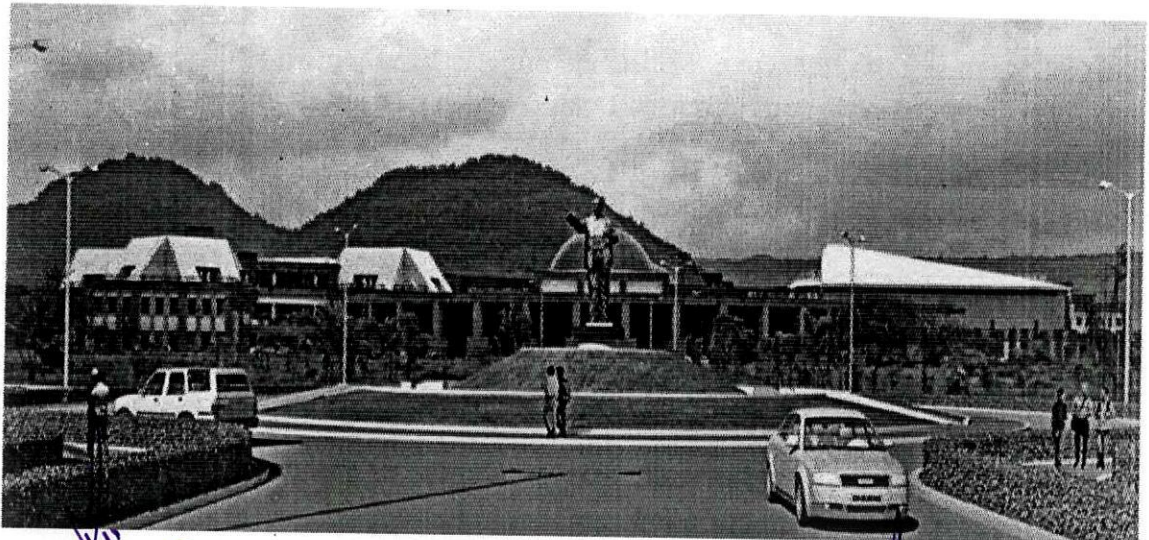DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Dr. Babasaheb Ambedkar Technological University
(Established as 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
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PROPOSED CURRICULUM
UNDER GRADUATE PROGRAMME
B.TECH

COMPUTER ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR 2020-2021

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 specified courses.
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 of Studies 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 outstanding achievement.

EE Grade: The 'EE' grade stands for minimum passing grade.

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:

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

Where
   'n' is the number of subjects for the semester,
   'c_i' is the number of credits allotted to a particular subject, and
   'g_i' is the grade-points awarded to the student for the subject based on his
        perfor- mance 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 the Institute. CGPA is also calculated at the end of every semester (upto 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:

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

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 / SWAYAM courses 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 (eg. 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.

Different Categories of Courses and Credits for Degree Requirements

a) Basic Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTBS101	Engineering Mathematics – I	(3-1-0) 4
2	BTBS102	Engineering Physics	(3-1-0) 4
3	BTBS107L	Engineering Physics Laboratory	(0-0-2) 1
4	BTBS201	Engineering Mathematics-II	(3-1-0) 4
5	BTBS202	Engineering Chemistry	(3-1-0) 4
6	BTBS207L	Engineering Chemistry Laboratory	(0-0-2) 1
7	BTBS301	Engineering Mathematics-III	(3-1-0) 4
8	BTBS404	Probability Theory and Random Processes	(3-0-0) 3
		TOTAL	25

b) Engineering Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES103	Engineering Graphics	(2-0-0) 2
2	BTES105	Energy and Environment Engineering	(2-0-0) 2
3	BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
4	BTES108L	Engineering Graphics Laboratory	(0-0-4) 2
5	BTES203	Engineering Mechanics	(2-1-0) 3
6	BTES204	Computer Programming	(3-0-0) 3
7	BTES205	Workshop Practices	(0-0-4) 2
8	BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
9	BTES208L	Engineering Mechanics Laboratory	(0-0-2) 1
10	BTES209L	Basic Computer Programming Laboratory	(0-0-2) 1
11	BTES405	Digital Logic Design & Microprocessors	(3-1-0) 4
		TOTAL	20

c) Humanities and Social Science including Management Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTHM104	Communication Skills	(2-0-0) 2
2	BTHM109L	Communication Skills Laboratory	(0-0-2) 1
3	BTHM403	Basic Human Rights	(3-0-0) 3
4	BTHM605	(A) Development Engineering (B) Employability and Skills Development (C) Consumer Behaviour	(3-0-0) 3
5	BTHM505	(A) Economics and Management (B) Business Communication	(3-0-0) 3
6	BTHM706	Foreign Language Studies	Audit
		TOTAL	**12**

d) Professional Core Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOC302	Discrete Mathematics	(3-1-0) 4
2	BTCOC303	Data Structures	(3-1-0) 4
3	BTCOC304	Computer Architecture & Organization	(3-1-0) 4
4	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	(0-0-4) 2
5	BTCOC401	Design & Analysis of Algorithms	(3-1-0) 4
6	BTCOC402	Operating Systems	(3-1-0) 4
7	BTCOC501	Database Systems	(3-1-0) 4
8	BTCOC502	Theory of Computation	(3-1-0) 4
9	BTCOC503	Software Engineering	(3-1-0) 4
10	BTCOL506	Database Management System & Software Engineering Lab	(0-0-4) 2
11	BTCOC601	Compiler Design	(3-1-0) 4
12	BTCOC602	Computer Networks	(3-1-0) 4
		TOTAL	44

e) Professional Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE504	(A) Human Computer Interaction (B) Numerical Methods	(3-0-0) 3
2	BTCOE604	(A) Geographic Information System (B) Internet of Things (C) Embedded Systems	(3-0-0) 3
3	BTCOE703	(A) Bioinformatics (B) Distributed System (C) Big Data Analytics	(3-0-0) 3
		TOTAL	09

f) Open Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE704	(A) Cryptography and Network Security (B) Business Intelligence (C) Block Chain Technology	(3-0-0) 3
2	BTCOE705	(A) Virtual Reality (B) Deep Learning (C) Design Thinking	(3-0-0) 3
		TOTAL	06

g) Seminar / Mini Project / Internship

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	Audit
2	BTCOS307	Seminar-I	(0-0-4) 2
3	BTCOS407	Seminar-II	(0-0-4) 2
4	BTCOM507	Mini Project-I	(0-0-4) 2
5	BTCOM607	Mini Project-II	(0-0-4) 2
6	BTCOS708	Project Phase-I	(0-0-4) 2
7	BTCOF801	Project Work / Internship	(0-0-24) 12
		TOTAL	22

h) Emerging Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOL305	Object Oriented Programming in Java	(3-1-0) 4
2	BTCOL406	Operating Systems & Python Programming Lab	(1-0-4) 3
3	BTCOC603	Machine Learning	(3-1-0) 4
4	BTCOL606	Competitive Programming & Machine Learning Lab	(1-0-4) 3
5	BTCOC701	Artificial Intelligence	(3-0-0) 3
6	BTCOC702	Cloud Computing	(3-0-0) 3
7	BTCOC707	Artificial Intelligence & Cloud Computing Lab	(0-0-4) 2
		TOTAL	22

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-long learning.

(j) A knowledge of technology: A knowledge 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)
Proposed Scheme w.e.f. July – 2021

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 Evaluation	-	-	-	-	-	-	-	Audit
		TOTAL	15	5	8	220	100	380	700	24

Semester –IV (Second Year)
Proposed Scheme w.e.f. January – 2022

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
	BTBS404	Probability Theory and Random Processes	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 Evaluation						-	-	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

Semester –V (Third Year)
Proposed Scheme w.e.f. July – 2022

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC501	Database Systems	3	1	-	20	20	20	100	4
	BTCOC502	Theory of Computation	3	1	-	20	20	20	100	4
	BTCOC503	Software Engineering	3	1	-	20	20	20	100	4
	BTCOE504	Elective – II (A) Human computer Interaction (B) Numerical Methods	3	-	-	20	20	20	100	3
	BTHM505	Elective – III (A) Economics and Management (B) Business Communication	3	-	-	20	20	20	100	3
	BTCOL506	Database Systems & Software Engineering Lab	-	-	4	60	-	40	100	2
	BTCOM507	Mini-project – I	-	-	4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
		TOTAL	15	3	8	220	100	380	700	22

Semester –VI (Third Year)
Proposed Scheme w.e.f. January – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC601	Compiler Design	3	1	-	20	20	60	100	4
	BTCOC602	Computer Networks	3	1	-	20	20	60	100	4
	BTCOC603	Machine Learning	3	1	-	20	20	60	100	4
	BTCOE604	Elective – IV (A) Geographic Information System (B) Internet of Things (C) Embedded Systems	3	-	-	20	20	60	100	3
	BTHM605	Elective – V (A) Development Engineering (B) Employability and Skill Development (C) Consumer Behaviour	3	-	-	20	20	60	100	3
	BTCOL606	Competitive Programming & Machine Learning Lab	1*	-	4	60	-	40	100	3
	BTCOM607	Mini-project – II	-	-	4	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit to be Evaluated in VII Sem.
		TOTAL	16	3	8	220	100	380	700	23

*Note: Lecture should be conducted only for Competitive Programming

Semester –VII (Final Year)
Proposed Scheme w.e.f. July – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC701	Artificial Intelligence	3	-	-	20	20	60	100	3
	BTCOC702	Cloud Computing	3	-	-	20	20	60	100	3
	BTCOE703	Elective – VI (A) Bioinformatics (B) Distributed System (C) Big Data Analytics	3	-	-	20	20	60	100	3
	BTCOE704	Open Elective – VII (A) Cryptography and Network Security (B) Business Intelligence (C) Block chain Technology	3	-	-	20	20	60	100	3
	BTCOE705	Open Elective – VIII (A) Virtual Reality (B) Deep Learning (C) Design Thinking	3	-	-	20	20	60	100	3
	BTHM706	Foreign Language Studies	-	-	4	-	-	-	-	Audit
	BTCOL707	Artificial Intelligence & Cloud Computing Lab	-	-	4	60	-	40	100	2
	BTCOS708	Project Phase – I	-	-	-	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit
		TOTAL	15	-	8	220	100	380	700	19

Semester –VIII (Final Year)
Proposed Scheme w.e.f. January – 2024

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOF801	Project phase – II (In-house) / Internship and Project in Industry	-	-	24	60	-	40	100	12
		TOTAL	-	-	24	60	-	40	100	12

BTES 301: Engineering Mathematics-III

[UNIT 1] [7 Hours]

Introduction, Vectors in R^n, Vector Addition and Scalar Multiplication, Dot (Inner) Product, Located Vectors, Hyperplanes, Lines, Curves in R^n, Vectors in R^3 (Spatial Vectors), ijk Notation, Complex Numbers, Vectors in C^n.

[UNIT 2] [7 Hours]

Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.

[UNIT 3] [7 Hours]

Introduction, Basic Definitions, Solutions, Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations, Elementary Matrices, LU Decomposition. Applications: Linear Programming, Fourier series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography.

[UNIT 4] [7 Hours]

Determinants: Introduction, Determinants of Orders 1 and 2, Determinants of Order 3, Permutations, Determinants of Arbitrary Order, Properties of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical Adjoint, Applications to Linear Equations, Cramer's Rule, Submatrices, Minors, Principal Minors, Block Matrices and Determinants, Determinants and Volume, Determinant of a Linear Operator, Multilinearity and Determinants.

[UNIT 5] [7 Hours]

Diagonalization Introduction, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem, Diagonalization, Eigenvalues and Eigenvectors, Computing Eigenvalues and Eigenvectors, Diagonalizing Matrices, Diagonalizing Real Symmetric Matrices and Quadratic Forms, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices. Applications: Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.

Text Book:

1. Linear Algebra, Seymour Lipschutz, Schaums outlines, 4th Edition, McGraw-Hill Publication.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley-Cambridge Press.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.

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.

Elective –I

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

BTBS404: 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

List of Experiments:

1. Program to calculate area of triangle, rectangle, circle
2. Program to find the union of two lists.
3. Program to find the intersection of two lists.
4. Program to remove the "i" th occurrence of the given word in a list where words repeat.
5. Program to count the occurrences of each word in a given string sentence.
6. Program to check if a substring is present in a given string.
7. Program to map two lists into a dictionary.
8. Program to count the frequency of words appearing in a string using a dictionary.
9. Program to create a dictionary with key as first character and value as words starting with that character.
10. Program to find the length of a list using recursion.
11. compute the diameter, circumference, and volume of a sphere using class
12. Program to read a file and capitalize the first letter of every word in the file.

BTCOL406: Operating Systems Laboratory

List of Experiments:

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers and systems administration of different operating systems. Writing utilities and OS performance tuning

BTCOS407: Seminar – II

[Unit 1]
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.

[Unit 2]
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.

[Unit 3]
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().

[Unit 4]
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.

[Unit 5]
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.

BTCOC501: Database Systems

[Unit 1] Introduction [7 Hours]

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture Data modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, , Reduction of an ER diagrams to tables.

[Unit 2] Relational Data Model, Relational Algebra and Calculus [7 Hours]
Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

[Unit 3] Introduction to SQL [7 Hours]

Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database Intermediate SQL : Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization, Advanced SQL : Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,

[Unit 4] Relational Database Design and File Organization, Indexing & Hashing [7 Hours]

Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.

File Organization, Ordered Indices, B+tree Index files, B Tree Index File, Static Hashing, Dynamic Hashing,

[Unit 5] Transaction Processing [7 Hours]

Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, ACID Properties, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols, Recovery System.

Text Book:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011.

Reference Books:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-HillPublication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.
4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2ndEdition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Reprint by Addison-Wesley.

BTCOC502: Theory of Computation

[Unit 1] Finite Automata and Regular Expressions   **[7 Hours]**

Definition of deterministic finite automata, Non-deterministic finite automata, Moore and Mealy machines and their conversions, Regular expressions, Recursive definition, NFA with e-moves, Inter-conversion between NFA and DFA, Regular expression and FA, Pumping lemma.

[Unit 2] Context Free Grammars   **[7 Hours]**

Definition, Production rules, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) – definition, Simplification of CFG.

[Unit 3] Context Free Languages   **[7 Hours]**

Definition of context free languages, Regular grammar definition, Left linear, Right linear grammar, Inter-conversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, Derivation graphs, Type 0 and Type 1 grammars.

[Unit 4] Push down Automata   **[7 Hours]**

Formal definition, Pushdown automata (PDA), Deterministic Pushdown automata (DPDA) – definition, Non-deterministic Pushdown automata (NPDA) - definition, relative powers of DPDA and NPDA.

[Unit 5] Turing Machines and Undecidability   **[7 Hours]**

Definition, Computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars, The Church's Turing hypothesis, Universal Turing machines, The Halting problem, Unsolvable problems about Turing machines.

Text Book:
1. Hopcroft, Ullman, Motwani, *Introduction to Automata Theory, Languages, and Computation*, Addison Wesley Publication, 2nd Edition, 2001.

Reference Books:
1. Daniel I. A. Cohen, *Introduction to Computer Theory*, Wiley Publication, 1st Edition, 1986.
2. John C. Martin, *Introduction to Languages and Theory of Computation*, McGraw-Hill Publication, 4th Edition, 2010.
3. Krithivasan Kamala, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education, 1st Edition, 2009.
4. Papadimitriou, Lewis, *Elements of the Theory of Computations*, PHI Publication, 2nd Edition, 1997.
5. E. V. Krishnamurthy, *Introductory Theory of Computer Science*, Springer-Velang New York Inc., 1st Edition, 1985.

BTCOC503: Software Engineering

[Unit 1] [7 Hours]

Introduction: Professional software development, Software engineering ethics, Case studies. Software processes: Software process models, Process activities, Coping with change, The rational unified process.

[Unit 2] [7 Hours]

Agile software development: Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods. Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

[Unit 3] [7 Hours]

System modeling: Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering. Architectural design: Architectural design decisions, Architectural views, Architectural patterns, Application architectures.

[Unit 4] [7 Hours]

Design and implementation, Object-oriented design using UML, Design patterns Implementation issues, Open source development.

[Unit 5] [7 Hours]

Software testing, Development testing, Test-driven development, Release testing, User testing. Dependability properties, Availability and reliability, Safety Security.

Text Book:

1. Ian Sommerville, *Software Engineering*; 9th Edition, Addison-Wesley Publishing Company, USA.

Reference Books:

1. S.A. Kelkar, Software Engineering, , Prentice Hall of India, 2007.
2. Pressman, Software Engineering, Tata McGraw Hill, 6th Edition, 2006.
3. Pankaj Jalote, Software Engineering, Narosa Publishers, 3rd Edition, 2006.

NPTEL Course:

1. Software Engineering, Prof. Rajib Mall, Department of Computer Science and Engineering, IIT Kharagpur.

BTCOE504 (A): Human Computer Interaction

[Unit 1] **[7 Hours]**

Introduction: Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.

[Unit2] **[7 Hours]**

Design processes: Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Soft- ware Process, Design Rules.

[Unit3] **[7 Hours]**

Implementation and Evaluation: Implementation Support, Evaluation Techniques, Universal Design, Use Support.

[Unit4] **[7 Hours]**

Models: Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models. Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.

[Unit5] **[7 Hours]**

Modern Systems: Group ware, Ubiquitous Computing and Augmented Realities, Hypertext, Multimedia and World Wide Web.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale "Human Computer Interaction", Pearson Education, 3rd Edition, 2003.

Reference Books:

1. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
3. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.
4. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O'Reilly Media, 2nd Edition, 2010.

NPTEL Course:

1. Human Computer Interaction, Prof. K. Ponnurangam, Dept. of Computer Science and Engineering, IIIT Delhi.

BTCOE504 (B): Numerical Methods

[Unit 1] [7 Hours]

Solution of Algebraic and Transcendental Equation: Bisection method, Method of false position, Newton's method and Newton-Raphson method.

