and Report Writing", R.C. Sharma, Krishna Mohan, McGraw Hill.
3. "Communication for Business", Shirley Taylor, V. Chandra, Pearson.

REFERENCE BOOK
1. "Business Communication", HorySankar Mukherjee, Oxford University Press.
2. "Basic Business Communication", Lesikar I Flatley, McGraw Hill.
3. "Business Communication Today", Bovee, Thill and Chaterjee, Pearson.

BTCSD 506L Database System Design Lab

Course Objectives:
1. To develop basic, intermediate, and advanced Database programming skills.
2. To develop basic Database administration skills.
3. To apply advance database programming concept for database application.
4. To provide a strong formal foundation in database concepts, technology, and practice.
5. To learn a powerful, flexible, and scalable general-purpose database to handle big data.

Course Outcomes:
1. Demonstrate the ability to handle databases of varying complexities.
2. Use advanced database Programming concepts.
3. Implement program for database connectivity using java/PHP/Python.
4. Use and handle NoSQL databases like mongoDB, Cassandra.
5. Implement database triggers, procedures, and cursor for database application.

Assignments:
1. Study of Open-Source Relational Databases: MySQL/Oracle and Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence.

2. Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, delete with operators, functions, and set operator, all types of Joins, Sub-Query and View.

3. Unnamed PL/SQL code block: Use of Control structure and Exception handling is mandatory. Write a PL/SQL block of code for the following requirements: - Schema:
   1. Borrower (Rollin, Name, DateofIssue, NameofBook, Status)
   2. Fine (Roll_no,Date,Amt)

4. Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor) Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table, then that data should be skipped.

5. PL/SQL Stored Procedure and Stored Function.

   Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks 899 and 825 category is Higher Second Class Write a PL/SQL block for using procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class) Frame the separate problem statement for writing PL/SQL Stored Procedure and function, inline with above statement. The problem statement should clearly state the requirements.

6. Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted

records should be added in Library_Audit table. Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.

7. Study of Open Source NOSQL Database: MongoDB (Installation, Basic CRUD operations, Execution).

8. Implement aggregation and indexing with suitable example using MongoDB. Use Zipcode Dataset (download from url https://media.mongodb.org/zips.json) and import in mongoDB and perform following operations.
   a. Return States with Populations above 10 million.
   b. Return Average City Population by State.
   c. Return Largest and Smallest Cities by State.
   d. Return States with Population,
   e. Create single field index,
   f. Create a compound index.

9. Implement Map reduce operation with suitable example using MongoDB. Use Movies Dataset. Write the map and reduce methods to determine the average ratings of movies. The input consists of a series of lines, each containing a movie number, user number, rating, and a timestamp: The map should emit movie number and list of rating and reduce should return for each movie number a list of average rating.

10. Write a program to implement MongoDB database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit etc.) using ODBC/JDBC.

Reference Books
1. Ivan Bayross, BPB Publication, "SQL, PL/SQL: The Programming Language of Oracle"
2. Kristina Chodorow, Michael Dirolf, "MangoDB: The Definitive Guide", O'Reilly Publications
3. http://www.tutorialspoint.com/json/ & http://docs.mongodb.org/manual/

BTCSD 506L Predictive Analytics Lab

Couse Objectives:
1. To develop the fundamental understanding and application of Mathematics and Statistics in business organizations.
2. To initiate effective use of SPSS in business problem.
3. To evaluate and solve the business problems logically.
4. To avoid risks and spot opportunities.

Course Outcomes:
1. Student will be able to understand fundamentals and application of Mathematics and Statistics in business organizations.
2. Students will be able to initiate effective use of SPSS in business problem.
3. Student will learn to evaluate and solve the business problems logically.
4. Students will be able to avoid risks and spot opportunities.
5. Students will be able to do predictive analysis using various techniques.

