Dr. Babasaheb Ambedkar Technological University, Lonere
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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Course Structure and Detailed Syllabus
for

Final Year
B. Tech. Programme in Information Technology
(Academic Year 2023-24)

Rules and Regulations

1. The normal duration of the course leading to a 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 maximum 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 every institute to inform the 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 Postgraduate 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 Prerequisites:

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 eight semesters of the 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
	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, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory courses.

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 students 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. (SGPA is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

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

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance
As per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPAis the weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (up to two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

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

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. Students willing to opt for majors have 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. Students 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)

Students complying with these criteria will be awarded B.Tech (honours) Degrees.

B. **Eligibility Criteria for Minors**

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Students willing to opt for minors have to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional courses from other disciplines of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Students 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)

Students 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 Degrees the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

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

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

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 to appear for 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 the 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 the academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

Teaching and Evaluation Scheme for Final Year B. Tech. Programme in Information Technology

(Academic year 2023-24)

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total Marks	Credits	Total Hours
			L	T	P	MSE	CA		ESE				
							CA-I	CA- II	Internal	External			
Semester VII													
1	BTITC701	Cloud Computing and Storage Management	2	-	-	20	20		60		100	2	2
2	BTITC702	Artificial Intelligence#	3	-	-	20	20		60		100	3	3
3		**Elective VII**	3	-	-	20	20		60		100	3	3
	BTITE703A	A) Pattern Recognition											
	BTITE703B	B) Soft Computing											
	BTITE703C	C) Electronic Payment System[@]											
4		**Elective VIII** (Open)	3	-	-	20	20		60		100	3	3
	BTITOE704A	A) Financial Accounting											
	BTITOE704B	B) Machine Learning											
	BTITOE704C	C) Deep Learning											
5		**Elective IX**	3	-	-	20	20		60		100	3	3
	BTITPE705A	A) Real Time Systems											
	BTITPE705B	B) Information Security											
	BTITPE705C	C) Management Information Systems											
	BTITPE705D	D) Distributed Computing											
	BTITPE705E	E) Natural Language Processing											
6	BTITL706	Cloud Computing and Storage Management Lab	-	-	2	-	15	15	10	10	50	1	2
7		**Elective VII Lab**	-	-	2	-	15	15	10	10	50	1	2
	BTITEL707A	A) Pattern Recognition Lab											
	BTITEL707B	B) Soft Computing Lab											
	BTITEL707C	C) Electronic Payment System Lab											
8		**Elective IX Lab**	-	-	2	-	15	15	10	10	50	1	2
	BTITPEL708A	A) Real Time Systems Lab											
	BTITPEL708B	B) Information Security Lab											
	BTITPEL708C	C) Management Information Systems Lab											
	BTITPEL708D	D) Distributed Computing Lab											
	BTITPEL708E	E) Natural Language Processing Lab											
9	BTITP709	Project Phase I*	-	-	4	-	30		10	10	50	2	4
10	BTITF710	Field Training / Internship/ Industrial Training-III Evaluation	-	-	-	-	-		50		50	1	-
Summary of Semester Assessment Marks, Credit & Hours			**14**	**-**	**10**	**100**	**220**		**430**		**750**	**20**	**24**

Semester VIII													
1	BTITC801	Internet of Things#	3	-	-	20	20	60		100	3	3
2	BTITC802	Mobile Computing#	3	-	-	20	20	60		100	3	3
3	BTITP803	Project Phase II/ Project with Internship**	-	-	24	-	50	50	50	150	12	24
Summary of Semester Assessment Marks, Credit & Hours			**6**	**-**	**24**	**40**	**90**	**220**		**350**	**18**	**30**

 # These courses are to be studied on self –study mode using SWAYAM/NPTEL/Any other source.

*@ Course **designed and run** by ELECTRONIC PAYMENT AND SERVICES (P) LTD, Mumbai.*

** In case of students opting for Internship in the eighth semester, the Project must be industry-based.*

*** Six months of Internship in the industry.*

Course Title:	**Cloud Computing and Storage Management**	**Semester**	**VII**
Course Code	**BTITC701**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**2 – 0 – 0**
Stream	**Core**	**Credits**	**2**

Course Objectives:

1. To learn the concept of cloud computing.
2. To understand the trade-off between deploying applications in the cloud over local infrastructure.
3. To identify different storage virtualization technologies and their benefits.
4. To understand and articulate business continuity solutions including backup and recovery technologies, local and remote replication solutions.

Course Outcomes:

After learning the course, the student will be able:

1. To understand the key dimensions of the challenge of Cloud Computing.
2. To assess the economics, financial and technological implications for selecting cloud computing for organization.
3. To describe and apply storage technologies.
4. To identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers.
5. To describe important storage technology features such as availability, replication, scalability and performance.

Course Content:

UNIT I

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, Deployment models and service models.

UNIT II

Virtualization: Issues with virtualization, Virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, Virtualization of data centers and Issues with Multi-tenancy, Storage virtualization, Challenges, Types of storage virtualization.

UNIT III

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from inside and outside a Cloud Architecture, MapReduce and its extensions to Cloud Computing, Hadoop, HDFS and GFS.

UNIT IV

Business Continuity and Recovery: Information Availability,Life cycle, Failure analysis: Backup and Recovery-Backup purpose, considerations, Backup Granularity, Recovery considerations- Backup methods, Process, backup and restore operations, Overview of emerging technologies: Duplication, Off site backup.

UNIT V

Storage security and Management: Storage security framework, Securing the Storage infrastructure, Risk triad: Managing the storage infrastructure, Monitoring the storage infrastructure, identify key parameters and components to monitor in a storage infrastructure, List key management activities and examples, Define storage management standards and initiative-Industry trend.

Text Books:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, ***"Cloud Computing Principles and Paradigms"***, Wiley Publishers, 2011.
2. Barrie Sosinsky, ***"Cloud Computing Bible"***, Wiley Publishers 2010.
3. Tim Mather, Subra Kumaraswamy, Shahed Latif, ***"Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance"***, O'Reilly 2010.
4. EMC Corporation, ***"Information Storage and Management"***, 1st Edition, Wiley India 2009.

Reference Books:

1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, ***"Mastering Cloud Computing"***, McGraw Hill, 2013.
2. Michael Miller, ***"Cloud Computing : Web-based Applications that change the way you work and collaborate online"***, Pearson Education, 2008.
3. IBM, ***"Introduction to Storage Area Networks and System Networking"***, 5th Edition, November 2012.

Course Title:	**Artificial Intelligence**	**Semester**	**VII**
Course Code	**BTITC702**	**Course Type**	**Compulsory**
Prerequisite	**-**	**L – T – P**	**3 – 0 – 0**
Stream	**Core**	**Credits**	**3**

Course Objectives:

1. To acquaint the students with the theoretical and computational techniques in Artificial Intelligence.
2. To use various symbolic knowledge representations to specify domains and reasoning tasks of a situated software agent.
3. To use different logical systems for inference over formal domain representations and trace how a particular inference algorithm works on a given problem specification.
4. To understand the conceptual and computational trade-offs between the expressiveness of different formal representations.

Course Outcomes:

After learning the course the students should be able:

1. To find appropriate idealizations for converting real world problems into AI search problems formulated using the appropriate search algorithm.
2. To analyze, formalize and write algorithmic methods for search problems.
3. To explain important search concepts, the definitions of admissible and consistent heuristics and completeness and optimality.
4. To implement and execute by hand alpha-beta search.
5. To design good evaluation functions and strategies for game playing.
6. To carry out proofs in first order and propositional logic using techniques such as resolution, unification, backward and forward chaining.
7. To choose and implement learning algorithms such as decision trees, support vector machines, and boosting.

Course Content:

UNIT I

Introduction: Overview of Artificial intelligence- Problems of AI, AI techniques, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, Nature of environment, Structure of agents, Goal based agents, Utility based agents, Learning agents.

UNIT II

Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, Production system, Problem characteristics and issues in the design of search programs. Search techniques: Solving problems by searching: problem solving agents, Searching for solutions; uniform search strategies: Breadth first search, Depth first search, Depth limited search, Bidirectional search, Comparing uniform search strategies.

UNIT III

Heuristic search strategies: Greedy best-first search, A* search, Memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, Simulated annealing search, Local beam search, Genetic algorithms; Constraint satisfaction problems, Local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, The minimax search procedure, Alpha-beta pruning, Additional refinements, Iterative deepening.

UNIT IV

Knowledge & reasoning: 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 versus declarative knowledge, Logic programming, Forward versus backward reasoning, Matching, Control knowledge, Probabilistic reasoning: Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory.

UNIT V

Natural Language processing & Expert, Fuzzy logics Systems: Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

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

Text Books:

1. Rich, E. and Knight K., ***"Artificial Intelligence"***, 3rd Edition, Tata McGraw- Hill, 2017.
2. Russell, S. and Norvig P., ***"Artificial Intelligence: A Modern Approach"***, 4th Edition, Pearson Education, 2010.
3. Patterson, Dan W. ,***"Introduction to Artificial Intelligence & Expert Systems"***, PHI, 2016.

Reference Book:

1. Nilsson N. J., Morgan Kaufmann, ***"Artificial Intelligence: A New Synthesis"***, Standard Edition, Tata McGraw-Hill, 1998.

Course Title:	**Pattern Recognition**	**Semester**	**VII**
Course Code	**BTITE703A**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To study pattern recognition topics and be exposed to recent developments in pattern recognition research.
2. To provide in-depth design concepts and implementation techniques of pattern recognitions.

Course Outcomes:

1. Identify and explain detailed aspects of internal structures of pattern recognitions.
2. Compare and contrast design issues for statistical pattern recognition.
3. Develop implementation skills for building pattern recognition.

Course Content:

UNIT I

Introduction: Machine Perception, Definition of Pattern Recognition (PR), Pattern Recognition System: Sensing, Segmentation & grouping, Feature extraction, Classification and Post-processing, Design Cycle: Data collection, Feature choice, Model choice, Training, Evaluation and computational complexity, Learning and adaptation: Supervised learning, Unsupervised learning, Reinforcement learning, Examples of PR Applications.

UNIT II

Statistical Pattern Recognition: Bayesian Decision Theory and Classifiers, Normal density and discriminant functions, Linear discriminant functions, **Discriminative Classifiers:** Decision Boundary, Separability, Perceptron, Support Vector Machines.

UNIT III

Parameter Estimation Methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods: Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), **Artificial neural networks:** Multilayer perceptron – feed-forward neural network, A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

UNIT IV

Nonparametric Techniques: Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification, **Tree Classifiers:** Decision Trees: CART, C4.5, ID3, Random Forests.

UNIT V

Unsupervised Learning & Clustering, Criterion functions for clustering, Clustering Techniques: K means, Hierarchical clustering, K-medoids, DBSCAN, Cluster validation, Feature selection & extraction, **Classifier Ensembles:** (a) Bagging, (b) Boosting / AdaBoost.

Text Books:

1. Duda, R.O., Hart, P.E., Stork, D.G. ***"Pattern Classification",*** Wiley, 2nd Edition, 2001.
2. EartGose, Richard Johnsonburg and Steve Joust, ***"Pattern Recognition and Image Analysis' "***, Prentice-Hall of India- 2003.

Reference Books:

1. Bishop, C. M. ***"Pattern Recognition and Machine Learning"*** Springer, 2nd Edition, 2007.
2. Marsland, S., ***"Machine Learning: An Algorithmic Perspective"***, CRC Press. 2009.
3. Theodoridis, S. and Koutroumbas, K., ***"Pattern Recognition"***, 4th Edition, Academic Press, 2008.
4. Russell, S. and Norvig, N., ***"Artificial Intelligence: A Modern Approach",*** Prentice Hall, Series in Artificial Intelligence, 2003.