[Unit 2] [7 Hours]

Solution of Linear Simultaneous Equation: Gauss elimination method, Gauss-Jordan method, Iterative method of solution- Jacobi iteration method, Gauss-Seidal iteration method, Relaxation method.

[Unit 3] [7 Hours]

Finite Differences: Forward difference operator, Backward difference operator, Central difference operator, New- ton's interpolation formulae, Newton's forward–backward-central interpolation formulae.

[Unit 4] [7 Hours]

Differentiation and Integration: Newton-Cortes formula, Trapezoidal rule, Simpson one–third rule, Simpson three- eighth rule.

[Unit 5] [7 Hours]

Numerical Solution of ODE: Picard's methods, Taylor series method, Euler's method, Modified Euler's method, Runge Kutta method.

Text Book:

1. B. S Grewal, Higher Engineering Mathematics, 40th edition, Khanna publication

Reference Books:

1. S. S. Shastri, Introduction to Numerical Methods, PHI publication.
2. V. Rajaraman, Computer Oriented Methods, 3rd edition, PHI publication.
3. Conte and De boor, Elementary Numerical Analysis, BPB publication.
4. E. Kreyszig, Advanced Engineering Mathematics, BPB publication.
5. Steven C Chapra, Numerical Methods for Engineers, 5th edition, McGraw Hill publication.

NPTEL Course:

1. Numerical Methods, Prof. Ameeya Kumar Nayak and Prof. Sanjeev Kumar, IIT Roorkee.

BTHM505 (A): Economics and Management

[Unit 1] [7 Hours]

Introduction, Market Equilibrium: Demand and Supply, Elasticity of Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System.

[Unit 2] [7 Hours]

Relevant Information and Decision Making, Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

[Unit 3] [7 Hours]

Financial Statements, Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

[Unit 4] [7 Hours]

Depreciation Accounting, Evolution of Management Thoughts, Functions of Management Directing.

[Unit 5] [7 Hours]

Product Development, Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

Text Book:
1. R. Paneerselvam, Engineering Economics, PHI publication.

Reference Books:
1. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
2. L. M. Prasad, Principles and Practices of Management.
3. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications.

NPTEL Course:
1. Economics / Management / Entrepreneurship, by Prof. P. K. J. Mohapatra Department of Industrial Engineering & Management, IIT Kharagpur.

BTHM505 (B): Business Communication

[Unit 1]   **[6 Hours]**

Introduction, Definitions & Concepts, Communicative Competence.

[Unit 2]   **[6 Hours]**

Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as Problematic Discourse.

[Unit 3]   **[6 Hours]**

Barriers to Communication, Listening, Communication Rules, Communication Style.

[Unit 4]   **[6 Hours]**

Interpersonal Communication, Relational Communication, Organizational Communication. Collaboration, Communication in Groups and Teams, Persuasive Communication.

[Unit 5]   **[7 Hours]**

Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication, Ethics in Business Communication.

Text Book:

1. Mary Ellen Guffey, Essentials of Business Communication, Sixth Edition, South-Western College Publishing

Reference Books:

1. Bovee, Courtland, John Thill & Mukesh Chaturvedi, Business Communication Today: Dorling kindersley, Delhi.
2. Kaul, Asha, Business Communication, Prentice-Hall of India, Delhi.
3. Monippally, Matthukutty M. Business Communication Strategies. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Sharma, Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd., New Delhi.

NPTEL Course:

1. International Business Communication, by Aradhana Malik, IIT Kharagpur.

BTCOL506: Database Systems Laboratory

List of Experiments:

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.

BTCOL506: Software Engineering Laboratory

List of Experiments:

1. To perform the system analysis: Requirement analysis, SRS. (Both Functional and Nonfunctional requirements. For a set of 10 sample problems, from a book on Software Engineering by Rajib Mall.)
2. To perform the function oriented diagram: DFD and Structured chart.
3. To perform the user's view analysis: Use case diagram.
4. To draw the structural view diagram: Class diagram, object diagram.
5. To draw the behavioral view diagram: Sequence diagram, Collaboration diagram.
6. To draw the behavioral view diagram: State-chart diagram, Activity diagram.
7. To draw the implementation view diagram: Component diagram.
8. To draw the environmental view diagram: Deployment diagram.
9. To perform various testing using the testing tool unit testing, integration testing

BTCOM507: Mini Project-1

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 / near by vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 20-25 pages report using latex
6. Present / demonstrate the solution in front of faculty member

BTCOC601: Compiler Design

[Unit 1] Introduction to Compiling [7 Hours]

Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler,

[Unit 2] Lexical Analysis [7 Hours]

The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

[Unit 3] Syntax Analysis [7 Hours]

The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.

[Unit 4] Syntax-Directed Translation [7 Hours]

Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S- Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes. Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

[Unit 5] Code Generation [7 Hours]

Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators.

Text Book:

1. Aho, Sethi, Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2013

Reference Books:

1. Hopcroft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publication, 2nd Edition, 2001.
2. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, Modern Compiler Design, Springer, 2nd Edition, 2012.

BTCOC602: Computer Networks

[Unit 1] Introduction [7 Hours]

Applications of computer networks, Network hardware, Network software: Protocol Hierarchy, Design Issue, connection oriented vs. connectionless, Service Primitives, Reference models: OSI and TCP/IP, Example networks: Internet, Network standardization, Performance: Bandwidth and Latency, Delay and bandwidth product, High- Speed Network, Application Performance Needs.

[Unit 2] LAN Technologies [7 Hours]

X5, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.

[Unit 3] Data Link Layer [7 Hours]

Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes.

[Unit 4] Network Layer and Congestion Control [7 Hours]

IPv4/IPv6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets, General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.

[Unit 5] Application Layer Protocols [7 Hours]

DNS, SMTP, POP, FTP, HTTP. Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Text Book:

1. A. Tanenbaum, Computer Networks, PHI Publication, 5th Edition, 2011.

Reference Books:

1. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
2. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman Publication, 5th Edition, 2012.
3. S. Keshav, An Engineering Approach to Computer Networking, Addison-Wesley Professional.
4. D. Comer, Computer Networks and Internet, Pearson Education, 6th Edition, 2014.
5. M. Gallo, W. Hancock, Computer Communications and Networking Technologies, Brooks/Cole Publisher, 2001.
6. Natalia Olifer, Victor Olifer, Computer Networks: Principles, Technologies and Protocols for Network Design, Wiley Publication, 2005.

BTCOC603: Machine Learning

[Unit 1]   **[7 Hours]**

Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation

[Unit 2]   **[7 Hours]**

Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

[Unit 3]   **[7 Hours]**

Perceptron, multilayer network, back propagation, introduction to deep neural network.

[Unit 4]   **[7 Hours]**

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

[Unit 5]   **[7 Hours]**

Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model.

Text Book:
1. Tom Mitchell, Machine Learning, First Edition, McGraw Hill, 1997.

Reference Books:
1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition,

BTCOE604 (A): Geographic Information System

[Unit 1]   **[6 Hours]**

What is Geographic Information Systems?, Different components of GIS, Different types of vector data, Raster data models and their types TIN data model.

[Unit 2]   **[6 Hours]**

Advantages and disadvantages associated with vector, raster and TIN Non-spatial data attributes and their type Raster data compression techniques Different raster data file formats spatial database systems and their types.

[Unit 3]   **[6 Hours]**

Pre-processing of spatial datasets Different map projections, Spatial interpolation techniques Different types of resolutions Digital Elevation Model (DEM).

[Unit 4]   **[6 Hours]**

Quality assessment of freely available DEMS GIS analysis-1

[Unit 5]   **[6 Hours]**

GIS analysis-2 and applications Errors in GIS Key elements of maps.

Text Book:

     1. Ian Heywood, Sarah Cornelius and Steve Carver, An Introduction to Geographical Information Systems (4th Edition) 2012.

Reference Books:

     1. Chang Kang-tsung (Karl), Introduction to Geographic Information Systems, 2006
     2. Tor Bernhardsen Geographic Information Systems: An Introduction, May 2002

NPTEL Course:

     1. Dr. Arun K. Saraf, Introduction to Geographical Information System, IIT Roorkee.

BTCOE604 (B): Internet of Things

[Unit 1] IoT Introduction [7 Hours]

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

[Unit 2] Smart Objects [7 Hours]

The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

[Unit 3] IP Layer [7 Hours]

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

[Unit 4] Data and Analytics for IoT [7 Hours]

An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

[Unit 5] IoT Physical Devices and Endpoints [7 Hours]

Building iot with Arduino: Arduino–Interfaces-Arduino IDE–Programming, RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Text Book:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things", 1st Edition, Pearson Education.

Reference Books:

1. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017.

BTCOE604 (C): Embedded Systems

[Unit 1] **[7 Hours]**

Introduction: Embedded system overview, Design challenge, Processor technology, IC technology, Design technology, Custom single processor technology, Hardware-combinational logic, Sequential logic, Custom single purpose processor design, RT-level custom single purpose processor design, Optimizing custom single purpose processors.

[Unit 2] **[7 Hours]**

General purpose processor Software: Basic architecture, Operation, Programmers view, Development environment, Application specific instruction set processor, Selecting a microprocessor, General purpose processor design. Introduction, ARM7TDMI-S processor, Block diagram, Memory mapping, Memory accelerator module.

[Unit 3] **[7 Hours]**

System control: Pin description, Register description, Crystal oscillator, External interrupt inputs, Other system controls, Memory mapping control, Phase locked loop, Power control, Reset, APB divider, Wakeup timer. GPIO: GPIO register map, Timer-TIMER / COUNTER0 and TIMER / COUNTER1 register map, Example timer operation, Architecture.

[Unit 4] **[7 Hours]**

UART: UART0/1 - UART0/1 register map, UART0/1 baud rate, UART0/1 auto-baud, UART0/1 block diagram. Serial peripheral interface: SPI data transfers, SPI pin description, SPI register map, SPI block diagram; I2C-bus interface: I2C bus configuration, I2C operating modes, I2C Bus serial interface block diagram, Summary of I2C registers.

[Unit 5] **[7 Hours]**

Introduction, Process scheduling, Examples of RTOS, Microprocessor and microcontroller based system design, typical design examples, system design and simulation using simulation software such as Proteus VSM. Digital Camera Example Introduction, Introduction to a Simple Digital Camera; User's Perspective, Designer's perspective requirements specification non functional requirements, Informal functional specification, refined functional specification.

Text Book:
1. Frank Vahid "Embedded System Design- A Unified system Hardwar/Software Introduction", (3rd Edition, John Wiley India) ISBN 978-81-265-0837-2.

Reference Books:
1. LPC 214x User manual (UM10139):- www.nxp.com..
2. Andrew N. Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide – Designing and Optimizing System Software", (Elsevier) ISBN: 1-55860-874-5.
3. LPC 17xx User manual (UM10360) :- www.nxp.com
4. ARM architecture reference manual : - www.arm.com
5. Steve Furber "An Engineer's Introduction to the LPC2100 series" Trevor Martin (Hitex (UK) Ltd.)."ARM System-on-Chip Architecture" (2nd Edition, Addison-Wesley Professional)ISBN-13: 9780201403527

BTHM605 (A): Development Engineering

[Unit 1]   **[7 Hours]**
Introduction, Various Definitions of Development Engineering.

[Unit 2]   **[7 Hours]**
World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer's Role.

[Unit 3]   **[7 Hours]**
Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

[Unit 4]   **[7 Hours]**
Development Strategies: Society, Technological Change, and Development, Development Economists' Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

[Unit 5]   **[7 Hours]**
Engineering for Sustainable Community Development: The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education. ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

Text Book:

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

BTHM605 (B): Employability and Skill Development

[Unit 1] 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 2] 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 3] 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 4] 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 5] 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.

Text Book:

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.

BTHM605 (C): Consumer Behavior

[Unit 1] [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: Behavioral 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 2] [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 3] [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 4] [7 Hours]

Psychological Influences on Consumer Decision Making: Consumers 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 5] [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.

Text Book:
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.

BTCOL606: Competitive Programming

[Unit 1] [7 Hours]

Introduction: Online Judge The Programming Challenges Robot Judge, Understanding Feedback From the Judge, Choosing Programming Languages, Reading Our Programs, Standard Input/Output, Programming Hints, Elementary Data Types.

Challenging Problems

(1) The 3n + 1 Problem (2) Minesweeper (3) The Trip, (4) LCD Display (5) Graphical Editor (6) Interpreter (7) Check the Check (8) Australian Voting.

[Unit 2] [7 Hours]

Elementary Data Structures: Data Structures: Elementary Data Structures, Stacks, Dictionaries, Priority Queues Sets, Object Libraries, The C++ Standard Template Library, The Java java.util Package, Program Design Example: Going to War, Hitting the Dec, String Input/Output, Winning the War, Testing and Debugging.

Challenging Problems

(1) Jolly (2) Poker Hands (3) Hartals (4) Crypt Kicker (5) Stack 'em Up (6) Erdos Numbers (7) Contest Scoreboard (8) Yahtzee.

[Unit 3] [7 Hours]

Strings: Character Codes, Representing Strings, Program Design Example: Corporate Renamings, Searching for Patterns, Manipulating Strings, Completing the Merger, String Library Functions.

Challenging Problems

(1) WERTYU (2) Where's Waldorf? (3) Common Permutation (4) Crypt Kicker II (5) Automated Judge Script (6) File Fragmentation (7) Doublets (8) Fmt

[Unit 4] [7 Hours]

Sorting: Sorting, Sorting Applications Sorting Algorithms, Program Design Example: Rating the Field, Sorting Library Functions, Rating the Field.

Challenging Problems

(1) Vito's Family (2) Stacks of Flapjacks (3) Bridge (4) Longest Nap (5) Shoemaker's Problem (6) CDVII (7) Shell Sort (8) Football.

[Unit 5] [8 Hours]

Arithmetic and Algebra: Machine Arithmetic, Integer Libraries, High-Precision Integers, High-Precision Arithmetic, Numerical Bases and Conversion, Real Numbers, Dealing With Real Numbers, Fractions, Decimals, Algebra, Manipulating Polynomials, Root Finding, Logarithms, Real Mathematical Libraries.

Challenging Problems

(1) Primary Arithmetic (2) Reverse and Add (3) The Archeologist's Dilemma (4) Ones (5) A Multiplication Game (6) Polynomial Coefficients (7) The Stern-Brocot Number System (8) Pairsumonious Numbers.

Combinatorics: Basic Counting Techniques, Recurrence Relations, Binomial Coefficients, Other Counting Sequences, Recursion and Induction Problems.

Challenging Problems

(1) How Many Fibs? (2) How Many Pieces of Land? (3) Counting (4) Expressions (5) Complete Tree Labeling (6) The Priest Mathematician (7) Self-describing Sequence (8) Steps

List of Practical:

At least twenty five problems solving on competitive programming platforms such as, https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/

Text Book:

1. Steven S. Skiena Miguel A. Revilla, Programming Challenges The Programming Contest Training Manual, Springer

Reference Books:

1. Antti Laaksonen, Competitive Programmer's Handbook.
2. Steven Halim, Competitive Programming 3: The Lower Bounds of Programming Contests.
3. Gayle Lakaman Cracking the Coding Interview.
4. The Hitchhiker's Guide to the Programming Contests.

BTCOL606: Machine Learning Laboratory

As a part of lab exercises for Machine Learning Laboratory, it is suggested that the student should get hands-on experience by solving data analysis problems available on Machine Learning competition platforms such as Hacker Earth and Kaggle. Some of the suggestive list of problem solving is given below. Knowledge of R programming or Python is required to solve these problems, students get this prerequisite in Second Year.

1	Regression Analysis and Plot interpretation.
2	Logistic Regression Analysis in R.
3	Random Forest and Parameter Tuning in R.
4	Clustering Algorithms and Evaluation in R.
5	Machine Learning Project in Python on Hourse Prices Data.

BTCOC701: Artificial Intelligence

[Unit1] Introduction [7 Hours]

What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

[Unit2]Problem-solving [7 Hours]

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.

[Unit 3]Knowledge & Reasoning [7 Hours]

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.

[Unit 4]Probabilistic Reasoning [7 Hours]

Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics,
Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

[Unit5]Natural Language processing: [7 Hours]

Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing.
Learning: Forms of learning, Inductive learning, Learning decision trees, explanation based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells and knowledge acquisition.

Text Book:
1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill

Reference Books:
1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

BTCOE702 Cloud Computing

[Unit 1] Introduction [7 Hours]

Definition and evolution of Cloud Computing, Enabling Technologies, Service and Deployment Models, Popular Cloud Stacks and Use Cases, Benefits, Risks, and Challenges of Cloud Computing, Economic Models and SLAs, Topics in Cloud Security.

[Unit 2] Cloud Infrastructure [7 Hours]

Historical Perspective of Data Centres, Data centre Components: IT Equipment and Facilities, Design Considerations: Requirements, Power, Efficiency, & Redundancy, Power Calculations, PUE and Challenges in Cloud, Data Centres, Cloud Management and Cloud Software Deployment Considerations.

[Unit 3] Virtualization [7 Hours]

Virtualization (CPU, Memory, I/O) Case Study: Amazon EC2, Software Defined Networks (SDN). Software Defined Storage (SDS).

[Unit 4] Cloud Storage [7 Hours]

Introduction to Storage Systems, Cloud Storage Concepts, Distributed File Systems (HDFS, CephFS), Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB),

[Unit 5] Cloud Object Storage [6 Hours]

Cloud Object Storage (Amazon S3, Open Stack Swift, Ceph).

Text Book:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.