Course Contents:
Introduction to IBM SPSS Statistics: Course Introduction, Introducing IBM SPSS Statistics, Reading Data, Variable Properties, working with the Data editor, Summarizing Individual Variables.

Modifying Data Values: Recode, Modifying Data Values: Compute, Describing Relationship between Variables, Selecting Cases, Creating and Editing Charts, Output in the Viewer, Syntax Basics, Course Summary, Menus, and the Help System.

Data Management and Manipulation with IBM SPSS Statistics, Helpful Data Management Features, Transformations: Computing with Numeric Data.

Transformations: Computing with Date and Time Variables, Transformations: Computing with Alphanumeric Data. Additional Data Transformations, Identifying Duplicates and Restructuring Data, Aggregating Data.

Introduction to Statistical Analysis Using IBM SPSS Statistics, Introduction to Statistical Analysis, Understanding Data Distribution Theory, Data Distribution for Categorical Variables, Regression Analysis and Multiple regression analysis.

Multidimensional scaling, Factor analysis and Cluster analysis, Concepts of Logistic Regression, Comparison of Several Populations (One way analysis of Variance and Analysis of Variance of Ranks)

Assignment List:

1. Introduction to SPSS, Sorting File, Split File, Compute File, Recode File and Select Cases.

2. Chi- Square Test (Parametric and Non-Parametric Test) to examine whether the observed results are in order with the expected values.

3. Identify the structure of the relationship between the variable and the respondent using Exploratory Factor Analysis.

4. The company can send personalized advertisements or sales letters to each household based on how likely they are to respond to specific types of advertisements. Using Cluster Analysis identify the following clusters:
   Cluster 1: Small family, high spenders
   Cluster 2: Larger family, high spenders
   Cluster 3: Small family, low spenders
   Cluster 4: Large family, low spenders

5. Using Logistic Regression find Email spam or ham, will buy, or not buy a product, disease predictions such as cancerous or noncancerous cells.

6. Discriminant Analysis for heart failure.
7. Confirmatory Factor Analysis
8. Conjoint Analysis
9. Time Series
10. MANOVA
11. Decision Tree Analysis

BTCSDM 507 Mini Project-I

Guidelines for Mini Project

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.

2. Do the literature survey.

3. Design the solutions.

4. Implement solution using latest technology.

5. Write 20-25 pages report (use of latex is more suitable).

6. Present / demonstrate the solution in front of faculty member.

The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

BTCSDF 508
Field Training / Internship/ Industrial Training Evaluation

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.

2. Student can also apply through online platforms such as Internshala for industrial training.

3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).

4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.

5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.

6. Evaluation of the students' performance should be done in the next upcoming semester.

7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

BTCSD 601 Software Engineering and Testing

Course Objectives:
1. To understand software lifecycle development models.
2. To apply software requirements engineering techniques, software design principles, modelling, and software testing techniques.
3. To study fundamental concepts in software testing, including software testing objectives, processes, criteria, strategies, and methods.
4. To learn planning of a test project, designing test cases and test data, conducting test operations, managing software problems and defects, and generating a test report.
5. To develop an understanding of the meaning and importance of quality in relation to software systems and the software development process.

Course Outcomes:
1. To use the techniques, skills, and modern engineering tools necessary for engineering practice.
2. To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3. To apply software testing knowledge and its processes to software applications.
4. To identify various software testing problems and solving software testing problems by designing and selecting software test models, criteria, strategies, and methods.
5. To apply the techniques learned to improve the quality of software development.

UNIT I: [7 Hours]

Software crisis and myths, Software process and development: Generic view of process, Software life cycle and models, Analysis, and comparison of varies models, an agile view of process. Requirements engineering tasks, Initiating requirement engineering process, eliciting requirement, developing use-cases, Building the analysis model, Negotiating and validating requirement, Building the analysis model.