Course Title:	**Soft Computing**	**Semester**	**VII**
Course Code	**BTITE703B**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
2. To gain insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems.
3. To create awareness of the application areas of soft computing technique.
4. To learn alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After learning the course the student will be able:

1. To use a new tool /tools to solve a wide variety of real world problems.
2. To find an alternate solution, more adaptable, resilient and optimum.
3. To apply knowledge of the soft computing domain to real world problems.

Course Content:

UNIT I

Artificial Neural Network: Artificial Neural Network, Biological neuron , Artificial neuron model , Concept of bias and threshold , McCulloch Pits Neuron Model , Implementation of logical AND, OR, XOR functions , Learning paradigms: Supervised, Unsupervised, Reinforcement , Linear neuron model , Gradient descent algorithm, Activation functions: Binary, Bipolar (linear, signup, log sigmoid, tan sigmoid) , Learning mechanisms: Hebbian, Delta Rule of Perceptron and its limitations.

UNIT II

Artificial Neural Network: Multilayer perceptron (MLP) and backpropagation algorithm, Application of MLP, Self-organizing Feature Maps, Clustering of Learning vector quantization, Radial Basis Function networks, Hopfield network, auto associative and hetero - associative memory, A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

UNIT III

Fuzzy Logic -I (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT IV

Fuzzy Logic-II (Fuzzy Membership, Rules): Membership functions, Interference in fuzzy logic, Fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications & Defuzzification , Fuzzy Controller , Industrial applications.

UNIT V

Evolutionary computation: Genetic Algorithms, Survival of the Fittest, Fitness Computations, Crossover, Mutation, Reproduction, Rank method, Rank space method, Simulated annealing, Evolutionary computation, Ant colony optimization algorithms, Particle swarm optimization.

Text Books:

1. Laurene Fausett, ***"Fundamentals of Neural Networks: Architectures, Algorithms And Applications"***, Pearson Education, 2008.
2. Timothy Ross, "***Fuzzy Logic With Engineering Applications"***, 3rd Edition, John Wiley & Sons, 2010.
3. J.S. Jang, C.T. Sun, E. Mizutani, ***"Neuro- Fuzzy and Soft Computing"***, PHI Learning Private Limited.
4. S. N. Sivanandam, S. N. Deepa, ***"Principles of Soft Computing"***, John Wiley & Sons, 2007.

Reference Books:

1. John Hertz, Anders Krogh, Richard Palmer, ***"Introduction to the theory of neural computation"***, Addison – Wesley Publishing Company, 1991.
2. Simon Haykin, ***"Neural Networks A comprehensive foundation"***, Prentice Hall International Inc-1999.
3. José C. Principe Neil R. Euliano , W. Curt Lefebvre, ***"Neural and Adaptive Systems: Fundamentals through Simulations"***, John-Wiley & Sons, 2000.
4. Peter E. Hart, David G. Stork Richard O. Duda, ***"Pattern Classification"***, 2nd Edition, 2000.
5. SergiosTheodoridis, Konstantinos Koutroumbas, ***"Pattern Recognition"***, 4th Edition, Academic Press, 2008.
6. Hung T. Nguyen, Elbert A. Walker, ***"A First Course in Fuzzy Logic"***, 3rd Edition, Taylor & Francis Group, LLC, 2008.
7. S. N. Sivanandam, S. Sumathi, S. N. Deepa, ***"Introduction to Fuzzy Logic using MATLAB"***, Springer Verlag, 2007.

Course Title:	**Electronic Payment System**	**Semester**	**VII**
Course Code	**BTITE703C**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To understand common payment methods, working of different payment systems.
2. To learn basic payments processes and systems.
3. To understand emerging payments trends.
4. To gain knowledge on the underlying technologies governing payment systems.

Course Outcomes:

After learning the course, the students should be able:

1. To learn and speak Financial Services language.
2. To familiarize with banking regulations in the payment industry.
3. Gain domain knowledge for a careerin the financial industry: Banks, Insurance & NBFC.

Course Content:

UNIT I

Evolution of payment systems in the digital world: Role of RBI in payment/clearing/settlement Indian payment systems: IMPS, NEFT/RTGS, eWallet, eKYC, AADHAR / AADHAR VAULT, RUPAY Debit/Credit cards, *99#, NACH,ABPS, BHIM, BHARAT PAY, CREDIT CARD, VISA/MASTER ROLE in CREDIT CARD PAYMENTS, CTS, UPI, BBPS, ATM.**Transformation in Social media channels & Payments:** ChatBot, WhatsApp, FB.

UNIT II

Risks in Payment Systems : Credit Risk, Liquidity Risk, Systemic Risk, Operational Risk.**Risk mitigation techniques:** Carefully chosen members, Novation, Central counterparty system, Loss sharing arrangements, Collateral, Other mitigation techniques like RECO.**Relationship structures:** Correspondent banking, Bilateral clearing, arrangements, Network managed banking.

UNIT III

Payment types: Book payments, Local payments, Domestic payments, Cross border payments.**Regional payments systems:**USA payment systems :Fedwire, CHIPS, NSS, ACH, SEPA payment systems : TARGET2, STEP 2 (SCT/SDD) PE- AC, China payment system : CDFCPS/CIPS, Hong Kong payment system : CHATSCanadian payment system : LVTS, Indian payment systems : RTGS, NEFT, IMPS, UPI.

UNIT IV

Overview of SWIFT messaging: MT and MX messages, Role of SWIFT in payment systems, SWIFTnet Fin, File act, Interact, Browse SWIFT payment message processing – MT 1XX, MT 2XX, MT 9XX, MX PAIN/PACS, SWIFT Payment Messages examples, SWIFT for corporate.

UNIT V

Use of code in payment systems:Codes – IBAN, BBAN, BIC, BEI, UID, UPIC, ABA routing codes etc., IFSC.
Foreign exchange transactions: Cash, TOM, Spot, Forwards, Interbank transactions, Merchant transactions, Exchange rate determination and rate computation.**Cash management products:** Concept of float, Cash concentration, notional pooling and sweep, Virtual account management (VAM), ACH filter/ACH block, Lockboxes. **Impact of regulation:** Basel, FATF/OFAC compliance, FATCA compliance, AML compliance, FRM compliance. Practical: Working of ATMs, Insides of an ATM, Vulnerability Points, Care to be taken while using ATM.

Text Book:

1. S. K. Nippani, B. K. Murthy, ***"Digital India Governance Transformation"***, 2018.

Online Reference for books & documentations:

https://rbidocs.rbi.org.in/rdocs/

Course Title:	**Financial Accounting**	**Semester**	**VII**
Course Code	**BTITOE704A**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To learn basic concepts of financial accounting and reporting.
2. To understand the financial reports rather than to prepare them.
3. To help the participants to become intelligent users of accounting information.
4. To develop the ability in students to use financial statements to assess a company's performance.

Course Outcomes:

After learning the course, the student will be able:

1. Understand the basic accounting and financial terminology.
2. Understand how events affect firm value.
3. Understand how financial transactions are recorded.
4. Make the participants' comfortable looking through financial statements.

CourseContent:

UNIT I

Introduction to Financial Accounting: Accounting as an Information System, Financial, Cost and Management Accounting and their Interrelationships, Finance Function and Accounting, Auditing and Internal Control, Ethical Issues in Accounting, Forms of Organisations and Their Effect on Accounting, Accounting and Corporate Governance, Accounting Concepts and Convention, Accounting Policies, Generally Accepted Accounting Principles (GAAP), International Financial Reporting Standards (IFRS), Indian Accounting Standards (Ind AS), Indian Government Accounting Standards (IGAS).

UNIT II

Presentation of Financial Statements: Balance Sheet- Conceptual Basis of a Balance Sheet, Capital and Revenue Expenditure and Receipts, Classification of Items on a Balance Sheet, Format of Balance Sheet, Balance Sheet Equation, Preparing Balance Sheet. **Preparation of Final Accounts:** The Income Statements-Introduction, Format of Profit and Loss Account, Profit and Loss Account of a Manufacturing Concern, Appropriation of Profit, Advantages of Profit and Loss Account.

UNIT III

Mechanics of Accounting: Introduction, Classification of Accounts, Double Entry System, Overview of Accounting Cycle, Preparing Journals, Subsidiary Books, Ledger, Preparation of Trial Balance, Accounting Errors and Their Rectification, Bank Reconciliation Statement (BRS), Computerised Accounting. **Fixed Assets and Depreciation Accounting:** Introduction, Cost of Fixed Assets, Depreciation, Method of Computing Depreciation, Accounting Treatments for Transactions, Impairment of Assets. **Inventory Valuation:**Introduction,Record Keeping for Inventory, Perpetual Inventory System, Inventory Valuation/Measurement, Methods of Valuation of Inventories, Analysis of Inventories.

UNIT IV

Corporate Accounts: Introduction to Companies, Types of Companies, Shares and Share Capital, Issue of Shares, Share Issue: Payments in Installment, Buyback of Shares, Debentures and Bonds, Income Statement/Profit and Loss Account, Balance Sheet, Company Annual Report. **Cash Flow Statement:** Introduction to Cash Flow Statement, Cash and Cash Equivalents, Cash Flow Activities, Operating Activities, Some Special Items, Free Cash Flow, Fund Flow Statement, Analysis of Cash Flow Statement, Preparation of Cash Flow Statement.

UNIT V

Financial Statement Analysis: Introduction, Techniques for Financial Statement Analysis, Horizontal Analysis: Comparative and Trend Statements, Vertical Analysis: Common Size, Liquidity Ratios: Current and Quick Ratio, Solvency Ratios: D/E, Interest Coverage, Profitability Ratios: GP, NP, EBIT, EBDITA, EPS, Return Ratios: ROI, ROE, Turnover Ratios, Analysis of Stock and Debtors, Working Capital Management, Stock Prices and Financial Data: P/E.

Investments: Introduction, Financial Instrument, Assets and Liabilities, Joint Ventures, Subsidiaries and Associates, Consolidated Financial Statement, Business Combinations, Accounting for Investments, Contemporary Issues in Accounting.

Text Books:

1. Bapat and Raithatha, **"*Financial Accounting – A Managerial Perspective"***, McGraw Hill, 2017.
2. C.T. Horngren, "***Accounting for Management Control: An introduction"***, Prentice Hall, 2018.

Reference Books:

1. Ramchandran and Kakani, ***"Financial Accounting for Management "***, McGraw Hill, 2018.

Course Title:	**Machine Learning**	**Semester**	**VII**
Course Code	**BTITOE704B**	**Course Type**	**Elective**
Prerequisite	**Engineering Mathematics-II**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To understand the basic concepts and methods of machine learning.
2. To make use of some elementary machine learning techniques in the design of computer systems.
3. To develop a broad perspective about the applicability of ML algorithms in different fields.
4. To understand the major machine learning algorithms, the problem settings and assumptions that underlies them.
5. To possess insights, concerning the relative strengths and weaknesses of various common machine learning methods.

Course Outcomes:

After learning the course the student will be able:

1. To demonstrate knowledge of machine learning literature.
2. To describe how and why machine learning methods work.
3. To demonstrate results of parameter selection.
4. To explain relative strengths and weaknesses of different machine learning methods.
5. To select and apply appropriate machine learning methods to a selected problem.
6. To implement machine learning algorithms on real datasets.
7. To suggest ways to improve results.

Course Content:

UNIT I

Introduction: Basic definitions, types of learning, Well-posed learning problems, Designing a Learning System, Perspectives and Issues in Machine learning, hypothesis space and inductive bias, evaluation, cross-validation,

Evaluating Hypothesis: Estimating Hypothesis accuracy, Basics of sampling theory, A General approach for deriving confidence intervals, Difference in error of two hypothesis, Hypothesis testing, comparing learning algorithms.

UNIT II

Probability and Bayes learning: Bayes theorem and concept learning, Maximum likelihood and least square error hypotheses, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Computational Learning Theory: Probably learning an approximately correct hypothesis, PAC learnability, PAC learning model, Sample complexity, The VC Dimension., Linear regression, Logistic Regression,Instance based learning, Feature reduction, Collaborative filtering based recommendation, Practical Machine Learning: Bias-Variance; Training/Testing; Overfitting; Cross-Validation; Occam's razor; Regularization and Model Selection.