Reference Books:

1. Gautam Shroff, Enterprise Cloud Computing - Technology, Architecture, Applications; Cambridge University Press, 2010.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
3. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
4. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH, 2010

NPTEL Course:

1. Cloud Computing, Prof. Soumya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur.

BTCOE703 (A): Bioinformatics

[Unit 1] Introduction to Bioinformatics [6 Hours]

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological Databases The Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

[Unit 2] Genomics & Proteomics [7 Hours]

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for Medical Science Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

[Unit 3] Phylogenetic Analysis [7 Hours]

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

[Unit 4] Bioinformatics in Drug Discovery [6 Hours]

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

[Unit 5] Human Genome Project [6 Hours]

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

Text Book:

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.

NPTEL Course:

1. Prof. M. Michael Gromiha, Algorithms and Applications.

BTCOE703 (B): Distributed Systems

[Unit1]Introduction [7 Hours]

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message-Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multidatagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

[Unit 2] Remote Procedure Calls [7 Hours]

RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, Case studies: Sun RPC, DCE, RPC.

[Unit 3] Distributed Shared Memory [6 Hours]

General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

[Unit 4] Resource Management And Process Management [6 Hours]

Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

[Unit 5] Distributed File System [6 Hours]

Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Book:

1. P. K. Sinha, Distributed Operating System, PHI Publication

Reference Books:

1. Colorouis, Distributed Systems, Addison Wesley Publication.
2. M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley, 2004.

NPTEL Course:

1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

BTCOE703 (C): Big Data Analytics

[Unit 1] Introduction to Big Data   **[6 Hours]**

Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.

[Unit 2] Big Data Platforms   **[7 Hours]**

Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

[Unit 3] Big Data Streaming Platforms   **[6 Hours]**

Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.

[Unit 4] Big Data Applications   **[6 Hours]**

Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, Spark MLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.

[Unit 5] Database for the Modern Web   **[7 Hours]**

Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript' sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.

Text Book:

1. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley and SAS Business Series.

Reference Books:

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, "Big Data Principals and Paradiagram", Elsevier, ISBN: 978-0-12-805394-2
2. Kyle Banker, Peter Bakkum and Shaun Verch, "MongoDB in Action", 2nd Edition Dream tech Press, ISBN: 978-9351199359.
3. Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", 3rd edition, Cambridge University Press
4. Sima Acharya, Subhashini Chhellappan, "BIG Data and Analytics", ,Willey publication, ISBN: 978-8126554782.

NPTEL COURSE:

1. Big Data Computing by Prof. Rajiv Misra, Dept. of Computer Science and Engineering, IIT Patna

BTCOE704 (A): Cryptography & Network Security

[Unit 1] **[6 Hours]**

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon's Theory.

[Unit 2] **[6 Hours]**

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES).Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

[Unit 3] **[6 Hours]**

Stream Ciphers and Pseudo-randomness: Stream Ciphers, Pseudo-random functions. Hash Functions and MACs: Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs).

[Unit 4] **[6 Hours]**

Asymmetric Key Ciphers: Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie-Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.

[Unit -5] **[6 Hours]**

Digital Signatures: Signature schemes: I, Signature schemes: II. Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II. Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

Text Book:

1. Douglas Stinson, *"Cryptography Theory and Practice"*, 2nd Edition, Chapman & Hall/CRC.

Reference Books:

1. B. A. Forouzan, *"Cryptography & Network Security"*, McGraw Hill Publication.
2. William Stallings, *"Cryptography and Network Security"*, Pearson Education.
3. Dr. B. B. Meshram, *TCP/IP & Network Security*, SPD Publication.
4. Wenbo Mao, *"Modern Cryptography, Theory & Practice"*, Pearson Education.
5. Hoffstein, Pipher, Silvermman, *"An Introduction to Mathematical Cryptography"*, Springer.
6. Alang.Konheim, *Computer Security and Cryptography*, Wiley Publication.
7. A. Joux, *"Algorithmic Crypt-analysis"*, CRC Press.
8. S. G. Telang, *"Number Theory"*, McGraw Hill.
9. Matt Bishop, *"Computer Security"*, Pearson Education.

BTCOE704 (B): Business Intelligence

[Unit 1] Business Intelligence Introduction [6 Hours]

Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics, BI Life Cycle. Data for BI – Data Issues and Data Quality for BI.

[Unit 2] BI Implementation [6 Hours]

Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making. Business Analytics: Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.

[Unit 3] Business/Corporate Performance Management [6 Hours]

Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma. Advanced BI: Big Data and BI, Social Networks, Mobile BI, emerging trends. Working with BI Tools: Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization. Critical issues in planning, physical design process, deployment and ongoing maintenance.

[Unit 4] Data Warehousing (DW) [6 Hours]

Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery. ETL: Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc., Data Loading, Data Staging, Data Quality.

[Unit 5] Dimensional Modeling [6 Hours]

Dimensional Modeling: Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, Fact constellation, slow changing Dimensions. OLAP: OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP; Data Warehouse Project Management: Critical issues in planning, physical design process, deployment and ongoing maintenance.

Text Book:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009

Reference Books:

1. David Loshin, Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 2009.

BTCOE704 (C): Blockchain Technology

[Unit 1] Introduction [6 Hours]

Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Crypto currency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

[Unit 2] Bitcoin and Blockchain [7 Hours]

Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

[Unit 3] Permissioned Blockchain [7 Hours]

Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport- Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

[Unit 4] Enterprise application of Blockchain [6 Hours]

Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain.

[Unit 5] Blockchain Application Development [6 Hours]

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text Book:
1. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.

Reference Books:
1. Josh Thompsons, "Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming".
2. Daniel Drescher, "Blockchain Basics", Apress; 1st Edition, 2017.
3. Anshul Kaushik, "Blockchain and Crypto Currencies", Khanna Publishing House, Delhi.
4. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing.
5. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing.
6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

NPTEL Course:
1. Prof. Sandip Chakraborty, Department of Computer Science And Engineering, IIT Kharagpur and Dr. Praveen Jayachandran, Research Staff Member, IBM.

BTCOE705 (A): Virtual Reality

[Unit 1] Introduction to Virtual Reality **[6 Hours]**

Virtual Reality and Virtual Environment: Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

[Unit 2] Geometric Modelling **[6 Hours]**

From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

[Unit 3] Virtual Environment **[6 Hours]**

Animating the Virtual Environment: The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation, particle system.

[Unit 4] Physical Simulation **[4 Hours]**

Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

[Unit 5] VR Hardware and Software **[6 Hours]**

Human factors: The eye, the ear, the somatic senses. VR Hardware: Sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.
VR Applications: Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

Text Book:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

Reference Books:

1. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.
2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
3. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
4. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2008.
5. www.vresources.org
6. www.vrac.iastate.edu
7. www.w3.org/MarkUp/VRM

BTCOE705 (B): Deep Learning

[Unit 1] [6 Hours]

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks.

[Unit 2] [6 Hours]

FeedForward Neural Networks, Backpropagation. Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp. Principal Component Analysis and its interpretations, Singular Value Decomposition.

[Unit 3] [6 Hours]

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying. Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

[Unit 4] [6 Hours]

Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Learning Vectorial Representations of Words,

[Unit 5] [6 Hours]

Recurrent Neural Networks, Back propagation through time, Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Book:
1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press

Reference Books:
1. Raúl Rojas, Neural Networks: A Systematic Introduction, 1996.
2. Christopher Bishop, Pattern Recognition and Machine Learning, 2007.

NPTEL Courses:
1. Prof. Prof. Mitesh M. Khapra, Prof. Sudarshan Iyengar, Dept. of Computer Science and Engineering, IIT Madras & IIT Ropar, NPTEL Course on Deep Learning (Part-I).

BTCOE705 (C): Design Thinking

[Unit 1] Overview of Design Thinking Process   **[6 Hours]**

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

[Unit 2] Empathize   **[5 Hours]**

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions.

[Unit 3] Analyze or Define   **[5 Hours]**

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

[Unit 4] Test (Prototyping and Validation)   **[5 Hours]**

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

[Unit 5] Design Innovation   **[5 Hours]**

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

Text Book:

    1. Bala Ramadurai, "Karmic Design Thinking", First Edition, 2020.

Reference Books:

    1. Vijay Kumar," 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization ".
    2. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World by IDEO.
    3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
    4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

BTCOL706 Artificial Intelligence

List of Experiments:

1. Study of PROLOG. Write the following programs using PROLOG.
2. Write a program to solve 8 queens problem.
3. Solve any problem using depth first search.
4. Solve any problem using best first search.
5. Solve 8-puzzle problem using best first search.
6. Solve Robot (traversal) problem using means End Analysis.
7. Solve traveling salesman problem.

BTCOL706 Cloud Computing

List of Experiments:

(Pl. Note: List of Experiments should be as per theory covered in the class based on Cloud Environments.

Following list can be used as a reference.)

1. Sketch out and analyze architecture of Moodle cloud portal and moodle cloud site and create different entities dynamically.
2. Create a scenario in wordpress for Social Marketing, Search engine and Sharing Tools.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Implement and configure Google App Engine to deploy Python Program application.
6. Installation and configuration of virtual machine with guest OS.
7. Demonstrate the use of map and reduce tasks.
8. Implementation of SOAP Web services in C#/JAVA Applications.
9. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
10. Implement and use sample cloud services with the help of Microsoft Azure.
11. Design and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
12. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
13. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.

BTCOS707: Project phase - I

BTCOF801: Project phase – II (In-house) / Internship and Project in the Industry

In this course, it is expected that students will go to industry for internship for one semester and do industry based project in that period. Student will be assigned one dept. one Industry guide to monitor progress of the student. After, completion of the Internship student will submit project report to the dept. and project examination will be conducted in consultation with the Industry guide.

In case, if student not opting / not doing Internship in the Industry, such students can do project work in the dept.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Linear Algebra	BTES301	III	https://nptel.ac.in/courses/111/101/111101115/ https://nptel.ac.in/courses/111/106/111106051/	IIT, Madras	85 90	8 Weeks 12 Weeks
2	Discrete Mathematics	BTCOC302	III	https://nptel.ac.in/courses/106/106/106106094/ https://nptel.ac.in/courses/111/107/111107058/	IIT, Madras IIT, Roorkee	90 90	8 Weeks
3	Data Structures	BTCOC303	III	https://nptel.ac.in/courses/106/102/106102064/	IIT, Delhi	90	Not mentioned
4	Computer Architecture & Organization	BTCOC304	III	https://nptel.ac.in/courses/106/106/106106092/ https://nptel.ac.in/courses/106/103/106103180/ https://nptel.ac.in/courses/106/106/106106166/ https://nptel.ac.in/courses/106/105/106105163/ https://swayam.gov.in/nd1_noc20_cs64/preview	IIT, Madras IIT, Guwahati IIT, Madras ,IIT, Kharagpur IIT, Kharagpur	85 75 70 85 85	12 weeks
5	Object Oriented Programming in C++	BTCOC305	III	https://nptel.ac.in/courses/106/105/106105151/	IIT, Kharagpur	58	8 weeks
6	JAVA Programming	BTCOL306	III	https://nptel.ac.in/courses/106/105/106105191/	IIT, Kharagpur	90	12 Weeks
7	Design & Analysis of Algorithms	BTCOC401	IV	https://nptel.ac.in/courses/106/101/106101060/ https://nptel.ac.in/courses/106/105/106105164/ https://swayam.gov.in/nd1_noc20_cs71/preview	IIT, Kharagpur IIT, Madras Chennai Mathematical Institute	40	12 weeks
8	Probability & Statistics	BTBS402	IV	https://nptel.ac.in/courses/111/106/111106112/# https://nptel.ac.in/courses/111/105/111105090/	IIT, Madras IIT, Kharagpur	80 90	4 weeks 12 weeks
9	Operating Systems	BTCOC403	IV	https://nptel.ac.in/courses/106/108/106108101/ https://nptel.ac.in/courses/106/106/106106144/	IISc, Bangalore IIT, Madras	1. 85 2. 80	1. 8 Weeks 2. 8 Weeks
10	Basic Human Rights	BTHM404	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT, Kanpur	75	30 Hours

11	Digital Electronics & Microprocessors	BTES405	IV	https://nptel.ac.in/courses/108/105/108105132/ https://nptel.ac.in/courses/108/103/108103157/	IIT, Kharagpur IIT, Guwahati	50	12 weeks
12	Python Programming	BTCOL406	IV	https://nptel.ac.in/courses/106/106/106106182/	IIT, Ropar	95	12 weeks
14	Database Systems	BTCOC501	V	http://nptel.ac.in/courses/106106093/	IIT, Madras	95	12 Weeks
15	Theory of Computation	BTCOC502	V	https://nptel.ac.in/courses/106/104/106104028/ https://nptel.ac.in/courses/106/106/106106049/	IIT, Kharagpur IIT, Madras	92	45 Hrs 42 Hrs
16	Machine Learning	BTCOC503	V	https://nptel.ac.in/courses/106/105/106105152/	IIT, Kharagpur	100	8 Weeks
17	Human Computer Interaction	BTCOE504 (A)	V	https://nptel.ac.in/courses/106/103/106103115/#	IIT, Guwahati	70	8 Weeks
8	Numerical Methods	BTCOE504 (B)	V	https://nptel.ac.in/courses/111/107/111107105/	IIT, Roorkee	90	8 Weeks
19	Economics and Management	BTHM505 (A)	V	https://nptel.ac.in/courses/110/105/110105067/	IIT, Kharagpur	90	8 Week
20	Business Communication	BTHM505 (B)	V	https://nptel.ac.in/courses/110/105/110105052/	IIT, Kharagpur	90	8 Weeks
21	Compiler Design	BTCOC601	VI	https://nptel.ac.in/courses/106/108/106108113/ https://nptel.ac.in/courses/106/104/106104123/	IISc, Banglore IIT Kanpur	80	40 Hrs
22	Computer Networks	BTCOC602	VI	https://nptel.ac.in/courses/106/105/106105081/ https://nptel.ac.in/courses/106/105/106105080/	IIT Kharagpur	90	12 Weeks
23	Software Engineering	BTCOC603	VI	https://nptel.ac.in/courses/106/105/106105182/	IIT, Kharagpur	70	9 weeks
24	Geographic Information System	BTCOE604 (A)	VI	Introduction to Geographic Information Systems	IIT, Roorkee	90	4 weeks
25	Internet of Things	BTCOE604 (B)	VI	https://nptel.ac.in/courses/106/105/106105166/	IIT, Kharagpur	60	12 Weeks
26	Embedded Systems	BTCOE604 (C)	VI	https://nptel.ac.in/courses/106/105/106105193/	IIT, Kharagpur	80	8 Weeks
27	Development Engineering	BTCOE605 (A)	VI	https://nptel.ac.in/courses/109/103/109103023/ https://nptel.ac.in/courses/109/104/109104074/	IIT, Guwahati IIT, Kanpur	30 40	8 Weeks
28	Employability and Skills Development	BTCOE605 (B)	VI	https://nptel.ac.in/courses/109/105/109105144/	IIT, Kharagpur	75	8 Weeks
29	Consumer Behaviour	BTCOE605 (C)	VI	https://nptel.ac.in/courses/110/105/110105054/	IIT Kharagpur	90	40 Hrs

30	Artificial Intelligence	BTCOC701	VII	https://nptel.ac.in/courses/106/106/106106126/	IIT, Madras	70	48 Hrs
				https://nptel.ac.in/courses/106/105/106105078/	IIT, Kharagpur		41 Hrs
31	Cloud Computing	BTCOE702	VII	https://nptel.ac.in/courses/106/104/106104182/	IIT, PATNA	30	8 weeks
				https://nptel.ac.in/courses/106/105/106105167/	IIT, Kharagpur	40	
32	Bioinformatics	BTCOE703 (A)	VII	https://nptel.ac.in/courses/102/106/102106065/	IIT, Madras	50	12 Weeks
33	Distributed Systems	BTCOE703 (B)	VII	https://nptel.ac.in/courses/106/106/106106168/	IIT, PATNA	50	8 Weeks
34	Big Data Analytics	BTCOE703 (C)	VII	https://nptel.ac.in/courses/106/104/106104189/	IIT, PATNA	50	8 Weeks
35	Cryptography and Network Security	BTCOE704 (A)	VII	https://swayam.gov.in/nd2_nou19_cs08/preview	Uttarakhand Open University, Haldwani	20	12 Weeks
36	Business Intelligence	BTCOE704 (B)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, Kharagpur	10	12 Weeks
37	Blockchain	BTCOE704 (C)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, KANPUR	60	8 Weeks
38	Virtual Reality	BTCOE705 (A)	VII	https://nptel.ac.in/course/106/106/106106138	IIT Madras & UIUC	30	8 Weeks
39	Deep Learning	BTCOE705 (B)	VII	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs85/	IIT Madras & IIT Ropar	100	12 Weeks
40	Design Thinking	BTCOE705 (C)	VII	https://nptel.ac.in/courses/110/106/110106124/	IIT Madras	75	4 Weeks

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course	Name of Institute offering course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	1)https://www.coursera.org/learn/discrete-mathematics/home/welcome 2)https://www.coursera.org/specializations/discrete-mathematics	1)Shanghai Jiao Tong University 2)University of California San Diego National Research University Higher School of Economics	1) 75 2) 90	8 Weeks
2	Data Structures	BTCOC303	III	1) Data Structures 2) Data Structures & Algorithms	1) UC SanDiego 2) UC SanDiego	1) 90 2) 80	1) 6 Weeks 2) 6 Weeks
3	Computer Architecture & Organization	BTCOC304	III	Computer Architecture	Princeton University, US	25	4 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	C++ For C Programmers, Part A	University of California, Santa Cruz	27	5 Weeks
5	Digital Electronics & Microprocessors	BTES403	IV	1) Digital Systems: From Logic Gates to Processors	1) Universitat Autonoma de Barcelona 2) Princetone University	20	4 Weeks
6	Design & Analysis of Algorithms	BTCOC401	IV	Algorithms Specialization	Stanford University	40	16 Weeks
7	Probability & Statistics	BTBS402	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
8	Operating Systems	BTCOC403	IV	Operating Systems and You: Becoming a Power User	Google	20	6 Week
9	Database Systems	BTCOC501	V	Relational database systems	Universidad Nacional Autónoma de México	30	4 Weeks
10	Theory of Computation	BTCOC502	V	Computer Science: Algorithms, Theory, and Machines	Princeton University	25	4 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python	IBM	50	6 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Interaction Design Specialization	UCSanDiego	30	13 Weeks
13	Economics and Management	BTHM505 (A)	V	Managerial Economics and Business Analysis Specialization	University of Illinois	30	4 Weeks