UNIT II: [7 Hours]

Design process and design quality, Design concepts, Design model, Pattern based software design, Architectural design, User interface design. UML: Different methods: Rambaugh / Booch / Jakobsons, Need for standardization. Developing diagrams in UML (Use CASE, Class, Interaction, State diagrams) CASE TOOLS

.
UNIT III: [8 Hours]

Principles of Testing Software development life cycle model: Phases of software project, Quality, Quality assurance and quality control, Testing, Verification and validation, Process models to represent various phases, Life cycle models, Software testing life cycle. White Box Testing (WBT) and Black Box Testing: Static testing, Structural testing, Challenges in WBT. Black box testing: Black box testing process.

UNIT IV: [7 Hours]

Integration Testing: Definition, as a type of testing: Top-down integration, Bottom-up integration, Bidirectional integration, System integration, choosing integration method, as a phase of testing, Scenario testing: System scenarios, Use case scenarios, Defect bash.

System and Acceptance Testing, Functional Vs Non-Functional, Functional system testing, non-functional system testing, Acceptance testing.

UNIT V: **[7 Hours]**
Performance testing, Regression testing, Internationalization testing, Adhoc testing. Factors governing performance of testing, Methodology, tools, and process for performance testing. Regression Testing: Introduction, Types of Regression testing, Regression testing process. Adhoc testing: Introduction, Buddy testing, Pair testing, exploratory testing, Iterative testing, Agile and extreme testing, XP workflow, Defect seeding. Testing Object Oriented Software: Introduction, Comparison of object oriented and procedural software, System testing example, Unit testing of classes, Tools for testing object-oriented software, Testing web applications.

Textbooks:
1. Roger S. Pressman, "Software Engineering", Tata McGraw-Hill, 6th Edition, 2006.
2. G. Booch, J. Rambaugh, and I. Jacobson, "The Unified Modeling Language User Guide", Addison Wesley, 2nd Edition, 2005.
3. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson publication, 2nd Edition, 2006.

Reference Books:
1. Shari Pfleeger, "Software Engineering", Pearson Education, 3rd Edition, 2008.
2. Ian Sommerville, "Software Engineering", Pearson Higher Education, 10th Edition, 2016.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer New York, 2nd Edition, 2013.
4. Loise Tamres, "Introducing Software Testing", Pearson publication, 2002. 5. Boris Beizer, "Software Testing Techniques", Dreamtech press, 2nd Edition, 2014.

BTCSD 602 Data Analysis and Visualization

Course Objectives:
1. To interpret data plots and understand core data visualization concepts such as correlation, linear relationships, and log scales.
2. To explore the relationship between two continuous variables using scatter plots and line plots.
3. To translate and present data and data correlations in a simple way, data analysts use a wide range of techniques — charts, diagrams, maps, etc.

Course Outcomes:
Students will be able to:
1. Demonstrate understanding of Data Visualization and key Terms.
2. Design Effective Data Visualization for visual Mapping and Design.
3. Will demonstrate skills on creating visual representation of Data.
4. Will demonstrate understanding of Visualization classification and its techniques.
5. Will demonstrate skills in creating different types of Representation.

UNIT I: Introduction
Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

UNIT II: Visual Representation
Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT III: Classification of Visual Systems
Classification of visualization systems, Interaction, and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text, and text documents.

UNIT IV: Visualization of Structures
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization.

UNIT V: Visualization of Data
Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations.

Textbooks:
1. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd, 1st Edition, 2010
2. Corey Lanum, Visualizing Graph Data 1st Edition, 2016

Reference Books:
1. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.2nd Edition, 2001
2. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, 2018
3. Andy Krik, Data Visualization: a successful design process 1st Edition, 2012

BTCSD 603 Machine Learning

Course Objectives:
1. To understand fundamental concepts of machine learning and its various algorithms.
2. To understand various strategies of generating models from data and evaluating them.
3. To apply ML algorithms on given data and interpret the results obtained.
4. To design appropriate ML solution to solve real world problems in AI domain.