UNIT III

McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

UNIT IV

Principal Component Analysis and its interpretations, Singular Value Decomposition, Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer Wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

UNIT V

Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs.

Text Books:

1. Mitchell, Tom. M., ***"Machine Learning",*** McGraw-Hill Education, 1st Edition, May 2013.
2. Miroslav, Kubat. ***"An Introduction to Machine Learning",*** Springer Publishing.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, ***"Deep Learning",*** An MIT Press book. (http://www.deeplearningbook.org)

Reference Books:

1. Bishop, C. M., ***"Pattern Recognition and Machine Learning"***, Springer Publishing.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ***"Deep Learning",*** 2016.
3. Web Reference: https://onlinecourses.nptel.ac.in/noc23_cs24/preview

Course Title:	**Deep Learning**	**Semester**	**VII**
Course Code	**BTITOE704C**	**Course Type**	**Elective**
Prerequisite	**Engineering Mathematics-II**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To understand the basic concepts and methods of Deep learning.
2. To make use of some elementary Deep learning techniques in the design of computer systems.
3. To develop a broad perspective about the applicability of DL algorithms in different fields.
4. To understand the major Deep learning algorithms, the problem settings and assumptions that underlies them.
5. To possess insights, concerning the relative strengths and weaknesses of various common Deep learning methods.

Course Outcomes:

After learning the course the student will be able:

1. To learn about the building blocks used in these Deep Learning based solutions.
2. To learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms.
3. To learn various optimization algorithms such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp.
4. To learn to train deep neural networks.
5. To get the knowledge of deep architectures used for solving various Vision and NLP tasks.

Course Content:

UNIT I

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, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks.

UNIT II

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

UNIT III

Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

UNIT IV

Learning Vectorial Representations Of Words Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.

UNIT V

Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, ***"Deep Learning",*** An MIT Press book. http://www.deeplearningbook.org
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ***"Deep Learning",*** 2016.

Reference Books:

1. Michael Nielsen, ***"Neural Networks and Deep Learning",*** 2016.
2. Yoshua Bengio, "***Learning Deep Architectures for AI"***, 2009.

Course Title:	**Real Time Systems**	**Semester**	**VII**
Course Code	**BTITPE705A**	**Course Type**	**Elective**
Prerequisite	**Operating Systems, Design and Analysis of Algorithms**	**L – T – P**	**3 – 0 – 0**
Stream	**Software Application and Development**	**Credits**	**3**

Course Objectives:

1. To introduce students to the fundamental problems, concepts and approaches in the design and analysis of real-time systems.
2. To study issues related to the design and analysis of systems with real-time constraints.
3. To learn real-time scheduling and schedulability analysis.
4. To understand formal specification and verification of timing constraints and properties.
5. To design methods for real-time systems.
6. To learn new techniques of state-of-the-art real-time systems research.

Course Outcomes:

After learning the course the student will be able:

1. To characterize real-time systems and describe their functions.
2. To analyze, design and implement a real-time system.
3. To apply formal methods to the analysis and design of real-time systems.
4. To apply formal methods for scheduling real-time systems.
5. To characterize and debug a real-time system.

Course Content:

UNIT I

Introduction: Hard vs. Soft real time systems, A reference model of real time system. Real-time scheduling: Clock driven approach, Weighted Round-robin approach, Priority driven approach, Dynamic vs. static system, Effective Release Times and Deadlines, EDF and LST algorithm, Optimality and Non-Optimality of the EDF and LST algorithms, Offline vs. online Scheduling.

UNIT II

Clock-Driven Scheduling: Static, Time-Driven Scheduler, General structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of a-periodic Jobs, Scheduling Sporadic Jobs.

Priority Driven Scheduling of Periodic Tasks: Fixed priority vs. Dynamic priority algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM algorithms, A Schedulability test for fixed-priority tasks with short response times, Sufficient Schedulability conditions for the RM and DM algorithms.

UNIT III

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches, Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and Weighted Fair-Queuing Servers.

UNIT IV

Resources and Resource Access control: Resource contention, Resource access control, Non Preemptive critical section, Basic Priority-Inheritance protocol, Basic Priority Ceiling Protocol, Stack based, Priority-ceiling protocol, preemption ceiling protocol.

UNIT V

Multiprocessor scheduling, Resource Access Control, and Synchronization: Model of multiprocessor & distributed systems, task assignment, multiprocessor Priority-ceiling protocol, Elements of Scheduling Algorithms for End-to-End Periodic Tasks- IPS protocols, PM protocols, MPM protocol.

Text Books:

1. Jane W. S. Liu, ***"Real-Time System"***, Pearson Education.
2. C. M. Krishna and K. G. Shin, ***"Real-Time Systems"***, McGraw Hill.

Reference Books:

1. Laplante, ***"Real Time System Design and Analysis: An Engineer Handbook"***, PHI.
2. Dr. K. V. K. Prasad, ***"Embedded Real Time System Concept Design and Programming"***, Wiley India.

Course Title:	**Information Security**	**Semester**	**VII**
Course Code	**BTITPE705B**	**Course Type**	**Elective**
Prerequisite	**Internetworking Protocols**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure and Security Management**	**Credits**	**3**

Course Objectives:

1. To understand information security's importance in the increasingly computer-driven world.
2. To master the key concepts of information security and its working.
3. To develop a security mindset.
4. To learn to critically analyze situations of computer and network security usage.
5. To identify the salient issues, viewpoints and trade-offs of information security.

Course Outcomes:

After learning the course the student will be able:

1. To explain the challenges and scope of information security.
2. To explain security concepts as confidentiality, integrity and availability.
3. To explain the importance of cryptographic algorithms used in information security .
4. To identify and explain symmetric algorithms for encryption-based security of information.
5. To describe the access control mechanism used for user authentication and authorization.
6. To describe Secure Sockets Layer (SSL), Internet Protocol (IP) communications by using Internet Protocol Security (IPSec).
7. To explain the use of security tools as firewalls and intrusion prevention systems.
8. To explain malicious software issues introduced by software-based viruses and worms.
9. To describe the process of risk assessment in the context of IT security management.

Course Content:

UNIT I

Introduction to Information Systems: Security concepts, Computer security concepts, Threats, Attacks and Assets, Security functional requirements, A security architecture for Open Systems, Computer security trends, Computer security strategy.

UNIT II

Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Practical Application: Encryption of Stored Data.

UNIT III

Models, Frameworks, Standards & Legal Framework: A structure and framework of compressive security policy, policy infrastructure, policy design life cycle and design processes, PDCA model, Security policy standards and practices - ISO 27001, SSE-CMM, IA-CMM, ITIL & BS 15000, BS7799, Understanding Laws for Information Security: Legislative Solutions, Contractual Solutions, Evidential Issues, International Activity, Indian IT Act, Laws of IPR, Indian Copyright Act.

UNIT IV

Controls: Access control principles, Subjects, Objects and access rights, Discretionary access control, Role-based access control, Case study.

Virus and Malware: Introduction & types of Malicious Software (Malware), Propagation–Infected Content–Viruses, Propagation–Vulnerability Exploit–Worms, Propagation–Social Engineering–SPAM Email, Trojans, Payload–System Corruption, Payload–Attack, Agent–Zombie, Bots, Payload–Information Theft–Keyloggers, Phishing, Spyware, Payload–Stealthing–Backdoors, Rootkits, Countermeasures.

UNIT V

Security issues: Database security challenge in the modern world, Federated Databases, securing Mobile databases, Network Security, Trusted and untrusted networks, Network attacks, Network security dimensions, Network attack – the stages; using firewalls effectively; Privacy – Privacy invasion due to direct marketing, Outsourcing using data masking ; privacy issues in smart card applications, Ethical Hacking ;Role of Cryptography in information security, digital signatures.

Text Books:

1. Nina Godbole, ***"Information Systems Security: Security Management, Metrics, Frameworks And Best Practices"***, Wiley, 2008.
2. Mark Rhodes –Ousley, ***"Information Security: The Complete Reference"***, McGraw-Hill Education, 2nd Edition, 2013.
3. Dhiren R Patel, ***"Information Security Theory and Practices"***, PHI Learning, 2008.
4. Mark Stamp, ***"Information Security: Principles and Practice"***, 2nd Edition, Wiley, 2011.

Reference Books:

1. Gary R. McGraw, ***"Software Security: Building Security In"*** Addison Wesley, 2006.
2. Ankit Fadia, ***"Network Security: A Hacker's Perspective"***, 2006.

Course Title:	**Management Information Systems**	**Semester**	**VII**
Course Code	**BTITPE705C**	**Course Type**	**Elective**
Prerequisite	**Decision Support Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

1. To create interest and awareness about the proliferation of the Information Systems in today's organizations.
2. To understand categories of MIS: Operations Support System, Management support system and Office automation system, Functional management system.
3. To learn Information systems for strategic management and strategic role of information systems.
4. To plan for information systems: Identification of Applications, Business Application Planning, Systems and Critical Success Factors, Method of Identifying Applications.
5. To understand System Development Process and Approaches, System Implementation, System maintenance, Introduction to MIS Risks, System Evaluation, IT Procurement Options. Change management in IT Projects.

Course Outcomes:

After learning the course the student will be able:

1. To understand the usage and constituents of MIS in organizations.
2. To understand the classifications, understanding and the different functionalities of these MIS.
3. To explain the functions and issues at each stage of system development.
4. To identify emerging trends in MIS technologies.
5. To identify and assess MIS in real-life organization.

Course Content:

UNIT I

Management & organizational support systems for digital firm: Definition of MIS; Systems Approach to MIS: Report writing s/w, MIS and Human factor considerations, concept of organizational information subsystem, MIS & problem solving.

UNIT II

Information systems & business strategy: Information Management, Who are the users? Manager & Systems, Evolution of Computer based information system (CBIS), Model of CBIS. Information services organization: Trend to End-User computing, Justifying the CBIS, Achieving the CBIS, Managing the CBIS, Benefits & Challenges of CBIS implementation. Strategic Information System, Business level and Firm level Strategy.

UNIT III

Information systems in the enterprise: Systems from Management and functional perspective and their relationship: Executive Information System, Decision support system sales and Marketing Information System, Manufacturing Information System, Human-Resource Information System. Finance and Account Information System.

UNIT IV

Information technology for competitive advantage: Firm in its environment, information resource management of information resource, Strategic planning for information resources. End-User Computing as a strategic issue, Information resource management concept.

UNIT V

E-commerce and international information system: Introduction to E-Commerce, Business Intelligence. E-Commerce strategy, Electronic Data Interchange, E-commerce methodology, E-commerce technology, Business application of the Internet. Electronic Business success strategies, International Information Systems architecture, Strategy: divide, conquer and appease, Cooptation, Business organization, Problems in implementing global information systems, Computer crime, ethics and social issues.

Text Book:

1. Kelkar, S.A., ***"Management Information Systems"***, 2nd Edition, Prentice Hall of India, 2009.

Reference Books:

1. Mark G. Simkin, ***"Introduction to Computer Information System for Business"***, 1996.
2. James A. Senn, ***"Analysis & Design of Information Systems"***, McGraw-Hill.

Course Title:	**Distributed Computing**	**Semester**	**VII**
Course Code	**BTITPE705D**	**Course Type**	**Elective**
Prerequisite	**Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Networking**	**Credits**	**3**

Course Objectives:

1. To understand the major tools and techniques that allow programmers to effectively program the parts of the code that require substantial communication and synchronization.
2. To study the core ideas behind modern coordination and communication paradigms and distributed data structures.
3. To introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs.
4. To realize basic principles and best practice engineering techniques of concurrent and distributed computing.
5. To study the safety and progress properties of concurrent and distributed algorithms.
6. To understand the performance of current multi-core and future many-core systems.