14	Business Communication	BTHM505 (B)	V	Communication theory: bridging academia and practice	National Research University Higher School of Economics	35	9 Weeks
15	Compiler Design	BTCOC601	VI	Nil	Nil	Nil	Nil
16	Computer Networks	BTCOC602	VI	The Bits and Bytes of Computer Networking	Google	50	4 Weeks
17	Software Engineering	BTCOC603	VI	Software Development Processes and Methodologies https://www.coursera.org/learn/software-Processes	University of Minnesota	25	4 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	1. GIS, mapping, and spacial analysis Specialization	University of Toronto	40	6 months
19	Internet of Things	BTCOE604 (B)	VI	Internet of Things Specialization	UC San Diego	40	6 Months
20	Development Engineering	BTCOE605 (A)	VI	Revolutionary Ideas: Utility, Justice, Equality, Freedom	Rutgers the State University of New Jersey	30	5 Wee.
21	Consumer Behaviour	BTCOE605 (C)	VI	Digital Marketing Specialization	Illinois	70	6 Months
22	Artificial Intelligence	BTCOC701	VII	Introduction to Artificial Intelligence (AI)	IBM	40	4 Weeks
23	Cloud Computing	BTCOE702	VII	Cloud Computing Applications, Part 1: Cloud Systems and Infrastructure	University of Illinois at Urbana-Champaign	70	4 Weeks
24	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics Capstone: Big Data in Biology	University of California San Diego	20	3 Weeks
25	Distributed System	BTCOE703 (B)	VII	Distributed Programming in Java	Rice University	30	4 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Information Security: Context and Introduction	Royal Holloway, University of London	40	4 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence Concepts, Tools, and Applications	University of Colorado System	30	5 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM
Edx

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Edx Course	Name of Institute offering Course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	https://www.edx.org/course/advanced-algorithmics-and- graph-theory-with-python	IMT Atlantique, a french technological university	50	6 Weeks
2	Data Structures	BTCOC303	III	1) Foundations of Data Structures 2) Algorithms and Data Structures	1) IIT Bombay 2) UCSanDiego	1) 90 2) 70	1) 6 Weeks 2) 4 Weeks
3	Computer Architecture & Organization	BTCOC304	III	1. Computer Organization 2. Computer Architecture	1. MITx 2. MITx	1. 20 2. 20	10 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	Object-oriented Programming	IIT BombayX	53	4 Weeks
5	Design & Analysis of Algorithms	BTCOC401	IV	Algorithm Design and Analysis	University of Pennsylvania	40	4 Weeks
6	Probability & Statistics	BTBS402	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Operating Systems	BTCOC403	IV	Computer Hardware and Operating Systems	New York University	40	6 Weeks
8	Digital Electronics & Microprocessors	BTES405	IV	Computer System Design: Advanced Concepts of Modern Microprocessors	1) Edx Edge	10	6 Weeks
9	Database Systems	BTCOC501	V	Databases: SQL	Stanford Online	50	8 Weeks
10	Theory of Computations	BTCOC502	V	Automata Theory	Stanford University	60	7 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python: A Practical Introduction	IBM	50	5 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Human-Computer Interaction	Georgia Tech	30	12 Weeks
13	Economics and Management	BTHM505 (A)	V	Introduction to Managerial Economics	IIM Bangalore	30	6 Weeks
14	Business Communication	BTHM505 (B)	V	Effective Business Communication	IIM Bangalore	40	6 Weeks
15	Compiler Design	BTCOC601	VI	Compilers	Stanford University	45	10 Weeks

16	Computer Networks	BTCOC602	VI	Introduction to Networking	New York University	40	7 Weeks
17	Software Engineering	BTCOC603	VI	Software Engineering Essentials https://www.edx.org/course/software-engineering-essentials	TUMx	40	8 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	No Program available	NA	NA	NA
19	Internet of Things	BTCOE604 (B)	VI	Getting Started with the Internet of Things (IoT)	Microsoft	30	4 Weeks
20	Development Engineering	BTCOE605 (A)	VI	Human Rights, Human Wrongs: Challenging Poverty, Vulnerability and Social Exclusion	SDGAcademyX, Middlesex University	40	11 Weeks
21	Consumer Behaviour	BTCOE605 (B)	VI	Consumer Behaviour	IITMB	50	4 Weeks
22	Artificial Intelligence	BTCOC701	VII	CS50's Introduction to Artificial Intelligence with Python	Harvard University	35	7 Weeks
23	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics	University of Maryland	40	24 Weeks
24	Distributed Systems	BTCOE703 (B)	VII	Reliable Distributed Algorithms - Part 1	KTHx	30	5 Weeks
25	Cloud Computing	BTCOE703 (C)	VII	Cloud Computing Management	University of Maryland	20	8 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Cyber security	Rochester Institute of Technology	50	40 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence for IoT Solutions	Microsoft	20	4 Weeks
28	Block Chain	BTCOE704 (C)	VII	1. Block chain Technology 2. Block chain Fundamentals	Berkeley University Of California	60	14 Weeks
29	Virtual Reality	BTCOE705 (A)	VII	How Virtual Reality Works	Ucsan Diego	10	6 Weeks
30	Deep Learning	BTCOE705 (B)	VII	Deep Learning Fundamentals with Keras	IBM	15	5 Weeks

Elective - IX Laboratory
BTCOL708 (A): Cloud Computing Laboratory

List of Experiments:
(Pl. Note: List of Experiments should be as per theory covered in the class based on Cloud
Environments. Following list can be used as a reference.)

1. Sketch out and analyze architecture of Moodle cloud portal and moodle cloud site and create different entities dynamically.
2. Create a scenario in wordpress for Social Marketing, Search engine and Sharing Tools.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Implement and configure Google App Engine to deploy Python Program application.
6. Installation and configuration of virtual machine with guest OS.
7. Demonstrate the use of map and reduce tasks.
8. Implementation of SOAP Web services in C#/JAVA Applications.
9. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
10. Implement and use sample cloud services with the help of Microsoft Azure.
11. Design and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
12. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
13. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Elective - IX Laboratory
BTCOL708 (B): Business Intelligence Laboratory

List of Experiments:

1. Installation of SQL server and Power BI.
2. Import the legacy data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system.
3. Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver / Power BI.
4. Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.
5. Create the ETL map and setup the schedule for execution.
6. Execute the MDX queries to extract the data from the data warehouse.
7. Apply the what – if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data.
8. Implementation of Classification algorithm in R Programming.
9. Practical Implementation of Decision Tree using R Tool.
10. Prediction Using Linear Regression.
11. Data Analysis using Time Series Analysis.

Dr. Babasaheb Ambedkar Technological University

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Detailed Syllabus
for
Third Year B. Tech. Program in Computer Engineering

With effective from July 2019-20

Head
Department of Computer Engineering
Dr Babasaheb Ambedkar Technological Universit
Lonere-402 103 Dist. Raigad (M.S.) India

Semester I
Group A

Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
		L	T	P	MSE	CA	ESE	
Mandatory	Induction Program	3 Weeks duration in the beginning of the semester.						
BTBS101	Engineering Mathematics - I	3	1	-	20	20	60	4
BTBS102	Engineering Physics	3	1	-	20	20	60	4
BTES103	Engineering Graphics	2	-	-	20	20	60	2
BTHM104	Communication Skills	2	-	-	20	20	60	2
BTES105	Energy and Environment Engineering	2	-	-	20	20	60	2
BTES106	Basic Civil and Mechanical Engineering	2	-	-	-	50	-	Audit
BTBS107L	Engineering Physics Lab	-	-	2	-	60	40	1
BTBS108L	Engineering Graphics Lab	-	-	4	-	60	40	2
BTHM109L	Communication Skill Lab	-	-	2	-	60	40	1
	TOTAL	14	2	8	100	330	420	18

Semester II

Group B

Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
		L	T	P	MSE	CA	ESE	
BTBS201	Engineering Mathematics - II	3	1	-	20	20	60	4
BTBS202	Engineering Chemistry	3	1	-	20	20	60	4
BTES203	Engineering Mechanics	2	1	-	20	20	60	3
BTES204	Computer Programming in C	2	-	-	20	20	60	2
BTES205	Workshop Practices	-	-	4	-	60	40	2
BTES206	Basic Electrical & Electronics Engineering	2	-	-	-	50	-	Audit
BTBS207L	Computer Programming Lab	-	-	2	-	60	40	1
BTBS208L	Engineering Chemistry Lab	-	-	2	-	60	40	1
BTES209L	Engineering Mechanics Lab	-	-	2	-	60	40	1
BTES210P	Mini Project	-	-	2	-	60	40	1
BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in First Semester and Second Semester or in at one time).	-	-	-	-	-	-	Credit to be evaluated in III Sem.
	TOTAL	12	3	12	80	430	440	19

Semester III

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
1	BTBSC301	Engineering Mathematics – III	3	1	-	20	20	60	4
2	BTCOC302	Discrete Mathematics	2	1	-	20	20	60	3
3	BTCOC303	Data Structures	2	1	-	20	20	60	3
4	BTCOC304	Computer Architecture & Organization	2	1	-	20	20	60	3
5	BTCOC305	Digital Electronics & Microprocessors	2	1	-	20	20	60	3
6	BTHM3401	Basic Human Rights	2	-	-	-	50	-	Audit
7	BTCOL306	Python Programming	1	-	2	-	60	40	2
8	BTCOL307	HTML and JavaScript	1	-	2	-	60	40	2
9	BTCOL308	Data Structures Lab	-	-	2	-	60	40	1
10	BTCOL309	Digital Electronics & Microprocessor Lab	-	-	2	-	60	40	1
11	BTES211P	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	50	1
		TOTAL	**15**	**5**	**8**	**100**	**390**	**510**	**23**

Semester IV

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
1	BTCOC401	Design & Analysis of Algorithms	2	1	-	20	20	60	3
2	BTCOC402	Probability & Statistics	2	1	-	20	20	60	3
3	BTCOC403	Operating Systems	2	1	-	20	20	60	3
4	**Elective-I**								
	BTCOE404A	Object Oriented Programming in Java	2	1	-	20	20	60	3
	BTCOE404B	Object Oriented Programming in C++							
5	BTID405	Product Design Engineering	1	-	2	-	60	40	2
6	**Elective-II**								
	BTBS405A	Physics of Engineering Materials	2	1	-	20	20	60	3
	BTCOE406B	Numerical Methods							
	BTHM3402	Soft Skills and Personality Development							
7	BTCOL407	Design & Analysis of Algorithms Lab	-	-	2	-	60	40	1
8	BTCOL408	Introduction to Data Science with R	1	-	2	-	60	40	2
9	BTCOL409	Object Oriented Programming Lab	-	-	2	-	60	40	1
10	BTCOL410	Operating System Lab	-	-	2	-	60	40	1
11	BTCOF411	Field Training/Internship/Industrial Training Evaluation (Credit to be evaluated in V Sem.)	-	-	-	-	-	-	*
		TOTAL	12	5	10	100	400	500	22

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
		Semester V							
			L	T	P	MSE	CA	ESE	
1	BTCOC501	Database Systems	3	1	-	20	20	60	4
2	BTCOC502	Theory of Computations	3	1	-	20	20	60	4
3	BTCOC503	Machine Learning	3	1	-	20	20	60	4
4	BTHME504	**Elective-III** (A) Introduction to Research (B) Cyber Laws **(C) Open Elective offered by other departments**	2	-	-	20	20	60	2
5	BTHME505	**Elective-IV** (A) Economics & Management (B) Business Communication	2	-	-	20	20	60	2
6	BTCOC506	Competitive Programming-I	1	-	2	-	60	40	2
7	BTCOL507	Database System Laboratory	-	-	2	-	60	40	1
8	BTCOL508	Machine Learning Laboratory	-	-	2	-	60	40	1
9	BTCOS509	Seminar	-	-	2	-	60	40	1
10	BTCOF411	Internship/Industrial Training	-	-	-	-	60	40	1
		TOTAL	**14**	**3**	**8**	**100**	**400**	**500**	**22**

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
Semester VI									
			L	T	P	MSE	CA	ESE	
1	BTCOC601	Compiler Design	3	1	-	20	20	60	4
2	BTCOC602	Computer Networks	3	1	-	20	20	60	4
3	BTCOE603	**Elective-V** (A) Human Computer Interaction (B) Artificial Intelligence (C) Object-Oriented Analysis Design	2	1	-	20	20	60	3
4	BTCOE604	**Elective-VI** (A) Geographic Information System (B) Biology (C) Internet of Things	2	-	-	20	20	60	2
5	BTHME605	**Open Elective-VII** (A) Development Engineering (B) National Social Service (C) Consumer Behaviour	2	-	-	20	20	60	2
6	BTCOC606	Competitive Programming-II	1	-	2	-	60	40	2
7	BTCOL607	(A) Mobile Application Development	1	-	2	-	60	40	2
		(B) Internet of Things Laboratory							
8	BTCOL608	Computer Networks Laboratory	-	-	2	-	60	40	1
9	BTCOF609	Filed Training / Internship / Industrial Training (Credit to be evaluated in VII Sem.)	-	-	-	-	-	-	*
		TOTAL	14	3	6	100	280	420	20

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
		·Semester VII							
1	BTCOC701	Software Engineering	2	-	-	20	20	60	2
2	BTCOE702	**Elective-VIII** (A) Bioinformatics (B) Distributed System (C) Cloud Computing	2	1	-	20	20	60	3
3	BTCOE703	**Elective-IX** (A) Advanced Operating System (B) Computer Graphics (C) Bio-Metrics (D) Digital Image Processing	2	1	-	20	20	60	3
4	BTCOE704	**Open Elective-X** (A) Information Security (B) Business Intelligence (C) Blockchain	2	1	-	20	20	60	3
5	BTCOL705	Full Stack Development (LAMP/MEAN)	1	-	2	-	60	40	2
6	BTCOL706	System Administration	1	-	2	-	60	40	2
7	BTCOP707	Project-I	-	-	6	-	60	40	6
8	BTCOF609	Internship/Industrial Training	-	-	-	-	60	40	1
		TOTAL	10	3	10	80	320	400	22

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
Semester VIII (Scheme A)									
1	BTCOE801	**Elective-XI** (A) Software Product Design (B) Quantum Computing (C) Software Testing (D) Big Data Analytics	2	1	-	20	20	60	3
2	BTCOE802	**Open Elective-XII** (A) 3D Printing And Design (B) Robotics (C) Advanced Database Techniques	2	1	-	20	20	60	3
3	BTCOE803	**Open Elective-XIII** (A) Virtual Reality (B) Deep Learning (C) Elective offered by other dept.	2	1	-	20	20	60	3
4	BTCOP804	Project-II	-	-	8	-	60	40	8
		TOTAL	6	3	8	60	120	220	17
Semester VIII (Scheme B)									
1	BTCOF805	Industrial In-plant Training	-	-	18	-	120	180	9
2	BTCOP804	Project-II	-	-	8	-	60	40	8
		TOTAL	-	-	26	-	180	220	17

NPTEL Mapping of Courses (Semester V to VIII)

No.	DBATU Course	NPTEL Course
Semester V		
1	Database Systems	Fundamental of Database System Prof. Arnab Bhattacharya, IIT Kanpur
2	Theory of Computations	Formal Languages and Automata Theory Prof. Diganta Goswami, IIT Guwhati
3	Machine Learning	Introduction to Machine Learning Prof. Sudeshana Sarkar, IIT Kharagpur
4	Introduction to Research	Introduction to Research Prof. Pratap Haridoss
5	Economics and Management	Economics, Management & Entrepreneurship Prof. P. K. Mahapotra, IIT Kharagpur
6	Business Communication	International Business Communication Prof: Aradhana Malik, IIT Kharagpur
Semester VI		
1	Compiler Design	Compiler Design By Prof. Santanu Chattopadhyay, IIT Kharagpur
2	Computer Network	Computer Network Prof. Soumya Kanti Ghosh, IIT Kharagpur
3	Human Computer Interaction	Human Computer Interaction Prof. K. Ponnurangam, IIT Delhi
4	Artificial Intelligence	Artificial Intelligence Prof. P. Dasgupta, IIT Kharagpur
5	Geographic Information System	Geographic Information System Prof. A K. Saraf, IIT Roorkee
6	Biology	Basic Biology Prof. Vishal Trivedi, IIT Guwahati
7	Internet of Things	Design for Internet of Things Prof. T. V. Prabhakar, IISC Bangalore
8	Consumer Behaviour	Introduction to Consumer Behavior Prof. Shrabanti Mukharjee, IIT Kharagpur
Semester VII		
1	Distributed System	Distributed System Prof. Rajiv Misra, IIT Patna
2	Cloud Computing	Cloud Computing Prof. Soumya Kanti Ghosh, IIT Kharagpur

3	Computer Graphics	Computer Graphics Prof. Sukhedu Das, IIT Madras
4	Blockchain	Blockchain Architecture Design and Use Cases Prof Sandip Chakraborty, IIT Kharagpur
	Semester VIII	
1	Software Testing	Software Testing Prof. Rajib Mall, IIT Kharagpur
2	Robotics	Robotics Prof. Dilip Kumar Pratihar, IIT Kharagpur
3	Virtual Reality	Virtual Reality Prof. Steve Lavalle, University of Illinois
4	Deep Learning	Deep Learning Prof. Mitesh Khapra, IIT Madras

BTCOC501 Database Systems

[Unit 1]   **6 Hrs**
Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).
Data models: Entity-relationship model, Relational integrity constraints, data manipulation operations.