Course Outcomes:
1. Develop a good understanding of fundamental principles of machine learning.
2. Formulation of a Machine Learning problem.
3. Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering.
4. Evaluate performance of various machine learning algorithms on various data sets of a domain.
5. Design and Concrete implementations of various machine learning algorithms to solve a given problem using languages such as Python.

UNIT I: Introduction to Machine Learning   [7 Hours]
Introduction to Machine Learning: Definition of Machine Learning, Definition of learning. Classification of Machine Learning: Supervised learning, unsupervised learning, Reinforcement learning, Semi-supervised learning. Categorizing based on required Output: Classification, Regression, and Clustering. Difference in ML and Traditional Programming, Definition of Data, Information and Knowledge. Split data in Machine Learning: Training Data, Validation Data and Testing Data. Machine Learning: Applications.

UNIT II: Machine Learning - Performance Metrics   [7 Hours]
Performance Metrics for Classification Problems- Confusion Matrix, Classification Accuracy, Classification Report- Precision, Recall or Sensitivity, Support, F1 Score, AUC (Area Under ROC curve). Performance Metrics for Regression Problems- Mean Absolute Error (MAE), Mean Square Error (MSE), R Squared (R2).

UNIT III: Linear and Logistic Regression   [7 Hours]
Introduction to linear regression: Introduction to Linear Regression, Optimal Coefficients, Cost function, Coefficient of Determination, Analysis of Linear Regression using dummy Data, Linear Regression Intuition. Multivariable regression and gradient descent: Generic Gradient Descent, Learning Rate, Complexity Analysis of Normal Equation Linear Regression, how to find More Complex Boundaries, Variations of Gradient Descent. Logistic regression: Handling Classification Problems, Logistic Regression, Cost Function, Finding Optimal Values, Solving Derivatives, Multiclass Logistic Regression, Finding Complex Boundaries and Regularization, Using Logistic Regression from Sklearn.

UNIT IV: Decision Trees and Random Forests   [7 Hours]
Decision trees: Decision Trees, Decision Trees for Interview call, Building Decision Trees, Getting to Best Decision Tree, Deciding Feature to Split on, Continuous Valued Features Code using Sklearn decision tree, information gain, Gain Ratio, Gini Index,

Decision Trees & Overfitting, Pruning. Random forests: Introduction to Random Forests, Data Bagging and Feature Selection, Extra Trees, Regression using decision Trees and Random Forest, Random Forest in Sklearn.

UNIT V: Naive Bayes, KNN and SVM   **[7 Hours]**

Naive Bayes: Bayes Theorem, Independence Assumption in Naive Bayes, Probability estimation for Discrete Values Features, how to handle zero probabilities, Implementation of Naive Bayes, Finding the probability for continuous valued features, Text Classification using Naive Bayes. K-Nearest Neighbours: Introduction to KNN, Feature scaling before KNN, KNN in Sklearn, Cross Validation, Finding Optimal K, Implement KNN, Curse of Dimensionality, Handling Categorical Data, Pros & Cons of KNN. Support Vector Machine: Intuition behind SVM, SVM Cost Function, Decision Boundary & the C parameter, using SVM from Sklearn, Finding Non-Linear Decision Boundary, Choosing Landmark Points, Similarity Functions, how to move to new dimensions, Multi-class Classification, Using Sklearn SVM on Iris, Choosing Parameters using Grid Search, Using Support Vectors to Regression.

Textbooks:
1. Ethem Alpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 0- 07- 115467-1
3. Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1. 4.Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622

Reference Books:
1. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001
2. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning (From Theory to Algorithms), Cambridge University Press, First Edition, ISBN No. 978-1-107-51282-5.
3. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
4. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.
5. https://python-course.eu/machine-learning/

ELECTIVE IV
BTCSD 604 (A) Internet of Things

Course Objectives:
1. To understand fundamentals of IoT and embedded systems including essence, basic design strategy and process modelling.
2. To introduce learners to a set of advanced topics in embedded IoT and lead them to understand research in networks.
3. To develop a comprehensive approach towards building small low cost embedded IoT applications.
4. To learn and implement secure infrastructure for IoT applications.
5. To learn real world application scenarios of IoT along with its social and economic impact using case studies and real time examples.