Course Outcomes:

After learning the course, the student will be able:

1. To identify the core concepts of distributed systems.
2. To learn orchestration of multiple machines to correctly solve problems in an efficient, reliable and scalable way.
3. To examine concepts of distributed systems in designing large systems.
4. To apply distributed computing concepts to develop sample systems.

Course Content:

UNIT I

Introduction: Historical background, Key characteristics, Design goals and challenges, Review of networking and internetworking, Internet protocols.

UNIT II

Processes and Inter process Communication: Processes and threads, Virtualization, Code migration, The API for the Internet protocols, External data representation, Client-server communication, Multicast communication, Message oriented communication, Network virtualization, Overlay networks, RPC and MPI.**Naming:** Name services and Domain Name System, Directory services, Case study: X.500 directory service.

UNIT III

Time, Global States and Synchronization: Physical and logical clocks, Global states, Mutual exclusion, Election algorithms, Consistency and Replication: Consistency models, Replica management, Consistency protocols.

UNIT IV

Fault Tolerance and Security: Distributed Commit, Recovery, Security Issues, Cryptography. Distributed File Systems: File service architecture, Case study: Sun Network File System, The Andrew File System.

UNIT V

Peer to peer Systems: Introduction, Napster, Peer-to-peer middleware, Routing overlays, **Case studies:** Pastry, Tapestry. **Distributed Object Based Systems:** Distributed objects, Java beans, CORBA.

Text Books:

1. Tanenbaum A.S, ***"Distributed Systems: Principles and Paradigms"***, 2nd Edition, Pearson Education, 2006.
2. Coulouris G., Dollimore J., Kindberg T. and Blair G., ***"Distributed Systems: Concepts and Design"***, 5th Edition, Addison Wesley, 2011.
3. Mahajan S., Shah S., ***"Distributed Computing"***, 1st Edition, Oxford University Press, 2010.

Reference Books:

1. Hwang K., Dongarra J., Geoffrey C. Fox, ***"Distributed and Cloud Computing: From Parallel Processing to the Internet of Things"***, Morgan Kaufmann, 2011.
2. Comer D.E. and Droms, R.E., ***"Computer Networks and Internets"***, 4th Edition, Prentice-Hall, 2004.

Course Title:	**Natural Language Processing**	**Semester**	**VII**
Course Code	**BTITPE705E**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To learn the leading trends and systems in natural language processing.
2. To understand the concepts of morphology, syntax, semantics and pragmatics of the language.
3. To recognize the significance of pragmatics for natural language understanding.
4. To describe a simple system based on logic and demonstrate the difference between the semantic presentation and interpretation of that presentation.
5. To describe applications based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:

After learning the course the student will be able:

1. To understand the models, methods and algorithms of statistical Natural Language Processing.
2. To implement probabilistic models in code, estimate parameters for such models and run meaningful experiments to validate such models.
3. To apply core computer science concepts and algorithms, such as dynamic programming.
4. To understand linguistic phenomena and explore the linguistic features relevant to each NLP task.
5. To identify opportunities and conduct research in NLP.
6. To analyze experimental results and write reports.

Course Content:

UNIT I

Introduction to NLP: Definition, Issues, Application domain, Tools for NLP, Linguistic organization of NLP, NLP vs. PLP. Morphology: Inflectional, derivational, Parsing and parsing with FST.

UNIT II

Introduction and Basic Text Processing, Language Modeling N-grams: Simple N-grams, Counting words in Corpora, smoothing (Add One, Written-Bell, Good-Turing), N-grams for spelling and pronunciation.

UNIT III

POS Tagging: Tagsets, Concept of HMM tagger, Rule based and stochastic POST, Algorithm for HMM tagging, Transformation based tagging, Models for Sequential tagging – MaxEnt, CRF.

UNIT IV

Parsing : CFG and different parsing techniques, Constituency Parsing, Dependency Parsing, Distributional Semantics, Lexical Semantics: Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, Internal structure of words, Metaphor and metonymy and their computational approaches. Word Sense Disambiguation: Selectional restriction based, Machine learning based and dictionary based approaches.

UNIT V

Topic Models, Entity Linking, Information Extraction, Text Summarization, Text Classification, Sentiment Analysis and Opinion Mining.

Text Books:

1. Jurafsky & J. H. Martin, ***"Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition"***, Pearson Education.
2. Allen, James, ***"Natural Language Understanding"***, 2nd Edition, Benjamin/Cummings, 1996.

Reference Books:

1. Bharathi, A.,Vineet Chaitanya and Rajeev Sangal, ***"Natural Language Processing-A Paninian Perspective",*** Prentice Hall India, 1995.
2. Eugene Cherniak, ***"Statistical Language Learning"***, MIT Press, 1993.
3. Manning, Christopher and Heinrich Schütze, ***"Foundations of Statistical Natural Language Processing",*** MIT Press, 1999.

Course Title:	**Cloud Computing and Storage Management Lab**	**Semester**	**VII**
Course Code	**BTITL706**	**Course Type**	**Compulsory**
Prerequisite	**Internetworking Protocols**	**L – T – P**	**0 – 0 – 2**
Stream	**Core**	**Credit**	**1**

Lab Experiments Objectives:

Learners will be able to...

1 Appreciate cloud architecture.
2 Create and run virtual machines on open source OS.
3 Implement Infrastructure, storage as a Service.
4 Install and appreciate security features for the cloud.

Lab Experiments List:

1. Study of Cloud Computing & Architecture.
2. Study and implementation of Infrastructure as a Service.
3. Implementation of Private cloud using Eucalyptus or Open stake.
   - Working with KVM to create a VM.
   - Installation and configuration of Private cloud.
   - Bundling and uploading images on a cloud.
   - Creating a web based UI to launch a VM.
   - Working with Volumes – Attached to the VM.

Course Title:	**Pattern Recognition Lab**	**Semester**	**VII**
Course Code	**BTITEL707A**	**Course Type**	**Elective**
Prerequisite	**NIL**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Lab Experiments Objectives:

1. To study pattern recognition topics and be exposed to recent developments in pattern recognitions research.
2. To provide in-depth design concepts and implementation techniques of pattern recognitions.

Lab Experiments List:

1. Feature Representation.
2. Mean and Covariance.
3. Linear Perceptron Learning.
4. Generation of Random Variables.
5. Bayesian Classification.
6. MLE: Learning the classifier from data.
7. Data Clustering: K-Means, MST-based.

Course Title:	**Soft Computing Lab**	**Semester**	**VII**
Course Code	**BTITEL707B**	**Course Type**	**Elective**
Prerequisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Lab Experiments Objectives:

1. To utilize Soft computing algorithms to solve engineering problems.
2. To compare results and provide an analysis of algorithm efficiency.
3. To apply a soft computing thought process for solving issues.

Lab Experiments List:

1. Implement a simple logic network using the MP neuron model.
2. Implement a simple linear regression with a single neuron model.
3. Implement and test MLP trained with back-propagation algorithms.
4. Implement and test RBF network.
5. Implement SOFM for character recognition.
6. Implement fuzzy membership functions (triangular, trapezoidal, gbell, PI, Gamma, Gaussian)
7. Implement defuzzification (Max-membership principle, Centroid method, Weighted average method).
8. Implement FIS with MamdaniInference mechanism.
9. A small project: may include classification or regression problems, using any soft computing technique studied earlier.

Course Title:	**Electronic Payment System Lab**	**Semester**	**VII**
Course Code	**BTITEL707C**	**Course Type**	**Elective**
Prerequisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Lab Experiments Objectives:

To design and write programs to demonstrate various real life payment system concepts.

Lab Experiments List:

Assignments and projects based on syllabus.

Course Title:	**Real Time Systems Lab**	**Semester**	**VII**
Course Code	**BTITPEL708A**	**Course Type**	**Elective**
Prerequisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Software Application and Development**	**Credit**	**1**

Lab Experiments Objectives:

1. To design and write programs to demonstrate various real time system concepts of scheduling processes.
2. To demonstrate how real time principles can be applied to business problems by simulating business processes.

Lab Experiments List:

1. Execute a program to demonstrate real time scheduling EDF vs. LST to show a comparative result.
2. Demonstrate clock driven scheduler system.
3. Develop a random generator to set priority and demonstrate a priority driven scheduler system.
4. Simulate a manufacturing process to demonstrate resource and resource control scheduling system in real time.
5. Simulate a logistics service provider scheduling of a product delivery system using the principles of real-time system learned in the course.

Course Title:	**Information Security Lab**	**Semester**	**VII**
Course Code	**BTITPEL708B**	**Course Type**	**Elective**
Prerequisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure and Security Management**	**Credit**	**1**

Lab Experiments Objectives:

1. To be familiar with the algorithms of data mining,
2. To be acquainted with the tools and techniques used for Knowledge Discovery in Databases.
3. To be exposed to web mining and text mining.

Lab Experiments List:

1. Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts:
   a. Caesar Cipher
   b. Playfair Cipher
   c. Hill Cipher
   d. Vigenere Cipher
   e. Rail fence – row & Column Transformation.
2. Implement the following algorithms
   a. DES
   b. RSA Algorithm
   c. Diffiee-Hellman
   d. MD5
   e. SHA-1
3. Implement the SIGNATURE SCHEME - Digital Signature Standard.
4. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG).
5. Set Up a honey pot and monitor the honeypot on the network (KFSensor).
6. Installation of rootkits and study about the variety of options.
7. Perform wireless audit on an access point or a router and decrypt WEP and WPA.(Net Stumbler).
8. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w).

Course Title:	**Management Information Systems Lab**	**Semester**	**VII**
Course Code	**BTITPEL708C**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments Objectives:

1. To prepare organizational data for MIS reports and dashboards.
2. To learn what data should be used to prepare MIS reports.
3. To write programs to produce MIS reports.
4. To depict data in a MIS report to support decision making.

Lab Experiments List:

1. Prepare a MIS report for the HR system to depict the various grades of employee in an organization by years of service.
2. Prepare a EIS report of Sales of an organization.
3. Prepare a graphical EIS dashboard of the Sales over a period of 1 year.
4. Prepare a manufacturing MIS report of all orders fulfilled, in progress and pending for management.
5. Prepare a monthly MIS profit and loss dashboard from financial data.
6. Prepare an EIS for reporting population demographics.

Course Title:	**Distributed Computing Lab**	**Semester**	**VII**
Course Code	**BTITPEL708D**	**Course Type**	**Elective**
Prerequisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Networking**	**Credit**	**1**

Lab Experiments Objective:

1. To implement distributed systems paradigms practically to understand impact on resources and processes.

Lab Experiments List:

1. Load Balancing Algorithm.
2. Scalability in Distributed Environment.
3. Client/server using RPC/RMI.
4. Inter-process communication.
5. Election Algorithm.
6. Distributed Deadlock.
7. Name Resolution protocol.
8. Clock Synchronization algorithms.
9. Mutual Exclusion Algorithm.
10. Group Communication.
11. CORBA architecture.
12. Parallel Algorithms.
13. Message Passing Interface.

Course Title:	**Natural Language Processing Lab**	**Semester**	**VII**
Course Code	**BTITPEL708E**	**Course Type**	**Elective**
Prerequisite	**Programming Skills**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Lab Experiments Objective:

To implement NLP concepts practically to understand how to develop NLP applications.

Lab Experiments List:

1. Morphology
2. word counting
3. word sense disambiguation
4. Part of speech tagging
5. N-gram
6. Entity linking
7. Emotion detection
8. Summarization

Course Title:	**Project Phase I**	**Semester**	**VII**
Course Code	**BTITP709**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 4**
Stream	**Core**	**Credits**	**2**

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 execution skills and perform analyzing and troubleshooting of their respective problem chosen for the project. The students should be able to write technical reports, understand the importance of teamwork and group tasks. The students will get knowledge about literature survey, problem definition, its solution, and method of calculation, troubleshooting, 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 is supposed to be utilized as a single task. A group of 03/04 students will have to work on assigned work. The topic could be product design, specific equipment, live industrial problems etc. The project work involves experimental/theoretical/computational work. It is expected to do necessary literature surveys by referring to current journals belonging to Information Technology reference books and the internet. After finalization of the project, requisites like equipment, data, tools etc. should be arranged.