[Unit 2]   **6 Hrs**
Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS – MYSQL, ORACLE, DB2, SQL server.

[Unit 3]   **6 Hrs**
Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.

[Unit 4]   **6 Hrs**
Query processing: Evaluation of relational algebra expressions, Query equivalence, Join strategies.

[Unit 5]   **6 Hrs**
File Organization and Indexing: Indices, B-trees, hashing.

[Unit 6]   **6 Hrs**
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

Text Books:
1. Henry Korth, Abraham Silberschatz & S. Sudarshan, *Database System Concepts*, McGraw-Hill Publication, 6th Edition, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems*, McGraw-Hill Publication, 3rd Edition, 2003.

Reference Books:
1. Joel Murach, *Murach's Oracle SQL and PL/SQL for Developers*, Mike Murach & Associates, 2nd Edition, 2014.
2. Wiederhold, *Database Design*, McGraw-Hill Publication, 2nd Edition, 1983.
3. Navathe, *Fundamentals of Database System*, Addison-Wesley Publication, 6th Edition, 2012.
4. Mark L. Gillenson, *Fundamentals of Database Management System*, Wiley Publication, 2nd Edition, 2011.
5. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer Science Press.
6. Serge Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Reprint by Addison-Wesley.

BTCOC502 Theory of Computations

[Unit 1]   **6 Hrs**
Finite Automata and Regular Expressions: Definition of deterministic finite automata, Non-deterministic finite automata, Moore and Mealy machines and their conversions, Regular expressions, Recursive definition, NFA with e-moves, Inter-conversion between NFA and DFA, Regular expression and FA, Pumping lemma.

[Unit 2]   **6 Hrs**
Context Free Grammars: Definition, Production rules, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) – definition, Simplification of CFG.

[Unit 3]   **6 Hrs**
Context Free Languages: Definition of context free languages, Regular grammar definition, Left linear, Right linear grammar, Inter-conversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, Derivation graphs, Type 0 and Type 1 grammars.

[Unit 4]   **6 Hrs**
Pushdown Automata: Formal definition, Pushdown automata (PDA), Deterministic Pushdown automata (DPDA) – definition, Non-deterministic Pushdown automata (NPDA) - definition, relative powers of DPDA and NPDA.

[Unit 5]   **6 Hrs**
Turing Machines and Undecidability: Definition, Computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars, The Church's Turing hypothesis, Universal Turing machines, The Halting problem, Unsolvable problems about Turing machines.

Reference Books:
1. John C. Martin, *Introduction to Languages and Theory of Computation*, McGraw-Hill Publication, 4th Edition, 2010.
2. Krithivasan Kamala, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education, 1st Edition, 2009.
3. Papadimitriou, Lewis, *Elements of the Theory of Computations*, PHI Publication, 2nd Edition, 1997.
4. E. V. Krishnmurthy, *Introductory Theory of Computer Science*, Springer-Velang New York Inc., 1st Edition, 1985.

Text Books:
1. Hopcroft, Ullman, Motwani, *Introduction to Automata Theory, Languages, and Computation*, Addison Wesley Publication, 2nd Edition, 2001.
2. Daniel I. A. Cohen, *Introduction to Computer Theory*, Wiley Publication, 1st Edition, 1986.

BTCOC503 Machine Learning

[Unit 1]   **6 hrs**

Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, overfitting.

[Unit 2]   **6 hrs**

Instance based learning, Feature reduction, Collaborative filtering based recommendation, Probability and Bayes learning.

[Unit 3]   **6 hrs**

Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

[Unit 4]   **6 hrs**

Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

[Unit 5]   **6 hrs**

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

[Unit 6]   **6 hrs**

Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.

Reference Books:

1. Machine Learning, Tom Mitchell, First Edition, McGraw Hill, 1997.

2. Introduction to Machine Learning, 2nd Edition, by Ethem Alpaydin.

BTHME504(A) Introduction to Research

[Unit 1]
What is research; Overview of research.

[Unit 2]
Literature survey, Conducting Systematic Research Survey.

[Unit 3]
Experimental skills; Data analysis; modelling skills.

[Unit 4]
Technical writing, Technical Presentations, Creativity in Research.

[Unit 5]
Technical writing, Technical Presentations, Creativity in Research, Research plagiarism.

[Unit 6]
Conducting a sample Research Survey on a given topic

Reference Books:
1. Research Methodology, Methods and Techniques by C.R Kothari, 2nd Edition.

BTHME504(B) Cyber Laws

[Unit 1]

Internet, E-Commerce And E-Governance With Reference To Free Market Economy Understanding Computers, Internet and Cyber Laws, Conceptual Framework of E-commerce: E-governance, The Role of Electronic Signatures in E-commerce with Reference to Free Market Economy in India.

[Unit 2]

Law Relating To Electronic Records And Intellectual Property Rights In India Legal Aspects of Electronic Records/Digital Signatures, The Rules and Regulations of Certifying Authorities in India, Protection of Intellectual Property Rights in Cyberspace in India.

[Unit 3]

International Efforts Relating To Cyberspace Laws And Cyber Crimes International Efforts Related to Cyberspace Laws, Council of Europe (COE) Convention on Cyber Crimes.

[Unit 4]

Penalties, Compensation And Offences Under The Cyberspace And Internet In India Penalties, Compensation and Adjudication of Violations of Provisions of IT Act and Judicial Review Some Important Offences under the Cyberspace Law and the Internet in India, Other Offences under the Information Technology Act in India.

[Unit 5]

Miscellaneous Provisions Of It Act And Conclusions The Role of Electronic Evidence and the Miscellaneous Provisions of the IT Act, Information Technology Act as Amended up to 2008, The Information Technology (Certifying Authorities) Rules, 2000, The Information Technology (Certifying Authorities) Rules, 2000, Ministerial Order on Blocking of Websites.

Reference Books:
1. Harish Chander, Cyber Laws and It Protection, PHI Publication.
2. Faiyaz Ahamad, KLSI, Cyber Law and Information Security, Dreamtech Press.
3. Murray, Information Technology Law: Law and Society, 3rd Edition, Oxford University Press Oxford 2016.
4. Sunit Belapure Nina Godbole, Cyber Security, Wiley India Pvt. Ltd.
5. Vivek Sood, Cyber Law Simplified, McGraw-Hill Publication.

BTHME505(A) Economics and Management

[Unit 1]

Introduction, Market Equilibrium: Demand and Supply, Elasticity of Demand Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System

[Unit 2]

Relevant Information and Decision Making, Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

[Unit 3]

Financial Statements, Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

[Unit 4]

Depreciation Accounting, Evolution of Management Thoughts, Functions of Management Directing.

[Unit 5]

Product Development, Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

[Unit 6]

Inventory Management, Supply Chain Management, Marketing Management, Forms of Ownership, Starting a New Company and Small-Scale Industrial Understandings, Capital Financing, Entrepreneurship.

BTHME505(B) Business Communication

[Unit 1]
Introduction, Definitions & Concepts, Communicative Competence.

[Unit 2]
Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as Problematic Discourse.

[Unit 3]
Barriers to Communication, Listening, Communication Rules, Communication Style.

[Unit 4]
Interpersonal Communication, Relational Communication, Organizational Communication.

[Unit 5]
Collaboration, Communication in Groups and Teams, Persuasive Communication.

[Unit 6]
Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication, Ethics in Business Communication.

BTCOC506 Competitive Programming-I
[Unit 1]

Introduction
Online Judge The Programming Challenges Robot Judge, Understanding Feedback From the Judge, Choosing Programming Languages, Reading Our Programs, Standard Input/Output, Programming Hints, Elementary Data Types.

Challenging Problems
(1) The 3n + 1 Problem (2) Minesweeper (3) The Trip, (4) LCD Display (5) Graphical Editor (6) Interpreter (7) Check the Check (8) Australian Voting.

[Unit 2]

Elementary Data Structures
Data Structures: Elementary Data Structures, Stacks, Dictionaries, Priority Queues Sets, Object Libraries, The C++ Standard Template Library, The Java java.util Package, Program Design Example: Going to War, Hitting the Dec, String Input/Output, Winning the War, Testing and Debugging.

Challenging Problems
(1) Jolly (2) Poker Hands (3) Hartals (4) Crypt Kicker (5) Stack 'em Up (6) Erd˜os Numbers (7) Contest Scoreboard (8) Yahtzee.

[Unit 3]

Strings
Character Codes, Representing Strings, Program Design Example: Corporate Renamings, Searching for Patterns, Manipulating Strings, Completing the Merger, String Library Functions.

Challenging Problems
(1) WERTYU (2) Where's Waldorf? (3)Common Permutation (4) Crypt Kicker II (5) Automated Judge Script (6) File Fragmentation (7) Doublets (8) Fmt

[Unit 4]

Sorting
Sorting, Sorting Applications Sorting Algorithms, Program Design Example: Rating the Field, Sorting Library Functions, Rating the Field.

Challenging Problems
(1) Vito's Family (2) Stacks of Flapjacks (3) Bridge (4) Longest Nap (5) Shoemaker's Problem (6) CDVII (7) ShellSort (8) Football.

[Unit 5]

Arithmetic and Algebra

Machine Arithmetic, Integer Libraries, High-Precision Integers, High-Precision Arithmetic, Numerical Bases and Conversion, Real Numbers, Dealing With Real Numbers, Fractions, Decimals, Algebra, Manipulating Polynomials, Root Finding, Logarithms, Real Mathematical Libraries.

Challenging Problems

(1) Primary Arithmetic (2) Reverse and Add (3) The Archeologist's Dilemma (4) Ones (5) A Multiplication Game (6) Polynomial Coefficients (7) The Stern-Brocot Number System (8) Pairsumonious Numbers.

[Unit 6]

Combinatorics

Basic Counting Techniques, Recurrence Relations, Binomial Coefficients, Other Counting Sequences, Recursion and Induction Problems.

Challenging Problems

(1) How Many Fibs? (2) How Many Pieces of Land? (3) Counting (4) Expressions (5) Complete Tree Labeling (6) The Priest Mathematician (7) Self-describing Sequence (8) Steps

List of Practical:

At least twenty five problems solving on competitive programming platforms such as, https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/

Reference Books:

1. Steven S. Skiena Miguel A. Revilla, PROGRAMMING CHALLENGES The Programming Contest Training Manual, Springer.

2. Antti Laaksonen, Competitive Programmer's Handbook.

3. Steven Halim, Competitive Programming 3: The Lower Bounds of Progamming Contests.

4. Gayle Lakaman Cracking the Coding Interview.

5. The Hitchhiker's Guide to the Programming Contests.

List of Experiments:

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.

BTCOL508 Machine Learning Laboratory

As a part of lab exercises for Machine Learning Laboratory, it is suggested that the student should get hands-on experience by solving data analysis problems available on Machine Learning competition platforms such as HackerEarth and Kaggle. Some of the suggestive list of problem solving is given below. The link address is as retrieved from www.hackerearth.com on 17 June 2019. Knowledge of R programming or Python is required to solve these problems, students get this prerequisite in Second Year.

1	Regression Analysis and Plot interpretation
2	Logistic Regression Analysis in R
3	Random Forest and Parameter Tuning in R
4	Clustering Algorithms and Evaluation in R
5	Machine Learning Project in Python on Hourse Prices Data

BTCOC601 Compiler Design

[Unit 1]   **6 Hrs**
Introduction to Compiling
Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler,

[Unit 2]   **6 Hrs**
Lexical Analysis
The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

[Unit 3]   **6 Hrs**
Syntax Analysis
The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.

[Unit 4]   **6 Hrs**
Syntax-Directed Translation
Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S- Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes.

Unit 5]   **6 Hrs**
Intermediate Code Generation
Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

[Unit 6]   **6 Hrs**
Code Generation
Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators.

Reference Books:
1. Jean Paul Tremblay & Paul Gordon Sorenson, *Theory and Practice of Compiler Writing*, McGraw Hill Publications, 2008.
2. Hunter, *The Essence of Compilers*, Pearson Publication, 1999.
3. Lewis, *Elements of the Theory of Computation*, Pearson Publication, 2nd Edition, 1997.
4. Ronald Mak, *Writing Compilers and Interpreters: A Software Engineering Approach*, Wiley Publication, 3rd Edition, 2011.
5. Doug Brown, John Levine, Tony Mason, *lex & yacc*, O'Reilly Media, 2nd Edition, 1992.

Text Books:
1. Aho, Sethi, Ullman, *Compilers Principles, Techniques and Tools*, Addison Wesley, 1st Edition, 1987.

2. Hopcroft, Motwani and Ullman, *Introduction to Automata Theory, Languages and Computation*, Pearson Publication, 2nd Edition, 2001.
3. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, *Modern Compiler Design*, Springer, 2nd Edition, 2012.

BTCOC602 Computer Networks

[Unit 1] 6 Hrs
Introduction: Applications of computer networks, Network hardware, Network software: Protocol Hierarchy, Design Issue, connection oriented vs. connectionless, Service Primitives, Reference models: OSI and TCP/IP, Example networks: Internet, Network standardization, Performance: Bandwidth and Latency, Delay and bandwidth product, High-Speed Network, Application Performance Needs.

[Unit 2] 6 Hrs
LAN Technologies: X.25, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.

[Unit 3] 6 Hrs
Data Link Layer: Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes.

[Unit 4] 6 Hrs
Network Layer and Congestion Control: IPv4/IPv 6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets.
Congestion Control and QOS: General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.

[Unit 5] 6 Hrs
Application Layer Protocols: DNS, SMTP, POP, FTP, HTTP.

[Unit 6] 6 Hrs
Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Reference Books:
1. S. Keshav, *An Engineering Approach to Computer Networking*, Addison-Wesley Professional, 1st Edition, 1997.
2. D. Comer, *Computer Networks and Internet*, Pearson Education, 6th Edition, 2014.
3. M. Gallo, W. Hancock, *Computer Communications and Networking Technologies*, Brooks/Cole Publisher, 2001.
4. Natalia Olifer, Victor Olifer, *Computer Networks: Principles, Technologies and Protocols for Network Design*, Wiley Publication, 2005.

Text Books:
1. Tanenbaum, *Computer Networks*, PHI Publication, 5th Edition, 2011.
2. B. Forouzan, *Data Communications and Networking*, McGraw Hill Publication, 5th Edition, 2013.
3. Larry Peterson and Bruce Davie, *Computer Networks: A Systems Approach*, Morgan Kufman Publication, 5th Edition, 2012.

BTCOE603(A) Human Computer Interaction

[Unit 1]   **6 Hrs**
Introduction: Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.

[Unit 2]   **6 Hrs**
Design processes: Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Software Process, Design Rules.

[Unit 3]   **6 Hrs**
Implementation and Evaluation: Implementation Support, Evaluation Techniques, Universal Design, Use Support.

[Unit 4]   **6 Hrs**
Models: Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models.

Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.

[Unit 5]   **6 Hrs**
Modern Systems: Group ware, Ubiquitous Computing and Augmented Realities, Hypertext, Multimedia and World Wide Web.

Reference Books:
1. Jenny Preece, Helen Sharp, Yvonne Rogers, *Interaction Design: Beyond Human-Computer Interaction*, Wiley Publication, 4th Edition, 2015.
2. Gerard Jounghyun Kim, *Human–Computer Interaction: Fundamentals and Practice*, CRC Press, 2015.
3. Jenifer Tidwell, *Designing Interfaces, Patterns for Effective Interaction Design*, O'Reilly Media, 2nd Edition, 2010.

Text Books:
1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, *Human Computer Interaction*, Pearson Education, 3rd Edition, 2003.
2. B. Shneiderman, *Designing the User Interface*, Addison-Wesley Publishing Company.

BTCOE603(B) Artificial Intelligence

[Unit 1]
Introduction
Introduction, What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art.

Intelligent Agents
Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

[Unit 2]
Problem-solving
Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

[Unit 3]
Constraint Satisfaction Problems
Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

[Unit 4]
Game Playing
Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.

[Unit 5]
Logical Agents
Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic

First-Order Logic
Representation Revisited Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic, Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

[Unit 6]
Uncertainty
Quantifying Uncertainty, Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First-Order Probability Models, and Other Approaches to Uncertain Reasoning.

Reference Books:
1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.

BTCOE603(C) Object Oriented Analysis Design

[Unit 1]
Introduction Overview of object oriented system, Object orientation, Objects, attributes, object behavior, Object respond to messages, encapsulation, Inheritance, Polymorphism, object relationships and association, aggregation, Object identity static and dynamic binding, Object persistence, meta classes. Object oriented system development life cycle.

[Unit 2]
Object oriented modeling Modeling, UML Modeling, class diagram, activity diagram, Sequence diagram, collaboration diagram state chart diagram, interaction diagram, Implementation diagram, use case diagram.

[Unit 3]
Object oriented analysis Use case analysis, CRC card analysis.

[Unit 4]
Object Oriented Design, Design Patterns.

[Unit 5]
Implementation from Design to Implementation, Programming Style, Object-Oriented languages, Non-Object-Oriented languages, Object Oriented Databases, Computer animation, Electrical Distribution design System, Future of Object-Oriented Technology.

Text Books:
1. Grady, Booch, Object Oriented analysis and design with applications, 2nd Edition, PHI.
2. James Rumbaugh, Object-Oriented Modeling And Design, 1st Edition, PHI Publication.
3. Ali Bahrami, Object Oriented Systems Development, 1st Edition, McGraw-Hill Publication.
4. Robert Lafore, Object Oriented Programming, Galgotia Publication.
5. Dan Pilone, Neil Pitman, UML 2.0 in a Nutshell: A Desktop Quick Reference, O'Reilly Media.
6. E. Balagurusamy, Object Oriented Programming, McGraw-Hill Publication.
7. S. Koshafian, Object Orientation, Wiley Publication.
8. Mike O'Docherty, Object-Oriented Analysis Design: Understanding System Development with UML 2.0, Wiley Publication.