Course Outcomes:
After successful completion of the course, student will be able to:
1. Implement an architectural design for IoT for specified requirement.
2. Solve the given societal challenge using IoT.
3. Explore IoT systems based on IoT design methodologies.
4. Choose between available middleware technologies and devices for stated IoT challenge.
5. Design and Implement Cloud based IoT implementations for real-world applications.

UNIT I: Introduction **[7 Hours]**

Embedded Systems: Application Domain and Characteristic of Embedded System, Real time systems and Real time scheduling, Processor basics and System-On-Chip: Arduino, Raspberry Pi, Introduction to ARM Processor and its architecture, Definition and Overview – History – Physical design – Logical design – Levels – communication technologies – Applications.

UNIT II: Networking **[7 Hours]**

Client/Server Model – An overview of internet communications: IP Address – MAC addresses – TCP and UDP protocols – Application Layer Protocols – AT Commands.

UNIT III: IoT Design Methodologies **[7 Hours]**

Purpose – requirements – process -domain – information – service – function – operation – component integration – Application development.

UNIT IV: Middleware for IoT **[7 Hours]**

Platform middleware – Embedded IoT Devices - communication middleware – M2M – RFID – WSN - SCADA – software middleware – Frameworks – Data standards – IoT information Security – Challenges.

UNIT V: Cloud of Things **[7 Hours]**

Introduction to Cloud Storage Models – Grid – SOA - cloud computing – cloud middleware – mobile cloud - Could of Things Architecture- Big-Data Analytics and Visualisation – Dependability – Security –Maintainability – IoT Standards.

Textbooks:

1. Honbo Zhou, ─The Internet of Things in the Cloud A Middleware Perspective, CRC Press, 2013.

2. Adrain Mc Ewen, Hakim Cassimally, ─Designing the Internet of Things, Wiley, 2014.

Reference Books:
1. Marco Schwartz, ─Internet of Things with the Arduino Yun, Packt Publishing, 2014.

2. Arshdeep Bahga, Vijay K. Madisetti, ─Internet of Things A Hands-on Approach, VPT, 1st Edition, 2014.

3. Rolf H. Weber, Romana Weber, ─Internet of Things Legal Perspectives, Springer 2010, ISBN 978-3-642-11709-1

4. Bahga, Internet of Things, University Press

5. Raj Kamal, Internet of Things, TMH.

ELECTIVE IV
BTCSD 604 (B) Augmented & Virtual Reality

Course Objectives:

1. To gain the knowledge of historical and modern overviews and perspectives on virtual reality.

2. To learn the fundamentals of sensation, perception, and perceptual training.

3. To have the scientific, technical, and engineering aspects of augmented and virtual reality systems.

4. To learn the Evaluation of virtual reality from the lens of design.

5. To learn the technology of augmented reality and implement it to have practical knowledge.

Course Outcomes:

On successful completion of this course, the student should be able to:

1. Identify, examine, and develop software that reflects fundamental techniques for the design and deployment of VR and AR experiences.

2. Describe how VR and AR systems work.

3. Choose, develop, explain, and defend the use of designs for AR and VR experiences.

4. Evaluate the benefits and drawbacks of specific AR and VR techniques on the human body.

5. Identify and examine state- of- the-art AR and VR design problems and solutions from the industry and academia.

UNIT I: Introduction   **[7 Hours]**

Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR, VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.

UNIT II: VR Systems   **[7 Hours]**

VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware: VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays.

UNIT III: Stereoscopic Vision & Haptic Rendering   **[7 Hours]**

Fundamentals of the human visual system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Algorithms for haptic rendering and parallax, Synthesis of stereo pairs, Pipeline for stereo images.