Project Activity

The project groups should interact with guides, who in turn advise the group to carry out 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 a 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%).

Course Title:	**Internet of Things**	**Semester**	**VIII**
Course Code	**BTITC801**	**Course Type**	**Compulsory**
Prerequisite	**Microprocessor & Microcontrollers**	**L – T – P**	**3 – 0 – 0**
Stream	**Core**	**Credits**	**3**

Course Objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Internet of Things (IoT).
2. To emphasize on core IoT functional Stack to build assembly language programs. To learn the Core IoT Functional Stack.
3. To understand the different common application protocols for IoT and apply IoT knowledge to key industries that IoT is revolutionizing.
4. To examine various IoT hardware items and software platforms used in projects for each platform that can be undertaken by a beginner, hobbyist, student, academician, or researcher to develop useful projects or products.

Course Outcomes:

After learning the course, the students should be able:

1. To understand the concepts of IoT and the Things in IoT.
2. To emphasize core IoT functional Stack and understand application protocols for IoT.
3. To examine various IoT hardware items and software platforms used in projects.
4. To apply IoT knowledge to key industries that IoT is revolutionizing.

Course Content:

UNIT I

Introduction to Internet of Things (IoT): What is IoT? - IoT and Digitization, IoT Impact – Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures, IoT Challenges, IoT and M2M, The IoT World Forum (IoTWF) Standardized Architecture, IoT Data Management and Compute Stack – Design considerations and Data related problems, Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud.

UNIT II

Things in IoT: Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications, Actuators – Definition, Principles, Classifications, Types, Characteristics and Specifications, Smart Object – Definition, Characteristics and Trends, Sensor Networks – Architecture of Wireless Sensor Network, Network Topologies, Enabling IoT Technologies - Radio Frequency Identification Technology, MicroElectro-Mechanical Systems (MEMS), NFC (Near Field Communication), Bluetooth Low Energy (BLE), LTE-A (LTE Advanced), IEEE 802.15.4– Standardization and Alliances, ZigBee.

UNIT III

The Core IoT Functional Stack: Layer 1 – Things: Sensors and Actuators Layer, Layer 2 – Communications Network Layer, Access Network Sublayer, Gateways and Backhaul Sublayer, Network Transport Sublayer, IoT Network Management Sublayer, Layer 3 – Applications and Analytics Layer, Analytics Vs. Control Applications, Data Vs. Network Analytics, Data Analytics Vs. Business Benefits, Smart Services.

UNIT IV

Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods, Application Layer Protocol Not Present, SCADA, Generic Web-Based Protocols, IoT Application Layer Protocols – CoAP and MQTT

Create your own IoT: IoT Hardware - Arduino, Raspberry Pi, ESP32, Cloudbit/Littlebits, Particle Photon, Beaglebone Black, IoT Software - Languages for Programming IoT Hardware, IoT Middleware Applications and API Development, Amazon Web Services for IoT, Making Front Ends, REST and JSON-LD.

UNIT V

Domain Specific IoTs: Home Automation – Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy – Smart Grids, Renewable Energy Systems, Prognostics, Retail – Inventory Management, Smart Payments, Smart Vending Machines, Logistics – Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Agriculture – Smart Irrigation, Green House Control, Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring, Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics.

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, ***"IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things"***, 1st Edition, Pearson Education, Inc, Cisco Press, 2017.
2. Hakima Chaouchi, ***"The Internet of Things - Connecting Objects to the Web"***, 1st Edition, Wiley, 2010.
3. Perry Lea, ***"Internet of things For Architects"***, 1st Edition, Packt Publication, 2018.
4. Arshdeep Bahga, Vijay Madisetti, ***"Internet of Things – Hands-On Approach"***, 2nd Edition, Universities Press, 2016.

Reference Books:

1. Adrian McEwen & Hakim Cassimally, ***"Designing the Internet of Things",*** 1st Edition, Wiley, 2014.
2. Donald Norris, ***"Raspberry Pi – Projects for the Evil Genius"***, 2nd Edition, McGraw Hill, 2014.
3. Anand Tamboli, ***"Build Your Own IoT Platform"***, 1st Edition, Apress, 2019.

Course Title:	**Mobile Computing**	**Semester**	**VIII**
Course Code	**BTITC802**	**Course Type**	**Compulsory**
Prerequisite	**Internetworking Protocols , Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Core**	**Credits**	**3**

Course Objectives:

1. To describe the basic concepts and principles in mobile computing.
2. To understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks.
3. To explain the structure and components for Mobile IP and Mobility Management.
4. To understand positioning techniques and location-based services and applications.
5. To describe the important issues and concerns on security and privacy.
6. To design and implement mobile applications to realize location-aware computing.
7. To design algorithms for location estimations based on different positioning techniques and platforms.
8. To acquire the knowledge to administrate and to maintain a Wireless LAN.

Course Outcomes:

After learning the course, the students should be able:

1. To describe wireless and mobile communications systems.
2. To choose an appropriate mobile system from a set of requirements.
3. To work around the weaknesses of mobile computing.
4. To interface a mobile computing system to hardware and networks.
5. To program applications on a mobile computing system and interact with servers and database systems.

Course Content:

UNIT I

Fundamentals of Wireless and basics of wireless network: Digital communication, Wireless communication system and limitations, Wireless media, Frequency spectrum, Technologies in digital wireless communication, Wireless communication channel specification, Wireless network, Wireless switching technology, Wireless communication.

UNIT II

Mobile Communications and Computing: An Overview Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination, Mobility Management, Security, Hand-held Pocket Computers, Hand-held Devices: Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems.

UNIT III

GSM and other architectures: GSM-Services and System Architectures, Radio Interfaces, Protocols Localization, Calling, Handover, Security, New Data Services, modulation, Multiplexing, Controlling the medium access, Spread spectrum, Coding methods, CDMA, IMT 2000, WCDMA and CDMA 2000, 4G Networks.

UNIT IV

Mobile Network and Transport Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route optimization, Dynamic Host Configuration Protocol, Mobile Transport Layer, Conventional TCP/IP Transport Layer Protocol, Indirect TCP, Snooping TCP, Mobile TCP, Mobile Ad-hoc Networks (MANET), Routing and Routing Algorithms in MANET, Security in ad-hoc networks.

UNIT V

Data Dissemination and Data Synchronization in Mobile Computing: Communication Asymmetry, classification of data delivery mechanism, data dissemination broadcast models, selective tuning and indexing techniques, synchronization, synchronization software for mobile devices, synchronization protocols.

Text Books:

1. Raj Kamal, ***"Mobile Computing",*** Oxford University Press-New Delhi, 2nd Edition.
2. Dr. Sunil kumar S. Manavi, Mahabaleshwar S. Kakkasageri, ***"Wireless and Mobile Networks, Concepts and Protocols"***, Wiley, India.

Reference Books:

1. Mark Ciampa, ***"Guide to Designing and Implementing wireless LANs"***, Thomson learning, Vikas Publishing House, 2001.
2. Ray Rischpater, ***"Wireless Web Development"***, Springer Publishing.
3. Sandeep Singhal, ***"The Wireless Application Protocol"***, Pearson Publication.
4. P. Stavronlakis ***"Third Generation Mobile Telecommunication Systems"***, Springer Publishers.

Course Title:	**Project Phase II/ Project with Internship**	**Semester**	**VIII**
Course Code	**BTITP803**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 24**
Stream	**Core**	**Credits**	**12**

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 powerpoint 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 II

1. Coding/Implementation.
2. Use cases.
3. Testing/Troubleshooting.
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.

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Course Structure and Detailed Syllabus
for

Third Year
B. Tech. Programme in Information Technology
(Effective from Academic Year 2022-23)

Third Year B. Tech. Information Technology Syllabus (With effect from 2022-23)

	Semester V									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	T	P	CA	MSE	ESE	Total	Credits
PCC	BTITC501*	Software Engineering	3	1	-	20	20	60	100	4
PCC	BTITC502	Computer Networks and Internetworking Protocols	3	1	-	20	20	60	100	4
PEC		**Elective- II**	3	-	-	20	20	60	100	3
	BTITPE503A	Embedded Systems								
	BTITPE503B	IT Service Management								
	BTITPE503C	Information Storage Management								
	BTITPE503D	Network Management								
	BTITPE503E	Data Visualization								
	BTITPE503F	Virtual Reality								
OEC		**Elective- III**	3	-	-	20	20	60	100	3
	BTITOE504A	Theory of Computation								
	BTITOE504B	Graph Theory								
	BTITOE504C	Programming in Java								
	BTITOE504D	Human Computer Interaction								
	BTITOE504E	Game Theory								
	BTITOE504F	3D Printing and Design								
LC	BTITL505	Computer Networks and Internetworking Protocols Lab	-	-	2	60	-	40	100	1
LC	BTITL506	Software Engineering and Elective- II Lab	-	-	4	60	-	40	100	2
Project	BTITP507	Mini Project - I	-	-	4	60	-	40	100	4
Internship	BTITF508	Internship – II Evaluation	-	-	-	-	-	-	-	Audit
			12	**2**	**10**	**260**	**80**	**360**	**700**	**21**
Semester VI										
PCC	BTITC601*	Operating Systems	3	1	-	20	20	60	100	4
PCC	BTITC602	Database Management Systems	3	1	-	20	20	60	100	4
PEC		**Elective- IV**	3	-	-	20	20	60	100	3
	BTITPE603A	Software Testing								
	BTITPE603B	Data Storage Technologies & Networks								
	BTITPE603C	Service Oriented Architecture								
	BTITPE603D	Network Programming								
	BTITPE603E	Data Warehousing & Data Mining								

OEC	BTITOE604A BTITOE604B BTITOE604C BTITOE604D BTITOE604E	**Elective- V** Compiler Design Enterprise Resource Planning Decision Support Systems Software Project Management Introduction to Data Science	3	-	-	20	20	60	100	3
LC	BTITL605	Database Management Systems Lab	-	-	2	60	-	40	100	1
LC	BTITL606	Operating Systems and Elective-IV Lab	-	-	4	60	-	40	100	2
Project	BTITP607	Mini Project - II	-	-	4	60	-	40	100	4
Internship	Internship- III	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in fifth semester and sixth semester or at one time).	-	-	-	-	-	-	-	To be audited in VII Sem.
			12	**2**	**10**	**260**	**80**	**360**	**700**	**21**

***** *These courses are to be studied on self –study mode using SWAYAM/NPTEL/Any other source.*

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Course Title:	**Software Engineering**	**Semester**	**V**
Course Code	**BTITC501**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**3 – 1 – 0**
Stream	**Core**	**Credits**	**4**

Course Objectives:

1. To understand software life cycle development models.
2. To understand and apply Software Requirements Engineering Techniques, Software design principles, modeling and Software testing techniques.
3. To understand the use of metrics in Software Engineering.
4. To understand Software Project Management.

Course Outcomes:

After learning the course, the students should be able:

1. To use the techniques, skills, and Modern Engineering tools necessary for Engineering practice.
2. To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3. To identify, formulate and solve Engineering Problems.

Course Contents:

UNIT I

Software Development Process: Software crisis and myths, Software process and development: Generic view of process, Software life cycle and models, Analysis and comparison of varies models, an agile view of process, Requirement Engineering: Requirements engineering tasks, Initiating requirement engineering process, Eliciting requirement, developing use-cases.

UNIT II

Building the analysis model, Negotiating and validating requirement, System Design Overview: Design process and design quality, Design concepts, Design model, Pattern based software design, Architectural design, User interface design. UML: Different methods: Rumbaugh / Booch / Jacobson, Need for standardization, Developing diagrams in UML (Use CASE, Class, Interaction, State diagrams).

UNIT III

Validation and Testing: Strategic approach to Software testing, Strategic issues, Test strategies for conventional software, Validation testing, System testing, Debugging, White box testing and Black box testing.