BTCOE604(A) Geographic Information System

[Unit 1]

What is Geographic Information Systems?, Different components of GIS, Different types of vector data, Raster data models and their types TIN data model.

[Unit 2]

Advantages and disadvantages associated with vector, raster and TIN Non-spatial data attributes and their type Raster data compression techniques Different raster data file formats Spatial database systems and their types.

[Unit 3]

Pre-processing of spatial datasets Different map projections, Spatial interpolation techniques Different types of resolutions Digital Elevation Model (DEM).

[Unit 4]

Quality assessment of freely available DEMS GIS analysis-1 GIS analysis-2 and applications Errors in GIS Key elements of maps

Reference Books:
1. An Introduction to Geographical Information Systems (4th Edition) by Ian Heywood, Sarah Cornelius and Steve Carver, 2012.
2. Introduction to Geographic Information Systems by Chang Kang-tsung (Karl), 2006
3. Geographic Information Systems: An Introduction.

BTCOE604(B) Biology

[Unit 1]

Introduction

Introduction, Different Fields of Biology.

[Unit 2]

Origin of Life and Evolution

Different theories of origin of life, Experimental evidences supporting different theories. Lamarck, Darwanism and other theories of evolution, Documentary evidences supporting different evolution theories.

[Unit 3]

Ecology

Ecosystem, Food Chain, Pollution

[Unit 4]

Physiology

Process of Food intake and Digestion, Nerves conduction and electrophysiology, Muscle contraction and locomotion, Different Methods of Reproduction in prokaryotic and eukaryotic system

[Unit 5]

Cell Biology and Sub-Cellular Structures

Structure and function of eukaryotic and prokaryotic cells

[Unit 6]

Biological System

Structure-function of biological macromolecules, Central Dogma of Life, Replication, Transcription, Translation,

Reference Books:

1. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 5th Ed, W. H. Freeman & Co.
2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, Macmillan Worth, 2000.
3. N. Hopkins, J. W. Roberts, J. A. Steitz, J. Watson and A. M. Weiner, Molecular Biology of the Gene, 4th Ed, Benjamin Cummings, 1987.
4. C. R. Cantor and P. R. Schimmel, Biophysical Chemistry (Parts I, II and III), W.H. Freeman & Co., 1980.

BTCOE604(C) Internet of Things

[Unit 1]   8 Hrs

Introduction to IoT

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

[Unit 2]   9 Hrs

Elements of IoT

Hardware Components Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces, Software Components Programming API's (using Python / Node.js / Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

[Unit 3]   18 Hrs

IoT Application Development

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

[Unit 4]   10 Hrs

IoT Case Studies

IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press

2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi

5. Adrian McEwen, "Designing the Internet of Things", Wiley

6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

7. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media.

BTHME605(A) Development Engineering

[Unit 1]
Introduction, Various Definitions of Development Engineering.

[Unit 2]
World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer's Role.

[Unit 3]
Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

[Unit 4]
Development Strategies: Society, Technological Change, and Development, Development Economists' Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

[Unit 5]
Engineering for Sustainable Community Development: The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education.

[Unit 6]
ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

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

BTHME605(B) National Social Service

[Unit 1] **6 Hrs**

Introduction and Basic Concepts of NSS: History, Philosophy, Aims & objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps, Basis of adoption village/slums, Methodology of conducting Survey.

[Unit 2] **6 Hrs**

Youth and community mobilization: Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism.

[Unit 3] **6 Hrs**

Importance and Role of Youth Leadership: Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership.

[Unit 4] **6 Hrs**

Life Competencies and skill: Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management.

[Unit 5] **6 Hrs**

Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

[Unit 6] **6 Hrs**

Youth Development Programmes in India: National Youth Policy, Youth development programmes at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations.

Reference Books:

1. *National Service Scheme Manual (Revised),* Government of India, Ministry of Youth Affairs and Sports, New Delhi, 2006.
2. University of Mumbai National Service Scheme Manual, 2009.
3. Avhan Chancellor's Brigade – NSS Wing, *Training camp on Disaster Preparedness Guidelines*, March 2012.
4. *Rashtriya Seva Yojana Sankalpana* – Prof. Dr. Sankay Chakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. *National Service Scheme Manual for NSS District Coordinators*, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya.
6. *Annual report of National Service Scheme (NSS)* published by DTE, Mantralaya.
7. *NSS Cell*, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. *Case material as a Training Aid for Field Workers*, Gurmeet Hans.
9. *Social service opportunities in hospitals*, Kapil K. Krishnan, TISS.
10. *New Trends in NSS*, Research papers published by University of Pune.
11. *ANOOGUNJ Research Journal*, published by NSS Unit C. K. Thakur College.

BTHME605(C) Consumer Behavior

[Unit 1]
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: Behavioral 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 2]
Market Segmentation and Positioning, Market Segmentation, Basis for Segmentation, Alternatives available for Segmentation, Positioning.

[Unit 3]
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 4]
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.

Psychological Influences on Consumer Decision Making
Consumers 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.

[Unit 5]
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.

Diffusion of innovation Diffusion Process, Adoption Process, Consumer Innovators, Multiplicative innovation adoption (MIA) model.

[Unit 6]
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.

Reference Books

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

2. Consumer Behavior, Concepts and Applications, Loudon, D.L. and Bitta, A.J.D, Tata McGraw Hill.

3. Consumer Behavior and Marketing Startegy, Peter, J.P. and Olson, J.C., Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

BTCOC606 Competitive Programming-II

[Unit 1]
Number Theory
Prime Numbers, Finding Primes, Counting Primes, Divisibility Greatest Common Divisor, Least Common Multiple, Modular Arithmetic, Congruence's Operations on Congruence's, Solving Linear Congruence's, Diophantine Equations, Number Theoretic Libraries.

Challenging Problems
(1) Light, More Light (2) Carmichael Numbers (3) Euclid Problem, (4) Factovisors, (5) Summation of Four Primes (6) Smith Numbers (7) Marbles (8) Repackaging.

[Unit 2]
Backtracking
Backtracking, Constructing All Subsets, Constructing All Permutations, Program Design Example: The Eight-Queens Problem, Pruning Search.

Challenging Problems
(1) Little Bishops (2) 15-Puzzle Problem (3) Queue (4) Servicing Stations (5) Tug of War (6) Garden of Eden (7) Color Hash (8) Bigger Square Please

[Unit 3]
Graph Traversal
Flavors of Graphs, Data Structures for Graphs, Graph Traversal: Breadth-First, Breadth-First Search, Exploiting Traversal, And Finding Paths Graph Traversal: Depth-First Finding Cycles Connected Components Topological Sorting.

Challenging Problems
(1) Bicoloring (2) Playing With Wheels (3) The Tourist Guide (4) Slash Maze (5) Edit Step Ladders (6) Tower of Cubes (7) From Dusk Till Dawn (8) Hanoi Tower Troubles Again!

[Unit 4]
Graph Algorithm
Graph Theory, Degree Properties, and Connectivity, Cycles in Graphs, Planar Graphs, Minimum Spanning Trees, Shortest Paths, Dijkstra's Algorithm, All-Pairs Shortest Path, Network Flows and Bipartite Matching

Challenging Problems (1) Freckles The Necklace (2) Fire Station (3) Railroads (4) War (5) Tourist Guide (6) The Grand Dinner (7) The Problem With the Problem Setter

[Unit 5]
Dynamic Programming
Don't Be Greedy, Edit Distance, Reconstructing the Path, Varieties of Edit Distance, Program Design Example: Elevator Optimization

Challenging Problems
(1) Is Bigger Smarter? (2)Distinct Subsequences (3) Weights and Measures (4) Unidirectional TSP (5) Cutting Sticks (6) Ferry Loading (7) Chopsticks (8) Adventures in Moving: Part IV.

[Unit 6]
Grids
Rectilinear Grids, Traversal, Dual Graphs and Representations, Triangular and Hexagonal Grids, Triangular Lattices, Hexagonal Lattices, Program Design Example: Plate Weight, Circle Packings, Longitude and Latitude.

List of Practical:
At least twenty five problems solving on competitive programming platforms such as, https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/

Reference Books:

1. Steven S. Skiena Miguel A. Revilla, Programming Challenges The Programming Contest Training Manual, Springer.

2. Antti Laaksonen, Competitive Programmer's Handbook.

3. Steven Halim, Competitive Programming 3: The Lower Bounds of Programming Contests.

4. Gayle Lakaman Cracking the Coding Interview.

5. The Hitchhiker's Guide to the Programming Contests.

BTCOL 607 Mobile Application Development for Android/iOS

Note: The course on mobile application development can be taught for two different mobile OS platforms either Android or iOS.

The students can opt any one either Android or iOS for studying mobile application development. Either Part (A) or Part (B) of the following syllabus needs to be completed. It is not required to complete both parts i.e. Part(A) and Part(B)

Part (A) Mobile Application Development for Andorid

1. Introduction to mobile computing, installing of required software and preparing the working environment, creating your first Android Application.

2. Layouts, Views, Resources, Activities, Intents, Background tasks, Connecting to the Internet, Fragments, Preferences.

3. User Interaction – input, menu items, custom views.

4. User Experience – themes and styles, material design, adaptive layouts, accessibility, localization, debugging the UI.

5. Storing Data, SQLite database, Sharing Data, content resolver and providers, loaders to load data Services, background work, alarms, broadcast receivers.

6. Notification, widgets, transferring data efficiently, publishing app, Multiple form factors, sensors, Google cloud messaging, monetizing your app.

List of Experiments:
1. Install the Android SDK and developer tools and build a test project to confirm that those tools are properly installed and configured.
2. Write a program using a Table Layout for our restaurant data entry form; add a set of radio buttons to represent the type of restaurant.
3. Write a program using activity class to show different events.
4. Write a program to send user from one application to another. (For example redirection to map).
5. Write a program to play audio files.
6. Write a program to play video files.
7. Write a program to capture image using built in camera.
8. Write a program to send SMS.
9. Write a program to convert text to speech.
10. Write a program to call a number.

Reference Books:
1. Brian Fling, *Mobile Design & Development*, O'Reilly Media, 1st Edition, 2009.
2. Meier, *Professional Android 4 Application Development*, Wrox Publication, 2012.
3. Lee, *Beginning Android™ 4 Application Development*, Wrox Publication, 2011.

4. J. F. DiMarzio, *Android A Programmers Guide*, McGraw-Hill Publication, 1st Edition, 2008.
5. Ian F. Darwin, *Android Cookbook*, O'Reilly Media, 2nd Edition, 2016.
6. Dawn Griffiths, David Griffiths, *Head First Android Development*, O'Reilly Media, 2nd Edition, 2015.

Part (B) Mobile Application Development with SWIFT for iOS

- Swift (Constants and Variables, Data Types, Operators, Control Flow), Xcode and Xcode Playgrounds, Interface Builder, Using API Reference Documentation.

- Swift (Strings, Functions, Structures, Classes, Collections, Loops), Controls, Events, Views, Images, View Controllers, Stack Views, AutoLayout

- Swift (Optionals, Type Casting, Guard, Scope, Enumerations), Segues, Navigation, Tab Bars, View Controller Life Cycle

- Swift (Protocols), App Lifecycle, Model-View-Controller, Scroll Views, Table Views, Simple Data Persistence, System-Provided View Controllers

- Swift (Closures, Extensions), UI Animation, HTTP and URL fetching, JSON Decoding, Concurrency AR Apps (3D Scenes, Detecting Planes, User Interactions, Image Recognition).

List of Experiments: (Programs for iOS**)**
1. Flashlight
2. Apple Pie Game
3. Personality Quiz
4. To-do List
5. Restaurant Menu
6. AR Drawing

Reference Books:
1. Vandad Nahavandipoor, *iOS 10 Swift Programming Cookbook*, O'Reilly Media, 1st Edition, 2015.
2. Craig Clayton, *iOS 10 Programming for Beginners*, Packt Publishing, 1st Edition, 2016.
3. Dan Pilone, Tracey Pilone, *Head First iPhone and iPad Development*, O'Reilly Media, 3rd Edition, 2013.

BTCOL607(B) Internet of Things Laboratory

1. Study of Raspberry-Pi, Beagle board, Arduino and other micro controller.
2. Study of different operating systems for Raspberry-Pi. Understanding the process of OS installation on Raspberry-Pi.
3. Study of Connectivity and configuration of Raspberry-Pi circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.
4. Understanding the connectivity of Raspberry-Pi circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs.
5. Understanding the connectivity of Raspberry-Pi circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
6. Understanding and connectivity of Raspberry-Pi with camera. Write an application to capture and store the image.
7. Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi.
8. Write an application using Raspberry-Pi to control the operation of a hardware simulated traffic signal.
9. Write an application using Raspberry-Pi to control the operation of a hardware simulated lift elevator.
10. Write a server application to be deployed on Raspberry-Pi. Write client applications to get services from the server application.
11. Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
12. Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group.

BTCOL608 Computer Networks Laboratory

1. Simulate and Understand IP forwarding within a LAN and across a router.
2. Study the working of spanning tree algorithm by varying the priority among the switches.
3. Understand the working of "Connection Establishment" in TCP using a network simulator.
4. Study how the Data Rate of a Wireless LAN (IEEE 802.11b) network varies as the distance between the Access Point and the wireless nodes is varied.
5. Study the working and routing table formation of Interior routing protocols, i.e. Routing Information Protocol (RIP) and Open Shortest Path First (OSPF).
6. Plot the characteristic curve throughput versus offered traffic for a Slotted ALOHA system.
7. Understand the impact of bit error rate on packet error and investigate the impact of error of a simple hub based CSMA / CD network.
8. Study the performance of networks based on Star, Bus and Ring topologies
9. TCP/IP Sockets: Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
10. Write a program for calculating the shortest oath using Link State Routing Algorithms

Experiments can be done using NS2, NETSIM, NCTU etc.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

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Under Maharashtra Act No. XXIX of 2014

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Detailed Syllabus

for

Final Year B. Tech in Computer Engineering

with effective from July 2020 - 21

11 August 2020

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DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Semester - I
Group A

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	Mandatory	Induction Program	3 weeks duration in the beginning of the semester						
2	BTBS101	Engineering Mathematics – I	3	1	-	20	20	60	4
3	BTBS102	Engineering Physics	3	1	-	20	20	60	4
4	BTES103	Engineering Graphics	2	-	-	20	20	60	2
5	BTHM104	Communication Skills	2	-	-	20	20	60	2
6	BTES105	Energy and Environment Engineering	2	-	-	20	20	60	2
7	BTES106	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	Audit
8	BTBS107L	Engineering Physics Lab	-	-	2	60	-	40	1
9	BTBS108L	Engineering Graphics Lab	-	-	4	60	-	40	2
10	BTHM109L	Communication Skills Lab	-	-	2	60	-	40	1
		TOTAL	14	2	8	330	100	420	18

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Semester - II
Group B

Sr. No.	Course Code	Course Title	L	T	P	CA	MSE	ESE	Credit
1	BTBS201	Engineering Mathematics – II	3	1	-	20	20	60	4
2	BTBS202	Engineering Chemistry	3	1	-	20	20	60	4
3	BTES203	Engineering Mechanics	2	1	-	20	20	60	3
4	BTES204	Computer Programming in C	2	-	-	20	20	60	2
5	BTES205	Workshop Practices	-	-	4	60	-	40	2
6	BTES206	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	Audit
7	BTES207L	Computer Programming Lab	-	-	2	60	-	40	1
8	BTBS208L	Engineering Chemistry Lab	-	-	2	60	-	40	1
9	BTES209L	Engineering Mechanics Lab	-	-	2	60	-	40	1
10	BTES210P	Mini Project	-	-	2	60	-	40	1
11	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in First Semester and Second Semester or in at one time).	-	-	-	-	-	-	Credit to be evaluated in III Sem
		TOTAL	12	3	12	430	80	440	19

Weekly Teaching hrs: L, T, P
Evaluation Scheme: CA, MSE, ESE

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Semester - III

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTBSC301	Engineering Mathematics – III	3	1	-	20	20	60	4
2	BTCOC302	Discrete Mathematics	2	1	-	20	20	60	3
3	BTCOC303	Data Structures	2	1	-	20	20	60	3
4	BTCOC304	Computer Architecture & Organization	2	1	-	20	20	60	3
5	BTCOC305	Digital Electronics & Microprocessors	2	1	-	20	20	60	3
6	BTHM3401	Basic Human Rights	2	-	-	50	-	-	Audit
7	BTCOL306	Python Programming	1	-	2	60	-	40	2
8	BTCOL307	HTML and JavaScript	1	-	2	60	-	40	2
9	BTCOL308	Data Structures Lab	-	-	2	60	-	40	1
10	BTCOL309	Digital Electronics & Microprocessor Lab	-	-	2	60	-	40	1
11	BTES211P	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	50	1
		TOTAL	15	5	8	390	100	510	23

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Semester - IV

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTCOC401	Design & Analysis of Algorithms	2	1	-	20	20	60	3
2	BTCOC402	Probability & Statistics	2	1	-	20	20	60	3
3	BTCOC403	Operating Systems	2	1	-	20	20	60	3
4	BTCOE404	Elective - I (A) Object Oriented Programming in Java (B) Object Oriented Programming in C++	2	1		20	20	60	3
5	BTID405	Product Design Engineering	1	-	2	60	-	40	2
6	BTBS405A BTCOE406B BTHM3402	Elective - II Physics of Engineering Materials Numerical Methods Soft skills and Personality Development	2	1	-	20	20	60	3
7	BTCOL407	Design & Analysis of Algorithms Lab	-	-	2	60	-	40	1
8	BTCOL408	Introduction to Data Science with R	1	-	2	60	-	40	2
9	BTCOL409	Object Oriented Programming Lab	-	-	2	60	-	40	1
10	BTCOL410	Operating System Lab	-	-	2	60	-	40	1
11	BTCOF411	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	Credit to be evaluated in V Sem.
		TOTAL	12	5	10	400	100	500	22

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Semester - V

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTCOC501	Database Systems	3	1	-	20	20	60	4
2	BTCOC502	Theory of Computations	3	1	-	20	20	60	4
3	BTCOC503	Machine Learning	3	1	-	20	20	60	4
4	BTCOE504	**Elective – III** (A) Introduction to Research (B) Cyber Laws (C) Open Elective offered by other departments	2	-	-	20	20	60	2
5	BTCOE505	**Elective – IV** (A) Economics & Management (B) Business Communication	2	-	-	20	20	60	2
6	BTCOC506	Competitive Programming-I	1	-	2	60	-	40	2
7	BTCOL507	Database System Laboratory	-	-	2	60	-	40	1
8	BTCOL508	Machine Learning Laboratory	-	-	2	60	-	40	1
9	BTCOS509	Seminar	-	-	2	60	-	40	1
10	BTCOF411	Field Training / Internship / Industrial Training Evaluation	-	-	-	60	-	40	1
		TOTAL	14	3	8	400	100	500	22

BTCOC501 - Database Systems: Content of this subject is updated. Pl. find below the updated content.