UNIT IV: VR Software Development [7 Hours]

Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).

UNIT V: AR Software Development & Applications [7 Hours]

AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

Textbooks:

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

2. The VR Book: Human- Centered Design for Virtual Reality, by Jason Jerald.

Reference Books:

1. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2nd edition, 2009.

3. Learning Virtual Reality by Tony Parisi, O' Reilly.

4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition.Wiley-IEEE Press, 2003/2006.

ELECTIVE IV
BTCSD 604 (C) Soft Computing

Course Objectives:

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

1. Differentiate between soft computing and hard computing.
2. Understand Neural Networks, its architecture, functions, and various algorithms involved.
3. Understand Fuzzy Logic and Genetic algorithms.

Course Outcomes:

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

1. Summarize the basic concept of soft computing and Neural network.
2. Choose appropriate activation and loss functions for neural network.
3. Demonstrate working of Feedforward and Backpropagation learning propagation.
4. Implement simple neural network in python.
5. Understand the need of fuzzy logic and genetic algorithm.

UNIT I: Introduction of soft computing and Artificial Neural Networks   **[7 Hours]**

Soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing, Introduction to Neural Network, Biological Neural Network, Introduction to neuron, A simple neural network model,, training/Learning procedure of neural network, anatomy of neural network: neurons, layers, weights, bias, threshold, learning constants, learning rate, loss function, optimizer, dot product computation , McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm.

UNIT II: Activation Functions, Loss Functions and optimizers   **[7 hours]**

Need of activation Functions, Linear and non-linear activation function: Linear, RELU, sigmoid, tanh, softmax etc. Loss functions: squared error, Binary cross entropy, categorical/multiclass cross entropy. Optimizers: Derivatives, Gradient decent, stochastic gradient descent, Mini batch gradient descent.

UNIT III: Feedforward and Backpropagation learning   **[7 hours]**

Learning propagation: forward propagation and backword propagation, Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed forward Neural Networks: Feedforward Neural Networks, Back propagation.

UNIT IV: Introduction to Artificial Neural Networks with python   [7 hours]

Introduction to pytorch, tensorflow and keras. Data representation for Artificial neural network: scalars, vectors, matrices, high dimensional arrays (tensors), preparing the dataset, building simple neural network, feeding data to neural network, training neural network validating network, using trained network to generate prediction on new data, working example of feedforward and backpropagation neural network, Parameters and Hyper Parameters, overfitting and underfitting, dealing with overfitting in neural networks.

UNIT V: Introduction to Fuzzy logic and Genetic Algorithms   [8 hours]

Fuzzy Logic: Classical sets, Fuzzy sets, fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences, fuzzification and Defuzzification, fuzzy controllers, Applications.

Genetic Algorithms: basic concepts, working principle, Applications of GA.

Textbooks:

1. Michael Nielsen, Neural Networks and Deep Learning, 2016
2. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", Wiley Publications.
3. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications.
4. Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville http://www.deeplearningbook.org.

Reference Books:

1. Francois Challot, "Deep Learning with Python", second edition.
2. B. Satish Kumar, "Neural Networks - A Classroom Approach", McGrawHill Publication S. Rajasekaran, Vijaylakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic algorithms Synthesis and Applications", PHI Publications.

Elective V

BTCSD 605 (A) Development Engineering

Course Objectives:

4. To understand the characteristics of rural Society and the Scope, Nature, and Constraints of rural Development.

5. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas

6. An exploration of human values, which go into making a _good human being, a good professional, a good society, and a good life in the context of work life and the personal life of modern Indian professionals.

7. To understand the Nature and Type of Human Values relevant to Planning Institutions

Course Outcomes:

1. Apply knowledge for Rural Development.

2. Apply knowledge for Management Issues.

3. Apply knowledge for Initiatives and Strategies

4. Develop acumen for higher education and research.

5. Master the art of working in group of different nature.

6. Develop confidence to take up rural project activities independently.

UNIT I: **[7 Hours]**

Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.