UNIT IV

Planning of Project: Project management, Metrics for process and projects, Estimation, Project scheduling.

UNIT V

Management of Project: Risk management, Importance of software quality and measurements, software engineering techniques for quality assurance, and Change management.

Text Books:

1. Roger S. Pressman, "***Software Engineering***", Tata McGraw-Hill, 7th Edition, 2018.
2. G. Booch, J. Rumbaugh, and I. Jacobson, "***The Unified Modeling Language User Guide***", Addison Wesley, 2nd Edition, 2005.

Reference Books:

1. Shari Pfleeger, "***Software Engineering***", Pearson Education, 4th Edition, 2012.
2. Ian Sommerville, "***Software Engineering***", Pearson Higher Education, 10th Edition, 2017.
3. Pankaj Jalote, "***An Integrated Approach to Software Engineering***", Springer New York, 2nd Edition, 2012.

Course Title:	**Computer Networks and Internetworking Protocols**	**Semester**	**V**
Course Code	**BTITC502**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**3 – 1 – 0**
Stream	**Core**	**Credits**	**4**

Course Objectives:

1. To understand the basic concepts of Computer Networks.
2. To Understand Network Layer and Applications.
3. To learn UDP and TCP applications.
4. To learn Transport Layer Reliability.

Course Outcomes:

After learning the course, the students should be able:

1. To compare and contrast TCP and UDP in terms of the application that uses them.
2. To design network-based applications using the socket mechanism.
3. To work with IPv4 addresses in terms of subnetting and supernetting.
4. To setup a host and network in terms of IP Addressing.
5. To trace the flow of a network packet over internet.
6. To design a network with subnets as specified.

Course Contents:

UNIT I

Introduction to Computer Networks and Underlying Technologies: Birth of the Internet, The Internet today, World Wide Web, Growth of the Internet, Protocols and Standards, Internet Standards, Internet Administration.

The OSI Model and the TCP/IP Protocol Suite:

Protocol Layers: Hierarchy Services, The OSI Model: Layered Architecture , Layer-to-Layer Communication, Encapsulation, Layers in the OSI Model, TCP/IP Protocol Suite: Comparison between OSI and TCP/IP Protocol Suite, Layers in the TCP/IP Protocol Suite, Addressing: Physical addresses, Logical addresses, Port addresses, Application-specific addresses, Wired Local Area Networks: IEEE Standard, Frame format, Addressing, Ethernet evolution, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Ten-Gigabit Ethernet.

UNIT II

Wireless LANS: IEEE standard, MAC Sublayer, Addressing Mechanism, Bluetooth, Point-to-Point WANs, Connecting devices: Repeaters, Bridges and Routers.

Introduction to Network Layer: Packet switching, Circuit switching, Packet switching at Network Layer, Network Layer Services, Other Network Layer Issues. IPv4 Addresses, Address Space Notation, Range of Addresses, Operations, Classful Addressing, Subnetting, Supernetting, Classless Addressing: Variable-Length Blocks, Two-Level Addressing, Block Allocation, Special Blocks, Special Addresses.

UNIT III

Delivery and Forwarding of IP Packets: Direct Delivery, Indirect Delivery, Forwarding, Structure of a Router, Components.
Internet Protocol Version 4(IPv4): Datagrams, Fragmentation, Maximum Transfer Unit (MTU), Fields Related to Fragmentation, Options: Format, Option Types, Checksum Calculation, IP Package.
Address Resolution Protocol (ARP): Address Mapping: Static Mapping, Dynamic Mapping, The ARP Protocol, ARP Package.
Internet Control Message Protocol (ICMP): Messages, Message Format, Error Reporting Messages, Query Messages, Checksum, Debugging Tools, ICMP Package.

UNIT IV

Introduction to Transport Layer: Transport-Layer Services, Process-to-Process communication, Addressing, Flow Control, Error Control, Congestion Control, Connectionless and Connection-Oriented Services.
User Datagram Protocol (UDP): User Datagram, UDP Services, Process-to-Process Communication, Connectionless Services, Flow Control, Error Control, UDP Applications, UDP Features, UDP Package.

UNIT V

Transmission Control Protocol (TCP): TCP Services, Process-to-Process Communication, Stream Delivery Service, Full-Duplex Communication, Multiplexing and Demultiplexing, Connection-Oriented Service, Reliable Service, TCP Features, Segment, Format, Encapsulation, A TCP Connection, State Transition Diagram, Scenarios, Windows in TCP, Flow Control, Silly Window Syndrome, Error Control, Data Transfer in TCP, Some Scenarios, Congestion Control, TCP Timers, TCP Package.

Text books:

1. Douglas E. Comer, "***Internetworking with TCP/IP: Principles, Protocols and Architecture***",Volume 1, 6th Edition, PHI publication, 2013.
2. Behrouz A. Forouzan, "***TCP-IP Protocol Suite***", 4th Edition, McGraw Hill publication, 2010.
3. A. S. Tanenbaum, "***Computer Networks***", 6th Edition, Pearson publication, 2022.

Reference books:

1. Comer, "***Internetworking with TCP-IP***", Volume 3, 6th Edition, Pearson publication, 2013.
2. W. Richard Stevens, "***UNIX Network Programming: Interprocess Communications***", Volume 2, 2nd Edition, PHI publication, 2002.
3. William Stalling, "***SNMP, SNMPv2, SNMPv3, and RMON 1 and 2***", 3rd Edition, Pearson education publication, 2006.
4. Hunt Craig, "***TCP-IP Network Administration***", 3rd Edition, O'Reilly publication, 2002.

Course Title:	**Embedded Systems**	**Semester**	**V**
Course Code	**BTITPE503A**	**Course Type**	**Elective**
Prerequisite	**Microprocessor & Microcontroller**	**L – T – P**	**3 – 0 – 0**
Stream	**Software Application and Development**	**Credits**	**3**

Course Objectives:

1. To understand the fundamental concepts in Embedded Systems.
2. To learn Real Time Operating Systems.
3. To get acquainted with hardware & interfaces.
4. To know Embedded System Design Techniques.

Course Outcomes:

After learning the course, the students should be able:

1. To demonstrate & explain embedded systems hardware & software components.
2. To define embedded systems using real time operating system – VxWorks/ μCOS II RTOS.
3. To design & develop embedded applications using C language.
4. To apply design techniques in real-life application.

Course Contents:

UNIT I

Introduction: Introduction to embedded systems overview, design challenges, common design metrics, processor technology, IC technology, Design technology. Design productivity gap.

ARM Architecture: ARM 7 processor fundamentals, memory management, ARM processor family, Instruction set & interfacing. Introduction to ASIPS, Microcontrollers and DSP.

UNIT II

Devices and Interfacing: Processor interfacing, Arbitration, Multilevel bus architecture. Basic protocol concepts: serial protocols, I2C,CAN, Firewire and USB, Parallel protocols, PCI bus, ARM bus, Wireless protocols: IrDA, Bluetooth, IEEE 802.11, Device Driver programming.

UNIT III

Programming concepts: State m/c & concurrent process model, FSM m/c, FSMD, PSM model & concurrent process model, Scheduling process, Data flow model, Embedding programming in C++, JAVA and program modeling concepts.

UNIT IV

Real Time OS: OS services, Process management, Memory management device, File &IO subsystem management, Interrupt routines in RTOS, RTOS task scheduling models, Securities issues, RTOS mCOS-II & RTOS VxWorks.

UNIT V

Design Examples and Case Studies: Personal Digital Assistants, Digital thermometer, Case Studies of digital camera, Smart card, Case study of coding for sending application layer byte stream on TCP/IP network using RTOS VxWorks.

Text Books:

1. Raj Kamal, ***"Embedded Systems Architecture, Programming and Design"***, McGraw Hill Publication, 3rd Edition, 2017.
2. Frank Vahid/Tony Givargis, ***"Embedded Systems Design"***, Wiley, 2002.
3. Andrew N. Sloss, ***"ARM System Developers Guide"***, ELSEVER Publication, 1st Edition, 2004.

Reference Books:

1. Wayne Wolf, ***"Computer as Components – Principles of Embedded Computing System Design"***, Morgan Kaufmann, 2005.
2. David E Simon, ***"An Embedded Software Primer"***, Addison Wesley Publication, 1st Edition, 2004.

Course Title:	**IT Service Management**	**Semester**	**V**
Course Code	**BTITPE503B**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure & Security Management**	**Credits**	**3**

Course Objectives:

1. To introduce practical implementation of Information Technology Service Management (ITSM).
2. To understand how an integrated ITSM framework can be utilized to achieve IT business integration, cost reductions and increased productivity.
3. To learn the best practices of ITSM methodology.

Course Outcomes:

After learning the course, the students should be able:

1. To identify IT services as a means to provide functionality and value to customers.
2. To describe the needs and targets of the different stakeholders (service providers, customers, suppliers/partners) in the services value chain.
3. To demonstrate the value of a service management framework.
4. To explain the service management processes for given customers.
5. To select the appropriate tools to support a given designed service management solution.

Course Contents:

UNIT I

IT Infrastructure: Introduction, Challenges in IT Infrastructure Management, Design Issues of IT Organizations and IT Infrastructure, IT System Management Process, IT Service Management Process, Information System Design Process.

UNIT II

Service Delivery Process: Service Level Management, Financial Management, IT Service Continuity Management, Capacity Management & Availability Management.

Service Support Process: Configuration Management, Incident Management, Problem Management, Change Management & Release Management.

UNIT III

Storage Management: Storage, Backup, Archive and Retrieve, Disaster Recovery, Space Management, Database and Application Protection and Data Retention.

UNIT IV

Security Management: Computer Security, Internet Security, Physical Security, Identity Management, Access Control System and Intrusion Detection.

UNIT V

Case Studies on how IT Service Management and ITIL processes make IT efficient and save cost for organizations.

Text Book:

1. Phalguni Gupta, Surya Prakash and Umarani Jayaraman, ***"IT Infrastructure & Its Management"***, Tata McGraw-Hill Education, 2009.

Reference Books:

1. W. Ronald Hudson, Ralph C. G. Haas, Waheed Uddin, ***"Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation"***, McGraw-Hill, 1997.

2. Anita Sengar, ***"IT Infrastructure Management"***, S. K. Kataria and Sons, 2nd Edition, 2009.

Course Title:	**Information Storage Management**	**Semester**	**V**
Course Code	**BTITPE503C**	**Course Type**	**Elective**
Prerequisite	**Computer Architecture & Organization**	**L - T - P**	**3 – 0- 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

1. To evaluate storage architecture, understand logical and physical components of storage Infrastructure including storage subsystems.
2. To describe Storage Networking Technologies such as FC-SAN, NAS, IP-SAN and data archival solution–CAS.
3. To identify different Storage Virtualization Technologies and their benefits.
4. To understand and articulate business continuity solutions including backup, recovery technologies and local, remote replication solutions.
5. To define Information security and storage security domains and identify parameters of managing and monitoring Storage Infrastructure. Also describe common storage management activities and solutions.

Course Outcomes:

After learning the course, the students should be able:

1. To describe and apply storage technologies.
2. To identify leading Storage Technologies that provides cost-effective IT solutions for medium to large scale businesses and data centers.
3. To describe important Storage Technologies' features such as availability, replication, scalability and performance.
4. To design, analyze and manage clusters of resources.

Course Contents:

UNIT I

Introduction to Information Storage Management: Intelligent Storage System (ISS) and its components Implementation of ISS as high-end and midrange storage-arrays, Direct Attached Storage - Introduction to SCSI.

Introduction to parallel SCSI, SCSI Command Model - Storage Area Networks - Fiber Channel Connectivity, Login types, Topologies.

UNIT II

Storage Networking Technologies: Network Attached Storage- General purpose servers vs. NAS Devices - Benefits of NAS, NAS File I/O - NAS Components, Implementation, File Sharing protocols, I/O operations - IPSAN-ISCSI, Components of ISCSI- Content-Addressed Storage.