BTCOC501: Database Systems

[Unit 1] Introduction [6 Hrs]

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture **Data modeling using the Entity Relationship Model:** ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, , Reduction of an ER diagrams to tables.

[Unit 2] Relational Data Model, Relational Algebra and Calculus [10 Hrs]

Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

[Unit 3] Introduction to SQL [6 Hrs]

Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database

Intermediate SQL : Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization, **Advanced SQL :** Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,

[Unit 4] Relational database design [8 Hrs]

Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process

[Unit 5] File Organiztion, Indexing and Hashing [6 Hrs]

File Organization, Ordered Indices, B+tree Index files, B Tree Index File, Static Hashing, Dynamic Hashing, **Query processing:** Overview, Measures of Query Cost, Selection Operation, Evaluation of relational algebra expressions, Query Optimization, Query equivalence Rules, Join strategies.

[Unit 6] Transaction processing [6 Hrs]

Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durablility, Transaction Isolation, ACID Properties, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols, Recovery System

Text Books:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, *Database System Concepts*, McGraw-Hill Publication, 6th Edition, 2011.

2. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems*, McGraw-Hill Publication, 3rd Edition, 2003.

Reference Books:

1. Joel Murach, *Murach's Oracle SQL and PL/SQL for Developers,* Mike Murach & Associates, 2nd Edition, 2014.

2. Wiederhold, *Database Design*, McGraw-Hill Publication, 2nd Edition, 1983.

3. Navathe, *Fundamentals of Database System*, Addison-Wesley Publication, 6th Edition, 2012.

4. Mark L. Gillenson, *Fundamentals of Database Management System*, Wiley Publication, 2nd Edition, 2011.

5. **Serge Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Reprint by Addison-Wesley.**

Semester – VI

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTCOC601	Compiler Design	3	1	-	20	20	60	4
2	BTCOC602	Computer Networks	3	1	-	20	20	60	4
3	BTCOE603	**Elective – V** (A) Human Computer Interaction (B) Artificial Intelligence (C) Object-Oriented Analysis Design	2	1	-	20	20	60	3
4	BTCOE604	**Elective – VI** (A) Geographical Information System (B) Biology (C) Internet of Things	2	-	-	20	20	60	2
5	BTCOE605	**Elective – VII** (A) Development Engineering (B) National Social Service (C) Consumer Behaviour	2	-	-	20	20	60	2
6	BTCOC606	Competitive Programming-II	1	-	2	60	-	40	2
7	BTCOL607	(A) Mobile Application Development **OR** (A) Internet of Things Laboratory	1	-	2	60	-	40	2
8	BTCOL608	Computer Networks Laboratory	-	-	2	60	-	40	1
9	BTCOF609	Field Training / Internship / Industrial Training	-	-	-	-	-	-	Credit to be Evaluated in VII Sem.
		TOTAL	14	3	6	280	100	420	20

BTCOE604 (C): Internet of Things: Content of this subject is updated. Pl. find below the updated content.

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BTCOE604 (B): Internet of Things

[Unit 1] IoT Introduction   **[6 Hrs]**
Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

[Unit 2] Smart Objects   **[6 Hrs]**
The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

[Unit 3] IP Layer   **[6 Hrs]**
IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

[Unit 4] Data and Analytics for IoT   **[7 Hrs]**
An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

[Unit 5] IoT Physical Devices and Endpoints   **[8 Hrs]**
Buildingiot with Arduino: Arduino–Interfaces-Arduino IDE–Programming , RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

REFERENCE BOOKS :

[1].David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education

[2].Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017.

[3].Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014.

[4].Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017.

Semester - VII

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTCOC701	Software Engineering	3	-	-	20	20	60	3
2	BTCOE702	**Elective - VIII** (A) Big Data Analytics (B) Distributed System (C) Fundamental of Digital Image Processing	3	-	-	20	20	60	3
3	BTCOE703	**Elective - IX** (A) Cloud Computing (B) Business Intelligence (C) Natural Language Processing	3	-	-	20	20	60	3
4	BTCOE704	**Open Elective - X** (A) Blockchain Technology (B) Computer Graphics (C) Embedded Systems (D) Design Thinking	3	-	-	20	20	60	3
5	BTCOL705	Full Stack Development (LAMP / MEAN)	1	-	2	60	-	40	2
6	BTCOL706	System Administration	1	-	2	60	-	40	2
7	BTCOL707	Elective – VIII Lab	-	-	2	60	-	40	1
8	BTCOL708	Elective – IX Lab	-	-	2	60	-	40	1
9	BTCOP709	Project phase - I	-	-	2	60	-	40	1
10	BTCOF609	Field Training / Internship / Industrial Training	-	-	-	-	-	50	1
		TOTAL	14	-	10	380	80	490	20

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Semester – VIII

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme			Credit
			L	T	P	CA	MSE	ESE	
1	BTCOE801	Elective – XI #	3	-	-	20	20	60	3
2	BTCOE802	Open Elective – XII #	3	-	-	20	20	60	3
3	BTCOE803	Project phase - II (In-house) $ / Internship and project in the Industry	-	-	24	60	-	40	12
		TOTAL	6	-	24	100	40	160	18

These subjects are to be studied on self–study mode using SWAYAM / NPTEL. The list of self-study online courses is given below.

The list of self-study online courses

BTCOE801: Elective – XI #	BTCOE802: Open Elective – XII #
(A) Deep Learning	(A) Introduction to Industry 4.0 and Industrial Internet of Things
(B) Social Networks	(B) Cryptography and Network Security ##
(C) Randomized Algorithms ##	(C) Model Checking

* Six months of Internship and Project in the industry.

$ This is for those students who are not doing Internship and project in the Industry, they can do project in the department.

Digital contents should be developed by University for the subjects:
1. Randomized Algorithm
2. Cryptography and Network Security

Elective - VIII
BTCOE702 (B): Distributed Systems

[Unit 1] Introduction [7 Hrs]

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message-Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multidatagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

[Unit 2] Remote Procedure Calls [7 Hrs]

Introduction, the RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case studies: Sun RPC, DCE, RPC.

[Unit 3] Distributed Shared Memory [6 Hrs]

Introduction, general Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

[Unit 4] Resource Management [6 Hrs]

Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

[Unit 5] Distributed File System [6 Hrs]

Introduction, Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Books:
1. P. K. Sinha, *Distributed Operating System*, PHI Publication.
2. Colorouis, *Distributed Systems*, Addison Wesley Publication.
3. M. L. Liu, *Distributed Computing: Principles and Applications*, Addison-Wesley, 2004.

NPTEL Course:
1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

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Elective - VIII
BTCOE702 (C): Fundamental of Digital Image Processing

[Unit 1] Digital Image Fundamentals and Image Transform [6 Hrs]
What is Digital Image Processing? The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Digital image representation, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of visual perception, Image sampling and quantization, Basic relationship between pixels, Discrete Fourier transform, Properties of 2D DFT.

[Unit 2] Image Enhancement Techniques [6 Hrs]
Spatial Domain Techniques, Point processing, Neighborhood processing, Spatial domain filtering, Image smoothing and Image sharpening using spatial domain filters, Enhancement based on histogram modeling, Frequency domain filtering, Image smoothing and Image sharpening using frequency domain filters.

[Unit 3] Image Compression [6 Hrs]
Fundamentals, Types of redundancies, Lossy and Lossless compression, Dictionary based coding, Run-length coding, LZW coding, Huffman coding, Arithmetic coding, Image compression model.

[Unit 4] Image Segmentation [6 Hrs]
Detection of Discontinuities - Point, Line and Edge detection, finding gradients using masks, Thresholding based image segmentation, global and local thresholding, Region based segmentation.

[Unit 5] Applications in different domains [6 Hrs]
Applications of image processing in satellite, sonar, radar and medical areas.

Text Books:
1. R. C. Gonzalez and Richard E Woods, "Digital Image Processing", 3'rd Edition, Pearson Education, ISBN 978-81-317-1934-3, 2008.
2. R.C. Gonzalez and R.E. Woods, "Digital Image Processing Using Matlab", Pearson Education, ISBN: 978-8177588989.
3. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall, ISBN: 0133361659, 9780133361650

Elective - IX
BTCOE703 (A): Cloud Computing

[Unit 1] Introduction to Cloud   [6 Hrs]

Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments. **Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.

Before the Move into the Cloud: Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications.

[Unit 2] Cloud Computing Architecture   [6 Hrs]

Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.

Ready for the Cloud: Web Application Design, Machine Image Design, Privacy Design, Database Management, Data Security, Network Security, Host Security, Compromise Response.

[Unit 3] Defining the Clouds for Enterprise   [6 Hrs]

Storage as a service, Database as a service, Process as a service, Information as a service, Integration as a service and Testing as a service; Scaling a cloud infrastructure - Capacity Planning, Cloud Scale. **Disaster Recovery:** Disaster Recovery Planning, Disasters in the Cloud, Disaster Management.

[Unit 4] Aneka: Cloud Application Platform   [6 Hrs]

Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

[Unit 5] Cloud Applications   [6 Hrs]

Scientific Applications – Health care, Geo-science and Biology; Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.

Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model.Microsoft Azure- Azure Core Concepts, SQL Azure.

Text Books:
1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi from TMH2013.
2. George Reese Cloud Application Architectures, First Edition, O"Reilly Media 2009.
3. Cloud Computing and SOA Convergence in Your Enterprise *A Step-by-Step Guide* by David S. Linthicum from Pearson 2010.
4. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India2012.
5. Cloud Computing – web based Applications that change the way you work and ollaborate Online – Micheal Miller, Pearson Education.

NPTEL Course:
1. Cloud Computing, Prof. Soumya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur.

Elective - X
BTCOE704 (B): Computer Graphics

[Unit 1] Basic Concepts   [6 Hrs]

Introduction to computer graphics, lines, line segments, pixels and frame buffers, anti-aliasing techniques and character generation methods. Graphics Display devices (monochrome, color) interactive devices, Scanners and digitizers, touch panels, tablets, mouse, joysticks, trackball, light pen.

[Unit 2] 2D Transformation   [7 Hrs]

Line and circle plotting using Breshemham's and other algorithms, transformation matrices, scaling, rotation, translation, picture transformation, mirror image.

Window and Clipping: Introduction, viewing transforms, 2-D clipping, Sutherland Cohen approach, Cyrus Beck Method, Midpoint subdivision algorithm, Liang-Barsky line clipping algorithm, polygon clipping, text clipping, generalized clipping.

[Unit 3] 3D Graphics   [7 Hrs]

Introduction, 3-D geometry, Coordination system, 3D transformation, rotation about an arbitrary axis, orthogonal projections, multiple views, isometric projection, perspective projections, 3-D clipping.

Hidden Surfaces and Lines: Introduction, Back face removal algorithm, Z-buffers, Scan line and Painter's algorithm hidden surface removal, curved surface generation, generation of solids, sweep method, interpolation.

[Unit 4] Graphical User Interface   [6 Hrs]

X-Windows, use of graphics tools like OPENGL, DirectX, Windows and Motif, Graphic Standards.

[Unit 5] Animation   [6 Hrs]

Introduction, devices for producing animation, computer assisted animation, real time animation, method for controlling animation (fully explicit control, procedural).

Text Books:
1. Peter Shirley, Michael Ashikhmin, Steve Marschner, *Fundamental of Computer Graphics*, 4th Edition, CRC Press.
2. Newman, Sprouall, *Interactive Computer Graphics*, McGraw-Hill Publication.
3. Hearn, Baker, *Computer Graphics*, PHI Publication.
4. Krishnamurthy, *Introduction to Computer Graphics*, McGraw-Hill Publication.
5. ISRD Group, *Computer Graphics*, McGraw-Hill Publication.

NPTEL Course:
1. Computer Graphics, Prof. Sukhendu Das, Department of Computer Science and Engineering, IIT Madras.

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Elective - X
BTCOE704 (C): Embedded Systems

[Unit 1] Introduction   **[6 Hrs]**

Embedded system overview, Design challenge, Processor technology, IC technology, Design technology, Custom single processor technology, Hardware-combinational logic, Sequential logic, Custom single purpose processor design, RT-level custom single purpose processor design, Optimizing custom single purpose processors.

[Unit 2] General purpose processor Software   **[6 Hrs]**

Basic architecture, Operation, Programmers view, Development environment, Application specific instruction set processor, Selecting a microprocessor, General purpose processor design. Introduction, ARM7TDMI-S processor, Block diagram, Memory mapping, Memory accelerator module.

[Unit 3] System control   **[7 Hrs]**

Pin description, Register description, Crystal oscillator, External interrupt inputs, Other system controls, Memory mapping control, Phase locked loop, Power control, Reset, APB divider, Wakeup timer. GPIO: GPIO register map, Timer-TIMER / COUNTER0 and TIMER / COUNTER1 register map, Example timer operation, Architecture.

[Unit 4] UART   **[6 Hrs]**

UART0/1 - UART0/1 register map, UART0/1 baud rate, UART0/1 auto-baud, UART0/1 block diagram. Serial peripheral interface: SPI data transfers, SPI pin description, SPI register map, SPI block diagram; I2C-bus interface: I2C bus configuration, I2C operating modes, I2C Bus serial interface block diagram, Summary of I2C registers.

[Unit 5] Process scheduling   **[7 Hrs]**

Examples of RTOS, Microprocessor and microcontroller based system design, typical design examples, system design and simulation using simulation software such as Proteus VSM. Digital Camera Example Introduction, Introduction to a Simple Digital Camera; User's Perspective, Designer's perspective requirements specification non functional requirements, Informal functional specification, Refined functional specification, Design

Text Books:
1. "Embedded System Design- A Unified system Hardwar/Software Introduction", Frank Vahid (3rd Edition, John Wiley India) ISBN 978-81-265-0837-2.
2. LPC 214x User manual (UM10139) www.nxp.com.
3. "ARM System Developer's Guide – Designing and Optimizing System Software", Andrew N. Sloss, Dominic Symes and Chris Wright (ELSEVIER) ISBN: 1-55860-874-5.

Reference Books:
1. LPC 17xx User manual (UM10360) :- www.nxp.com
2. ARM architecture reference manual : - www.arm.com
3. "An Engineer's Introduction to the LPC2100 series" Trevor Martin (Hitex (UK) Ltd.)
4. "ARM System-on-Chip Architecture" Steve Furber (2nd Edition, Addison-Wesley Professional)ISBN-13: 9780201403527

Elective - X
BTCOE704 (A): Blockchain Technology

[Unit 1] Introduction   [6 Hrs]

Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Cryptocurrency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. **Basic Crypto Primitives:** Hash functions, Properties of a hash function, Hash pointer and Merkle tree, Public key cryptography, Digital signatures, Zero-knowledge systems

[Unit 2] Bitcoin and Blockchain   [6 Hrs]

Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. **Working with Consensus in Bitcoin:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake,Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

[Unit 3] Permissioned Blockchain   [6 Hrs]

Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

[Unit 4] Blockchain Application Development   [5 Hrs]

Enterprise application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade –Trade Finance Network, Supply Chain Financing, Identity on Blockchain.

[Unit 5] Blockchain Application Development   [5 Hrs]

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text Books:

1. Melanie Swan, *"Blockchain: Blueprint for a New Economy"*, O' Reilly, 2015.

2. Josh Thompsons, *"Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming"*

3. Daniel Drescher, *"Blockchain Basics"*, Apress; 1st Edition, 2017.

4. Anshul Kaushik, *"Blockchain and Crypto Currencies"*, Khanna Publishing House, Delhi.

5. Imran Bashir, *"Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained"*, Packt Publishing.

6. Ritesh Modi, *"Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain"*, Packt Publishing.

7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O' Dowd, Venkatraman Ramakrishna, *"Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer"*, Import, 2018.

Elective - IX
BTCOE703 (B): Business Intelligence

[Unit 1] Introduction to Business Intelligence **[6 Hrs]**

Introduction to digital data and its types – structured, semi-structured and unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP).

[Unit 2] Basics of BI **[6 Hrs]**

BI Definitions & Concepts, BI Framework, Data Warehousing concepts and its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI best practices.

[Unit 3] Data Integration **[6 Hrs]**

Concepts of data integration, needs and advantages of using data integration, introduction to common data integration approaches, Meta data –types and sources.

[Unit 4] Data Processing **[6 Hrs]**

Introduction to data quality, data profiling concepts and applications, Introduction to ETL (Extract-Transform-Loading) using Open Source Software

[Unit 5] Data and Dimension Modeling **[6 Hrs]**

Introduction, ER Modeling, multidimensional data modeling, concepts of dimensional, facts, cubes, attribute, hierarchies, star and snowflake schema, Introduction to business metrics and KPLs, creating OLAP using Application Software.