UNIT II: **[7 Hours]**

Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.

UNIT III: **[7 Hours]**

Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives

and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.

UNIT IV: [7 Hours]

Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions, and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.

UNIT V: [7 Hours]

Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research, and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.

Textbook:

1. Kevin M. Passino, Humanitarian Engineering: Advancing Technology for Sustainable Development.

Reference Books:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi

2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai

3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi

4. Planning Commission, Five Year Plans, Planning Commission

5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi

6. Planning Guide to Beginners

7. Weaver, R.C., The Urban Complex, Doubleday.

8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.

9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.

10. Watson, V., Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407.

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Elective V

BTCSD 605 (B): Employability and Skill Development

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Course Objectives:

1. To develop soft skills and communication skills.

2. To develop analytical ability.

3. To enhance grammar of language.

4. To introduce the students to skills necessary for getting, keeping and being successful in a profession.

5. To expose the students to leadership and team-building skills.

Course Outcomes:

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

1. Be equipped with essential communication skills (writing, verbal and non-verbal)
2. Have skills and preparedness for aptitude tests.
3. Have grammatical knowledge of language.
4. Master presentation skills and be ready for interviews.
5. Build a team and lead it for problem solving.

UNIT I: Soft Skills & Communication basics: **[7 Hours]**

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing, and delivering presentation, technical writing.

UNIT II: Arithmetic and Mathematical Reasoning and Analytical Reasoning and

   Quantitative Ability: **[7 Hours]**

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem). Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

UNIT III: Grammar and Comprehension: **[7 Hours]**

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT IV: Skills for interviews: [7 Hours]

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT V: Problem Solving Techniques: [7 Hours]

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

Textbook:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, ―Soft Skills- An integrated approach to maximize personality‖, ISBN: 987-81-265-5639-7, First Edition 2016

Reference Books:

1. Wiley Wren and Martin, "English grammar and Composition", S. Chand publications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum's Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. McMurrey, ―A Guide to Writing as an Engineer‖, ISBN: 978- 1-118- 30027-5 4th Edition, 2014, Wiley.

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Elective V

BTCSD 605 (C) Consumer Behavior

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Course Objectives:

1. To develop an understanding of underlying concepts and issues in Consumer behavior.
2. To understand market segmentation and positioning.
3. To understand models of consumer behaviour.
4. To understand psychological influences on consumer decision making.
5. To understand decision making process.

Course Outcomes:

1. To explain the concept of Consumer Behaviour & describe Consumer research process in detail.
2. To evaluate the market segmentation and positioning.
3. To apply different models of the consumer behaviour.
4. To assess the impact of consumer's motivation, personality on the buying behaviour.
5. To impart the basic knowledge of consumer and organizational buying.

UNIT I: Introduction [7 Hours]

Introduction to the Study of Consumer Behavior: Defining Consumer Behavior, Scope and Application of Consumer Behavior, Why Study Consumer Behavior, Evolution of Consumer Behavior as a Field of Study and its relationship with Marketing: Behavioural Dimension, The Interdisciplinary Nature of Consumer Behavior. Market Research and Consumer Behavior, Relevance of Market Research with Consumer Behavior, Approaches to Consumer Behavior Research, Quantitative Research, Qualitative Research.

UNIT II: Market Segmentation [7 Hours]

Market Segmentation and Positioning, Market Segmentation, Basis for Segmentation, Alternatives available for Segmentation, Positioning. The Consumer Decision Making Process: Buying Motives, Buying Roles, Consumer Decision Making Process, Levels of Consumer Decision Making, Perspectives to Consumer Decision Making, Consumer Decision Making Process.

UNIT III: Models of Consumer Behaviour: [7 Hours]

Models of Consumer Behavior: The Economic model, Learning model, Psychoanalytic model, The sociological model. The Howard Sheth model of Buying Behaviour, The Nicosia model, The Engel - Kollat - Blackwell Model, Engel, Blackwell and Miniard (EBM) model.