UNIT III

Storage Virtualization: Fixed Content and Archives, Types, Features, Benefits, CAS Architecture, object storage and Retrieval, examples - Storage Virtualization - forms of virtualization, SNIA Taxonomy - Storage virtualization configurations, challenges, Types of storage virtualization, Business

Continuity- Overview of emerging technologies such as Cloud storage, Virtual provisioning, Unified Storage, FCOE, FAST.

UNIT IV

Business Continuity and Recovery: Information Availability, BC Terminology, Life cycle, Failure analysis - Backup and Recovery- Backup purpose, considerations, Backup Granularity, Recovery considerations- Backup methods, process, backup and restore operations, Overview of emerging technologies - duplication, offsite backup.

UNIT V

Storage Security and Management: Storage security framework, Securing the Storage Infrastructure Risk triad - Managing the storage infrastructure, Monitoring the storage infrastructure, Identify key parameters and components to monitor in a storage infrastructure List key management activities and examples define storage management standards and initiative-Industry trend.

Text Book:

1. EMC Corporation, ***"Information Storage and Management"*** *by* Somasundaram Gnanasundaram, Alok Shrivastava, Wiley India, 2nd Edition, 2012.

Reference Books:

1. IBM, "***Introduction to Storage Area Networks and System networking"***, 5th edition, 2012.
2. Robert Spalding, "***Storage Networks: The Complete Reference"***, Tata McGraw Hill, Osborne, 6th reprint 2003.
3. Marc Farley, "***Building Storage Networks"***, Tata McGraw Hill, Osborne, 1st Edition, 2001.
4. Tom Clark, "***Designing Storage Area Networks -A Practical Reference for Implementing Fiber Channel and IP SANs",*** Tata McGraw Hill 2003, 2nd edition.

Course Title:	**Network Management**	**Semester**	**V**
Course Code	**BTITPE503D**	**Course Type**	**Elective**
Prerequisite	**Computer Networks & Internetworking Protocols**	**L – T – P**	**3 – 0– 0**
Stream	**Network**	**Credits**	**3**

Course Objectives:

1. To understand the principles of network management, different standards and protocols used in managing complex networks.
2. To understand the automation of network management operations and making use of readily available network management systems.

Course Outcomes:

After learning the course, the students should be able:

1. To acquire the knowledge about network management standards (OSI and TCP/IP).
2. To acquire the knowledge about various network management tools and the skill to use them in monitoring a network.
3. To analyze the challenges faced by Network Managers.
4. To evaluate various commercial Network Management Systems and Open Network Management Systems.
5. To analyze and interpret the data provided by an NMS and take suitable actions.

Course Contents:

UNIT I

Data communication and network management overview: Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.

SNMPV1 Network Management Organization and Information Models, Managed network, Managed network: Case Histories and Examples.

UNIT II

The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The Information Model.

SNMPV1 Network Management Communication and Functional Models: The SNMP Communication Model, Functional model. SNMP MANAGEMENT SNMPv2: Major Changes in SNMPv2, SNMPv2 System architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility with SNMPv1.

SNMP MANAGEMENT RMON: What is Remote Monitoring? RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, Case Study of Internet Traffic Using RMON.

UNIT III

Telecommunication Management Network: Why TMN? Operations Systems, TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, TMN Integrated View, Implementation.

UNIT IV

Network management tools and systems: Network Management Tools, Network Statistics Measurement Systems, Network Management systems, Commercial Network Management Systems.

UNIT V

Web-Based Management: NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network, Future Directions. Case Studies.

Text Book:

1. Mani Subrahmanian, ***"Network Management Principles and Practice"***, Pearson Education, 2nd Edition, 2010.

Reference Books:

1. Morris, ***"Network Management"***, Pearson Education, 1st Edition, 2008.
2. Mark Burges, ***"Principles of Network System Administration"***, Wiley DreamTech, 1st Edition, 2008.

Course Title:	**Data Visualization**	**Semester**	**V**
Course Code	**BTITPE503E**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0– 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. To understand various steps in data visualization.
2. To read data from different file formats such as .csv, .xlsx, JSON, .txt etc. in to the data frames.
3. To learn the nature of data and its domains and the concepts and skills of data visualization by understanding, questioning, and problematizing how data are generated, analysed, and used.
4. To learn time series data and its visualization.
5. To understand basic and advance chart types used in data visualization.

Course Outcomes:

After learning the course, the student will be able:

1. To list out various stages of the data visualization.
2. To identify/choose suitable data for the specific data visualization problem.
3. To plot useful plots/charts for data visualization problem under consideration.
4. To interpret the finding from different types of charts/graphs.
5. To select the right graph/chart to review datasets.

Course Contents:

UNIT I

The seven stages of Data Visualization: Why data display requires planning, example, Iteration and Combination, Principles. Getting Started with Processing: Sketching with processing, Example and Distributing your work, Examples and references, Functions, Sketching and Scripting
Mapping: Drawing a Map, Locations on map, Data on Map, Using your own data, Next step.

UNIT II

Types of Digital Data: Data abstraction, Store, Classification of Digital Data, Structured versus Unstructured Data. Reading Data from Varied Data Sources into Python Data Frame: Read from Excel Data Source, Read Data from .csv, load a Python Dictionary into a Data Frame, Reading JSON data into a Pandas Data Frame, Reading Data from Microsoft Access Database, Reading Data from .txt File, Reading Data from XML File.

UNIT III

Pros and Cons of Charts: Pie Chart, Tree Map, Heat Map, Scatter Plot, Histogram, Word Cloud, Box Plot, chart chooser. Good Chart Designs: Mistakes That Can Be Avoided, Less Is More, Tables versus Charts. Animated bar char race, interactivity in plots.

UNIT IV

Data Wrangling in Python: Pandas Data Manipulation, Dealing with Missing Values, Date Reshaping, Filtering Data Merging Data, Subsetting Data Frames in Pandas, Reshaping the Data and Pivot Tables Backfill, Forward Fill. Functions in Python Pandas: Pandas DataFrame Functions, Pandas Correlations, Pandas DataFrame All Method. Matplotlib for Data Visualization: Exploratory Data Analysis using Python, Matplotlib.

UNIT V

Plotly for Data Visualization: Plotly Python Package, Seaborn for Data Visualization, Seaborn Plots Using “iris” Dataset, Seaborn Plots Using “Superstore” Dataset, Seaborn Plots Using “OLYMPIC” Dataset, Seaborn Plots Using “Passengers Flights” Dataset. Time series and spatial data visualization, stock market data visualization.

Text Book:

1. Seema Acharya***,”Reimagining Data Visualization using Python”,*** Wiley Publication, 2022.
2. Ben Fry, ***“Visualizing Data: Exploring and Explaining data with Processing Environment”***, Shroff/O’Reilly Media, 2016.

Reference Books:

1. Scott Murray, ***“Interactive Data Visualization for the web”***, Shroff/O’Reilly Media, 2016.
2. Tamara Munzner, “Visualization Analysis and Design”, CRC Press, 2014.
3. Julia Steele, Noah Lliinsky, ***“Designing Data Visualizations”***, Shroff/O’Reilly Media, 2012.
4. Kyran Dale, ***“Data Visualization with Python and JavaScript: Scrape, Clean, Explore &Transform your data”***, Shroff/O’Reilly Media, 2016.
5. Julia Steele, Noah Lliinsky, ***“Beautiful Visualization”***, Shroff/O’Reilly Media, 2016.

Course Title:	**Virtual Reality**	**Semester**	**V**
Course Code	**BTITPE503F**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0– 0**
Stream	**---**	**Credits**	**3**

Course Objective:

1. To provide a detailed understanding of the concepts of Virtual Reality.

Course Outcomes:

After learning the course, the student will be able:

1. To understand geometric modeling and Virtual environment.
2. To study about Virtual Hardware and Software.
3. To develop Virtual Reality applications.

Course Contents:

UNIT I

Introduction to Virtual Reality: Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

3D Computer Graphics: Introduction, 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 II

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

UNIT III

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

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

UNIT IV

VR Hardware and Software: Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

UNIT V

VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction.

Text Books:

1. John Vince, "***Virtual Reality Systems***", Pearson Education Asia, 2007.
2. Anand R., "***Augmented and Virtual Reality***", Khanna Publishing House, Delhi.
3. Adams, "***Visualizations of Virtual Reality***", Tata McGraw Hill, 2000.
4. Grigore C. Burdea, Philippe Coiffet ,"***Virtual Reality Technology***", Wiley Inter Science,2nd Edition, 2006.
5. William R. Sherman, Alan B. Craig, "***Understanding Virtual Reality: Interface, Application and Design***", Morgan Kaufmann, 2008.

Course Title:	**Theory of Computation**	**Semester**	**V**
Course Code	**BTITOE504A**	**Course Type**	**Elective**
Prerequisite	**Discrete Mathematics, Data Structure & Applications**	**L – T – P**	**3 – 0– 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To understand problem classification and problem solving by machines.
2. To understand the basics of automata theory and its operations.
3. To study and compare different types of computational models.
4. To encourage students to study theory of computability and complexity.
5. To understand the P and NP class problems and its classification.
6. To understand the fundamentals of problem decidability and reducibility.

Course Outcomes:

After learning the course, students should be able:

1. To construct finite state machines to solve problems in computing.
2. To write mathematical expressions for the formal languages.
3. To apply well defined rules for syntax verification.
4. To construct and analyse Push down Automata and Turing Machine for formal languages.
5. To express the understanding of the decidability and decidability problems.
6. To express the understanding of computational complexity.

Course Contents:

UNIT I

Finite State Machines and Automata theory: Symbols, Strings, Language, Formal Language, Natural Language, Basic Machine and Finite State Machine. Definition and Construction-DFA, NFA, NFA with epsilon-Moves, Minimization Of FA, Equivalence of NFA and DFA, Conversion of NFA with epsilon moves to NFA, Conversion of NFA with epsilon moves to DFA, FSM with output.

UNIT II

Regular Expressions: Definition and Identities of Regular Expressions, Construction of Regular Expression of the given L, Construction of Language from the RE, Construction of FA from the given RE using direct method, Conversion of FA to RE using Arden's Theorem, Pumping Lemma for RL, Closure properties of RLs, Applications of Regular Expressions..

UNIT III

Context free Grammar: Introduction, Formal Definition of Grammar, Notations, Derivation Process: Leftmost Derivation, Rightmost Derivation, derivation trees, Context Free Languages, Ambiguous CFG, Removal of ambiguity, Simplification of CFG, Normal Forms, Chomsky Hierarchy, Regular grammar, equivalence of RG (LRG and RLG) and FA.

UNIT IV

Push down Automata: Introduction and Definition of PDA, Construction (Pictorial/ Transition diagram) of PDA, Instantaneous Description and Acceptance of CFL by empty stack and final state, Deterministic PDA Vs Nondeterministic PDA, Closure properties of CFLs, pumping lemma.

UNIT V

Turing Machine: Formal definition of a Turing machine, Recursive Languages and Recursively Enumerable Languages, Design of Turing machines, Variants of Turing Machines: Multi-tape Turing machines, Universal Turing Machine, Nondeterministic Turing machines. Comparisons of all automata. Undecidability and Computational Complexity.

Text Books:

1. Michael Sipser, "***Introduction to the Theory of Computation",*** CENGAGE Learning, 3rd Edition, 2014.
2. Vivek Kulkarni, ***"Theory of Computation",*** Oxford University Press, 2013.

Reference Books:

1. Hopcroft Ulman, "***Introduction to Automata Theory"***, Languages and Computations, Pearson Education Asia, 3rd Edition, 2006.
2. DanielI A. Cohen, ***"Introduction to Computer Theory"***, Wiley-India, 2nd Edition, 1996.
3. K.L.P Mishra, N. Chandrasekaran, ***"Theory of Computer Science (Automata, Languages and Computation)"***, Prentice Hall India, 3rd Edition, 2006.