Basic of Enterprise Reporting: A typical enterprise, Malcolm Baldrige – quality performance framework, balanced scorecard, enterprise dashboard, balanced scorecard vs. enterprise dashboard, enterprise reporting using software tools, best practices in the design of enterprise dashboards.

Text Books:
1. R. N. Prasad and Seema Acharya, "Fundamentals of Business Analytics", Wiley Publication.

Reference Books
1. Raiph Kimball, Ross, "The Data Warehouse Lifecycle Toolkit" Wiley Publication, 2nd edition.
2. Anahory& Murray, "Data Warehousing in the Real World" Pearson Edt Ponniah, "Data Warehousing Fundamentals", Wiley Publication

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Elective - IX
BTCOE703 (C): Natural Language Processing

[Unit 1] Introduction   [6 Hrs]

Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

[Unit 2] Word level Analysis   [7 Hrs]

Morphology fundamentals; Morphological Diversity o f Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

[Unit 3] Syntax Analysis   [6 Hrs]

Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

[Unit 4] Semantic Analysis   [7 Hrs]

Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

[Unit 5] Applications   [6 Hrs]

Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

Text Books:

1. Allen, James, *Natural Language Understanding*, 2nd Edition, Benjamin / Cumming, 1995.
2. Charniack, Eugene, *Statistical Language Learning*, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, *Speech and Language Processing*, Second Edition, Prentice Hall, 2008.
4. Manning, Christopher and Heinrich, Schutze, *Foundations of Statistical Natural Language Processing*, MIT Press, 1999.

NPTEL Course:

1. Natural Language Processing, Prof. Pushpak Bhattacharyya, Department of Computer Science and Engineering, IIT Bombay.

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BTCOC701: Software Engineering

[Unit 1] Introduction [6 Hrs]
Professional software development, Software engineering ethics, Case studies.
Software processes: Software process models, Process activities, Coping with change, The rational unified process.

[Unit 2] Agile software development [6 Hrs]
Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods.
Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

[Unit 3] System modeling [6 Hrs]
Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering. **Architectural design:** Architectural design decisions, Architectural views, Architectural patterns, Application architectures.

[Unit 4] Design and implementation [6 Hrs]
Object-oriented design using UML, Design patterns Implementation issues, Open source development.

[Unit 5] Testing [6 Hrs]
Software testing, Development testing, Test-driven development, Release testing, User testing.

[Unit 6] [6 Hrs]
Dependability properties, Availability and reliability, Safety Security.

Text Books:
1. Ian Sommerville, *Software Engineering*; 9th Edition, Addison-Wesley Publishing Company, USA.

Reference Books:
1. Software Engineering, S. A. Kelkar, Prentice Hall of India, 2007
2. Software Engineering, Pressman, Tata McGraw Hill, 2006
3. Software Engineering, Pankaj Jalote, Narosa Publishers, 2006.

NPTEL Course:
    1Software Engineering, Prof. Rajib Mall, Department of Computer Science and Engineering, IIT Kharagpur.

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Elective - VIII
BTCOE702 (A): Big Data Analytics

[Unit 1] Introduction to Big Data   **[6 Hrs]**
Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.

[Unit 2] Big Data Platforms   **[7 Hrs]**
Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

[Unit 3] Big Data Streaming Platforms   **[6 Hrs]**
Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.

[Unit 4] Big Data Applications   **[6 Hrs]**
Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout- kmeans, Naïve Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, Spark MLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX

[Unit 5] Database for the Modern Web   **[7 Hrs]**
Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript' sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDBquery language.

Text Books:
3. "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Bart Baesens, Wiley and SAS Business Series.
4. "Big Data Principals and Paradiagram", Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Morgan Kaufmann, Elsevier, ISBN: 978-0-12-805394-2
5. "MongoDB in Action", Kyle Banker, Peter Bakkum and Shaun Verch, 2nd Edition Dream tech Press, ISBN: 978-9351199359.
6. "Mining of Massive Datasets", Anand Rajaraman, Jeffrey D. Ullman, 3rd edition, Cambridge University Press

Reference Books:
1. "BIG Data and Analytics", Sima Acharya, Subhashini Chhellappan,Wiley publication, ISBN: 978-8126554782.

NPTEL COURSE:
1. Big Data Computing by PROF. RAJIV MISRA, Dept. of Computer Science and Engineering, IIT Patna.

Elective - X
BTCOE704 (D): Design Thinking

[Unit 1] Overview of Design Thinking Process [7 Hrs]

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

[Unit 2] Empathize [6 Hrs]

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user persons, customer journey mapping, How might we questions.

[Unit 3] Analyze or Define [6 Hrs]

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

[Unit 4] Test (Prototyping And Validation) [5 Hrs]

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

[Unit 5] Design Innovation [5 Hrs]

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

Text Books:

1. Bala Ramadurai, "Karmic Design Thinking", First Edition, 2020.

Reference Books:

1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization by Vijay Kuma.

2. Human-Centered Design Toolkit: An Open-Source Toolkit To Inspire New Solutions in the Developing World by IDEO.

3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.

4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

BTCOL705: Full Stack Development (LAMP / MEAN)

[Unit 1] Basic HTML, Advanced HTML [4 Hrs]
HTML5: HTML5 Doctype, Some New HTML5 Elements, HTML5 Header And Footer, Allow spell check and editable areas, Adding audio, Drag & drop, User location: geolocation, Saving information - localStorage, Saving information - sessionStorage.

[Unit 2] CSS [6 Hrs]
What Is CSS?, How to write CSS: syntax, Using style sheets, Using external style sheets, Identities and classes, Style entire elements, CSS Comments, Change background colors, Setting background images, Change text color, Text formatting using CSS, Font Properties, Text Properties, Styling hyperlinks using CSS, Styling lists using CSS, Setting element width and height, Adding borders, Spacing: margin & padding, Change the mouse type: cursor, Hide, show and display elements, What to do with overflowing content.
CSS Advanced: Grouping & Nesting, Maximum & Minimum Dimensions, Move an element from its default position, Relative location & layering, Floating, Clear, Pseudos, Alignment Sprites: the most efficient way to load images, Make elements translucent: opacity, Different media types, Style elements based on their attributes, Browser prefixes.

[Unit 3] Javascript Basics [6 Hrs]
JavaScript Essentials, What is JavaScript?, JavaScript: Internal vs. External, JavaScript comments, document.write(); Display info from the browser: alert & confirm, Prompting the user for information, Programming fundamentals: Variables, Add two sentences together: concatenation, Basic math in JavaScript, Redirecting users and opening new windows, Creating empty hyperlinks, String Manipulation, Comparing variables and values, Programming fundamentals: If...Else Statements, Else...If Statements, Switch Statements, Functions; JavaScript Events, Selecting HTML elements using getElementById(), Escaping content, Programming fundamentals: Arrays, For Loops, While Loops, Breaking Out Of Loops, Skipping A Loop Cycle.
Javascripts Advanced: Getting parts of a value: split & substr, Programming fundamentals: Try...Catch And Throw, Getting the users date and time, Some more complex math (no homework), Programming fundamentals: Regular Expressions, Get the users browser (navigator), Add timing: setInterval & setTimeout.

[Unit 4] Ajax, jQuery, PHP, PHP Advanced. [4 Hrs]

Text Books:
1. Colin Ihrig, Full Stack JavaScript Development With MEAN: MongoDB, Express, AngularJS, and Node.JS, SitePoint; 1st Edition.
2. https://www.w3schools.com/whatis/whatis_fullstack.asp.
3. Robin Nixon, Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites, O'Reilly Media; 3rd edition,
4. Callum Macrae, Learning from jQuery, O'Reilly Media.

Elective - IX Laboratory
BTCOL708 (C): Natural Language Processing Laboratory

List of Experiments:

Practical may be implemented using programming Python / Java. Concern faculty member may add more experiments in the list make it minimum 10 to-12.

1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2. Morphological Analysis
3. N-gram model
4. POS tagging
5. Chunking
6. Named Entity Recognition
7. Case Study/ Mini Project based on Application mentioned in Module.

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BTCOP709: Project Phase – I

Guidelines for the project phase – I:

The project should enable the students to combine the theoretical and practical concepts studied in his / her academics. The project work should enable the students to exhibit their ability to work in a team, develop planning and execute.skills and perform analyzing and trouble shooting of their respective problem chosen for the project. The students should be able to write technical report, understand the importance of teamwork and group task. The students will get knowledge about literature survey, problem definition, its solution, and method of calculation, trouble shooting, costing, application and scope for future development.

Project work:

The project work is an implementation of learned technology. The knowledge gained by studying various subjects separately supposed to utilize as a single task. A group of 03/04 students will have to work on assigned work. The topic could be a product design, specific equipment, live industrial problem etc. The project work involves experimental/theoretical/computational work. It is expected to do necessary literature survey by referring current journals belonging to Information Technology reference books and internet. After finalization of project, requisites like equipments, data, tools etc. should be arranged.

Project Activity:

The project groups should interact with guide, who in turn advises the group to carry various activities regarding project work on individual and group basis. The group should discuss the progress every week in the project hours and follow further advice of the guide to continue progress. Guide should closely monitor the work and help the students from time to time. The guide should also maintain a record of continuous assessment of project work progress on weekly basis.

Phase - I:

1. Submission of project/problem abstract containing problem in brief, requirements, broad area, applications, approximate expenditure if required etc.
2. Problem definition in detail.
3. Literature survey.
4. Requirement analysis.
5. System analysis (Draw DFD up to level 2, at least).
6. System design, Coding/Implementation (20 to 30%).

BTCOF609: Field Training / Internship / Industrial Training

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 Programme 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.

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Elective - XI

BTCOE801 (A): Deep Learning

Week 1: Introduction to Deep Learning, Bayesian Learning, Decision Surfaces

Week 2: Linear Classifiers, Linear Machines with Hinge Loss

Week 3: Optimization Techniques, Gradient Descent, Batch Optimization

Week 4: Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

Week 5: Unsupervised Learning with Deep Network, Autoencoders

Week 6: Convolutional Neural Network, Building blocks of CNN, Transfer Learning

Week 7: Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Week 8: Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

Week 9: Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc.

Week 10: Classical Supervised Tasks with Deep Learning, Image Denoising, Semanticd Segmentation, Object Detection etc.

Week 11: LSTM Networks

Week 12: Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Link: https://swayam.gov.in/nd1_noc20_cs62/preview

Elective - XI
BTCOE801 (B): Social Networks

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) & Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behaviour in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudocore (How to go viral on web)

Link: https://swayam.gov.in/nd1_noc19_cs66/preview

Elective - XI
BTCOE801 (C): Randomized Algorithms

Week 1: Introduction to Randomized Algorithms

Week 2: Probability Review

Week 3: Moments and Deviation

Week 4: The Probabilistic Method

Week 5: Markov Chains - I

Week 6: Markov Chain - II

Week 7: Number Theoretic Algorithms

Week 8: Graph Algorithms

Week 9: Approximate Counting

Week 10: Data Structures

Week 11: Computational Complexity

Week 12: Review of the course

Link: https://swayam.gov.in/nd1_noc20_cs39/preview

Open Elective - XII
BTCOE802 (A): Introduction to Industry 4.0 and Industrial Internet of Things

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security inIIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

    Case study - I : Milk Processing and Packaging Industries
    Case study - II: Manufacturing Industries - Part I
    Case study - III : Manufacturing Industries - Part II
    Case study - IV : Student Projects - Part I
    Case study - V : Student Projects - Part II
    Case study - VI : Virtual Reality Lab
    Case study - VII : Steel Technology Lab

Link: https://swayam.gov.in/nd1_noc20_cs24/preview

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Open Elective - XII

BTCOE802 (B): Cryptography & Network Security

Week 1: Introduction to cryptography, Classical Cryptosystem, Block Cipher.

Week 2: Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher.

Week 3: LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory.

Week 4: Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem.

Week 5: Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem.

Week 6: Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals, Elliptic curve Modulo a Prime.

Week 7: Generalized ElGamal Public Key Cryptosystem, Rabin Cryptosystem.

Week 8 : Message Authentication, Digital Signature, Key Management, Key Exchange, Hash Function.

Week 9 : Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS).

Week 10: Cryptanalysis, Time-Memory Trade-off Attack, Differential and Linear Cryptanalysis.

Week 11: Cryptanalysis on Stream Cipher, Modern Stream Ciphers, Shamir's secret sharing and BE, Identity-based Encryption (IBE), Attribute-based Encryption (ABE).

Week 12: Side-channel attack, The Secure Sockets Layer (SSL), Pretty Good Privacy (PGP), Introduction to Quantum Cryptography, Blockchain, Bitcoin and Cryptocurrency.

Link: https://swayam.gov.in/nd1_noc20_cs21/preview

Open Elective - XII

BTCOE802 (C): Model Checking

Week 1: Modeling systems as Finite-state machines

Week 2: Using the model-checker NuSMV

Week 3: Linear-time properties for verification

Week 4: Regular properties – automata over finite words

Week 5: Omega-regular properties – automata over infinite words

Week 6: Model checking omega-regular properties

Week 7: Linear Temporal Logic (LTL)

Week 8: Algorithms for LTL

Week 9: Computation Tree Logic (CTL)

Week 10: Algorithms for CTL

Week 11: Binary Decision Diagrams (BDDs)

Week 12: Models with timing constraints – timed automata Regular properties – automata over finite words

Link: https://swayam.gov.in/nd1_noc20_cs38/preview

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BTCOP803: Project phase – II ^{s} / Internship and project in the Industry *

$ This is for those students who are not doing Internship and Project in the Industry, they can do project in the department.

* Six months of Internship and Project in the industry.

This is continuous work to the project phase - I. Every students will have to submit a completed report (3 copies)* of the project work. Report preparation guidelines should be followed as per given format. The students will prepare a power point presentation of the work. Panel of examiners comprising of guide, internal examiner, senior faculty, external examiner, etc. will assess the performance of the students considering their quality of work.

Phase phase - II
1. Coding / Implementation.
2. Use cases.
3. Testing / Trouble shooting.
4. Data dictionary / Documentation.
5. Finalization of project in all respects.

* (For guide, Personal copy, Departmental library)
In a presentation, the students should focus to clarify problem definition and analysis of the problem.

###End of the syllabus###

BTCOL706: System Administration

1. Installations of various Linux flavors (Optionally using Virtualbox): Centos (with LVM, without LVM), Ubuntu (with LVM, without LVM), Debian (with LVM, without LVM).
2. SSH Server (CentOS and Ubuntu): enable/disable root login.
3. Telnet server (CentOS and Ubuntu).
4. FTP Server (CentOS and Ubuntu).
5. Using command upload/download files from FTP Server.
6. Samba Server (CentOS and Ubuntu).
7. HTTP Server (CentOS and Ubuntu).
8. Configuration of Proxy Server.

Reference Books:

1. Tom Adelstein, Bill Lubanovic, *Linux System Administration: Solve Real-life Linux Problems Quickly*, O'Reilly Media.

2. Æleen Frisch, *Essential System Administration*, Third Edition, O'Reilly Media.

3. Terry Collings, Kurt Wall, *Red Hat Linux Networking and System Administration*, 3rd Edition, Wiley Publication.

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Elective - VIII Laboratory
BTCOL707 (A): Big Data Analytics Laboratory

List of Experiments:
1. Perform setting up and Installing Hadoop in its two operating modes:
   a) Pseudo distributed,
   b) Fully distributed.
2. Implement the following file management tasks in Hadoop:
   a) Adding files and directories
   b) Retrieving files
   c) Deleting files
3. To understand the overall programming architecture using Map Reduce API
4. Store the basic information about students such as roll no, name, date of birth and address Of student using various collection types such as List, Set and Map
5. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   a) Find the number of occurrence of each word appearing in the input file(s)
   b) Performing a MapReduce Job for word search count (look for specific keywords in a file)
6. Install and Run Hbase then use HbaseDDl and DML commands
7. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications usingScala.
8. Basic CRUD operations in MongoDB
9. Retrieve various types of documents from students collection
10. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of itemsfrequently reviewed together.
    a) Write a single Spark application that:
       i.   Transposes the original Amazon food dataset, obtaining a PairRDD of the type:<user_id> → <list of the product_ids reviewed by user_id>
       ii. Counts the frequencies of all the pairs of products reviewed together;
       iii. Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Elective - VIII Laboratory
BTCOL707 (B): Distributed Systems Laboratory

List of Experiments:

1. Implement the concept of RPC.
2. Implement the concept of RMI.
3. Design a Distributed Application using Message passing Interface for remote computation.
4. Implementation of Clock Synchronization (logical/physical).
5. To write Program multi-threaded client/server processes.
6. Implement concurrent echo client-server application
7. Implement concurrent day-time client-server application.
8. Configure following options on server socket and tests them:
   SO_KEEPALIVE,SO_LINGER, SO_SNDBUF, SO_RCVBUF, TCP_NODELAY .
9. Incrementing a counter in shared memory.
10. To Study Implementation of Election algorithm.
11. To study Implementation of Mutual Exclusion algorithms.
12. Implement Network File System (NFS).

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Elective - VIII Laboratory
BTCOL707 (C): Fundamental of Digital Image Processing Laboratory

List of Experiments:
1. Study of Matlab environment and implementation of matlab commands, functions and programming constructs.
2. Point processing in spatial domain
   a. Negation of an image
   b. Thresholding of an image
   c. Contrast Stretching of an image
3. Program to implement Bit Plane Slicing
4. Program for plotting a Histogram of an image
5. Program to implement Histogram Equalization
6. To write a Program for Histogram Specification
7. Zooming an image by interpolation and replication
8. Filtering in spatial domain
   a. Low Pass Filtering
   b. High Pass Filtering
   c. Median filtering
9. Edge Detection using derivative filter mask
   a. Prewitt
   b. Sobel
   c. Laplacian
10. Data compression using Huffman coding
11. Filtering in frequency domain
    a. Low pass filter
    b. High pass filter