UNIT IV: Consumer Decision Making: [7 Hours]

Psychological Influences on Consumer Decision Making: Consumer's Needs & Motivation, Emotions and Mood, Consumer Involvement, Consumer Learning, Personality, Self-concept and Self-image, Consumer Perception, Risk, and Imagery. Consumer Attitude: Belief, Affect, Attitude and Intention, Attitude Formation and Attitude Change, Consumer Communication. Sociological Influences on Consumer Decision Making: Consumer groups, Consumer reference groups, Family and Life cycle, social class and mobility, lifestyle analysis, Culture; Sub-Culture, Cross Culture, Interpersonal Communication and influence, Opinion Leadership.

UNIT V: Consumer and Organizational Buying: [7 Hours]

Diffusion of innovation Diffusion Process, Adoption Process, Consumer Innovators, Multiplicative innovation adoption (MIA) model. Organizational Buying: Differences between Industrial Markets and Consumer Markets, Differences between Organizational and Consumer Buying, Buying Decisions in Organizational Buying Process, Types of Decision Making, Organization Buyer's Decision Making Process, and Factors influencing Organizational Buying Behaviour, Decision Makers in Organizational Buying, Webster and Wind model of Organizational buying behaviour, The Sheth model of Industrial buying, The Sheth model of Industrial buying Consumer Behavior Analysis and Marketing Strategy: Consumer Behavior and Product Strategy, Consumer Behavior and Pricing Strategy, Consumer Behavior and Distribution Channel Strategy, Consumer Behavior and Promotion Strategy.

Textbook:

1. Consumer Behavior, Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

Reference Books:

1. Consumer Behavior, Concepts and Applications, Loudon, D.L. and Bitta, A.J.D, Tata McGrawHill.
2. Consumer Behavior and Marketing Startegy, Peter, J.P. and Olson, J.C., Schiffman, L.G. and Kanuk L.L., Prentice Hall, India

BTCSDL 606 Machine Learning Lab

List of practicals:

1. Python Libraries for Data Science

    a. Pandas Library
    b. Numpy Library
    c. Scikit Learn Library
    d. Matplotlib
2. Evaluation Metrics

    a. Accuracy
    b. Precision
    c. Recall
    d. F1-Score
3. Train and Test Sets by Splitting Learn and Test Data.

4. Linear Regression

5. Multivariable Regression

6. Decision Tree Algorithm implementation.

7. Random Forest Algorithm implementation.

8. Naive Bayes Classification Algorithm implementation.

9. K-Nearest Neighbour Algorithm implementation.

10. SVM Algorithm implementation.

BTCSDL 606 R Programming Lab

List of Practical's:

1. Study of data analysis using MS-Excel (Prerequisite).

2. Study of basic Syntaxes in R.

3. Implementation of vector data objects operations.

3. Implementation of matrix, array and factors and perform va in R.

4. Implementation and use of data frames in R.

5. Create Sample (Dummy) Data in R and perform data manipulation with R.

6. Study and implementation of various control structures in R.

7. Data Manipulation with dplyr package.

8. Data Manipulation with data.table package.

9. Study and implementation of Data Visualization with ggplot2.

10. Study and implementation data transpose operations in R.

BTCSDM 607 Mini Project-II

Guidelines for Mini Project

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.
2. Do the literature survey.
3. Design the solutions.
4. Implement solution using latest technology.
5. Write 20-25 pages report (use of latex is more suitable).
6. Present / demonstrate the solution in front of faculty member.

The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

BTCSDF 608
Field Training / Internship/ Industrial Training Evaluation

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

8. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.

9. Student can also apply through online platforms such as Internshala for industrial training.

10. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).

11. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.

12. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.

13. Evaluation of the students' performance should be done in the next upcoming semester.

14. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.