Course Title:	**Graph Theory**	**Semester**	**V**
Course Code	**BTITOE504B**	**Course Type**	**Elective**
Prerequisite	**Discrete Structures and Applications**	**L – T – P**	**3 – 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To understand and apply the fundamental concepts in graph theory.
2. To apply graph theory based tools in solving practical problems.
3. To improve the proof writing skills.

Course Outcomes:

After learning the course, the students should be able:

1. To solve problems using basic graph theory.
2. To identify induced sub graphs, cliques, matchings, covers in graphs.
3. To determine whether graphs are Hamiltonian and/or Eulerian.
4. To solve problems involving vertex and edge coloring.
5. To model real world problems using graph theory.

Course Contents:

UNIT I

Basics- Graphs, Degree sequences, Distance in graphs, Complete, Regular and bipartite graphs, Basic properties. Structure and Symmetry- Cut vertices, Bridges and blocks, Automorphism groups, Reconstruction problem.

UNIT II

Trees and connectivity - Properties of trees, Arboricity, Vertex and edge connectivity, Mengers theorem.

UNIT III

Eulerian and Hamiltonian graphs – Characterization of Eulerian graphs, Sufficient conditions for Hamiltonian graphs.

UNIT IV

Colouring and planar graphs - Vertex and edge colouring, Perfect graphs, Planar graphs, Euler's theorem, Kuratowski's theorem, Colouring of planar graphs, Crossing number and thickness.

UNIT V

External Graph theory - Turan's theorem, Ramsey's theorem, Szemeredi's regularity lemma, applications.

Text Books:

1. J. A. Bondy, U. S. R. Murthy, ***"Graph Theory"***, Springer; 1st Corrected ed. 2008, Corrected 3rd printing 2008 ed. (27 September 2011).
2. D. B. West, ***"Introduction to Graph Theory"***, Pearson Education India, 2nd edition,1st January 2015.

Reference Book:

1. Reinhard Diestel, "***Graph Theory"***, Springer Verlag, 5th Edition, 2017.

Course Title:	**Programming in Java**	**Semester**	**V**
Course Code	**BTITOE504C**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3– 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
2. To understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
3. To be able to use the Java SDK environment to create, debug and run simple Java programs.

Course Outcomes:

After learning the course, the students should be able:

1. To know the structure and model of the Java programming language.
2. To use the Java programming language for various programming technologies.
3. To develop software in the Java programming language (application).

Course Contents:

UNIT I

Introduction to Java: Fundamentals of Object-oriented Programming, Evolution of Java, Overview of Java Language: Data types in Java, Operators and expressions, Decision Making and Branching: Control Statements such as If Else, Do statement, For statement, The Else if ladder, Jumps in loops, Labelled loops, While repetition statement, Switch statement, Break and continue statement, Arrays, Strings and Vectors: Creating one dimensional and multidimensional array, Strings, Vectors, Wrapper classes, Enumerated types, Annotations.

UNIT II

Object Oriented Programming: Classes, Objects and Methods: Defining class, Methods, Creating objects, Accessing Class members, Static Methods, Finalize Methods, Visibility Control, Method overloading, Method Overriding, Recursion. Interfaces, Constructors and finalizes Methods.
Packages and Applet Programming: Java API Packages, Using System Packages, Naming conventions, Creating Packages and Jar Files, Accessing and using a package, Hiding Classes, Applet Programming.

UNIT III

Multithreading: Creating threads, Extending thread class, Stopping and Blocking a thread, Life cycle of a thread, Using thread method, Thread exceptions, Implementing the Run able interface, Inter thread communication. Managing Errors and Exceptions: Types of errors, Exceptions, Syntax of exception handling code, Multiple catch statements, Throwing your own exception, Using exceptions for debugging.

UNIT IV

Graphics Programming: The Graphics class, Lines and Rectangles, Circles, Arc and ellipses, Polygons, Drawing Bar charts, AWT Package and Swings.

UNIT V

Managing Files & I/O Handling: Files and Streams, Stream classes, Byte Stream Classes, Character Stream Classes, Using Streams, Reading / writing bytes and characters, Interactive Input and Output, Other Stream classes.

Text Books:

1. E. Balagurusamy, **"*Programming with Java – A Primer*"**, Tata McGraw-Hill Publication, 6th Edition, 2019.
2. Steven Holzner et al. **"*Java 2 Programming*"**, Black Book, Dreamtech Press, 2009.

Reference Books:

1. H.M. Deitel, P.J. Deitel, **"*Java - How to Program*"**, PHI Publication, 6th Edition, 2005.
2. Bruce Eckel, **"*Thinking in Java*"**, Pearson, 2008.
3. Tim Lindholm, Frank Yellin, Bill Joy, Kathi Walrath, **"*The Java Virtual Machine Specification*"**, Addison Wesley Publication, 8th Edition, 2014.

Course Title:	**Human Computer Interaction**	**Semester**	**V**
Course Code	**BTITOE504D**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

Upon successful completion of this course, students should be able:

1. To design, implement and evaluate effective and usable graphical computer interfaces.
2. To describe and apply core theories, models and methodologies from the field of HCI.
3. To describe and discuss current research in the field of HCI.
4. To implement simple graphical user interfaces using the Java Swing toolkit.
5. To describe special considerations in designing user interfaces for older adults.

Course Outcomes:

After learning the course, the students should be able:

1. To describe and apply core theories, models and methodologies from the field of HCI.
2. To describe what the user-centred design cycle is and explain how to practice this approach to design interactive software systems.
3. To analyze the main features of interactive systems, and explain how to gauge the usability of digital environments, tools and interfaces.

Professional Skills:

1. Conduct user and task analysis.
2. Implement graphical user interfaces with modern software tools.
3. Critique and evaluate interactive software using guidelines from human factor theories.

Course Contents:

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Text Books:

1. Alan Dix, Janet Finlay, ***"Human Computer Interaction"***, Pearson Education, 3rd edition, 2009.
2. Ben Shneiderman, ***"Designing the User Interface - Strategies for Effective Human Computer Interaction"***, Pearson Education, 2010.

Reference Books:

1. M. B. Rosson, J. M. Carroll, ***"Usability Engineering: Scenario-Based Development of Human-Computer Interaction"***, Elsevier, 2002.
2. Alan Cooper, ***"The Essentials of Interaction Design"***, Wiley Publishing, 2007.
3. Nielsen, J. Morgan Kaufmann, San Francisco, **"*Usability Engineering"***, 1993.
4. Heim, S., **"*The Resonant Interface: HCI Foundations for Interaction Design"***, Addison-Wesley, 2007.

Course Title:	**Game Theory**	**Semester**	**V**
Course Code	**BTITOE504E**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0– 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. The course is intended for students and teachers of institutions which offer undergraduate engineering programmes.
2. The aim of the course is to provide an introduction to the study of game theory which has found wide applications in economics, political science, sociology, engineering apart from disciplines like mathematics and biology.
3. The course would introduce to the fundamental tools of game theory, a few equilibrium concepts, apart from numerous exercises and applications.
4. Knowledge of game theory would help students to understand and analyze real life situations such as market behavior or voting in elections, apart from equipping them with analytical concepts which might be useful for decision to pursue social sciences, engineering, sciences or managerial higher studies.
5. This is an interdisciplinary course, hence not only social sciences but science and engineering departments of different universities can benefit from it.

Course Outcomes:

After learning the course, the students should be able:

1. To solve problems using basic graph theory.
2. To identify induced sub graphs, cliques, matching's, covers in graphs.
3. To determine whether graphs are Hamiltonian and/or Eulerian.
4. To solve problems involving vertex and edge coloring.
5. To model real world problems using graph theory.

Course Contents:

UNIT I

Introduction to Game Theory: Concept of game theory, Theory of rational choice, Interacting decision makers. Strategic Games and Nash Equilibrium: Strategic games: examples, Nash equilibrium: concept and examples, Best response functions, Dominated Actions, Symmetric games and symmetric equilibrium.

UNIT II

Illustrations of Nash Equilibrium: Cournot's model of duopoly market, Bertrand's model of duopoly market, Electoral Competition, War of Attrition, Auctions, Accident Laws.

UNIT III

Mixed Strategy Nash EquilibriumL: Introduction, Strategic games with randomisation, Mixed strategy Nash equilibrium: concept and examples, Dominated Actions, Formation of Players' beliefs.

UNIT IV

Extensive Games and Nash Equilibrium: Introduction to extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect Nash equilibrium, Backward induction.

UNIT V

Illustrations of Extensive Games and Nash Equilibrium: Stackelberg model of duopoly markets, Ultimatum game.

Text books:

1. Osborne, M.J., "***An Introduction to Game Theory***", Oxford University Press, 2004
2. Mas-Colell, A., M.D. Whinston and J.R. Green, "***Microeconomic Theory***", Oxford University Press, 1995

Reference Book:

1. Gibbons, R., "***A Primer in Game Theory***", Pearson Education, 1992.

Course Title:	**3D Printing and Design**	**Semester**	**V**
Course Code	**BTITOE504F**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0– 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objective:

1. To impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

Course Outcomes:

After learning the course, the students should be able:

1. To develop CAD models for 3D printing.
2. To import and Export CAD data and generate .stl file.
3. To select a specific material for the given application.
4. To select a 3D printing process for an application.
5. To produce a product using 3D Printing or Additive Manufacturing (AM).

Course Contents:

UNIT I

3D Printing (Additive Manufacturing): Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.
CAD for Additive Manufacturing: CAD Data formats, Data translation, Data loss, STL format.

UNIT II

Additive Manufacturing Techniques: Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process Selection for various applications.
Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.

UNIT III

Materials: Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties, Support Materials.

UNIT IV

Additive Manufacturing Equipment: Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting, Process Design.

UNIT V

Post Processing: Requirement and Techniques. Product Quality: Inspection and testing, Defects and their causes.

Text books:

1. Lan Gibson, David W. Rosen and Brent Stucker, "***Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing***", Springer, 2010.
2. Andreas Gebhardt, "***Understanding Additive Manufacturing: Rapid Prototyping, RapidTooling, Rapid Manufacturing***", Hanser Publisher, 2011.
3. Dr. Sabrie Soloman, "***3D Printing and Design***", the 4th Industrial Revolution, 2020.
4. CK Chua, Kah Fai Leong, "***3D Printing and Rapid Prototyping- Principles and Applications***", World Scientific, 2017.
5. J.D. Majumdar and I. Manna, "***Laser-Assisted Fabrication of Materials***", Springer Series in Material Science, 2013.

Reference Books:

1. L. Lu, J. Fuh and Y.S. Wong, "***Laser-Induced Materials and Processes for Rapid Prototyping***", Kulwer Academic Press, 2001.
2. Zhiqiang Fan and Frank Liou, "***Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy***", InTech, 2012.

Course Title:	**Computer Networks and Internetworking Protocols Lab**	**Semester**	**V**
Course Code	**BTITL505**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Core**	**Credit**	**1**

Lab Experiments List:

1. Conversion of IP addresses
   (e.g. I/P: 10.24.164.254 O/P: 00001010.00011000.10000000.11111110 and I/P:binary dotted O/P: decimal dotted)
2. Introduction to Wireshark
3. Wireshark Lab: Ethernet and ARP
4. Wireshark Lab: IP
5. Wireshark Lab: ICMP, study of ping and traceroute commands
6. Wireshark Lab: UDP
7. Wireshark Lab: TCP
8. Study of ftp, telnet tools and network configuration files
9. DHCP server configuration
10. Socket programming for UDP and TCP
11. Study of Network commands

Course Title:	**Software Engineering Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 –2**
Stream	**Core**	**Credit**	**1**

Lab Experiments List:

Part: I RDBMS

1. To develop a mini project for an RDBMS, the following exercise have been specified to give idea/ prerequisite learning for the concept required in defining the problem statement for an RDBMS.
2. Design and draw an ER/EER diagram and map this diagram to the database tables.
3. Create database tables for the problem. Perform add, insert, delete, update operations.
4. Use DDL statements and apply all constraints on tables to make the operations on tables.
5. Write and execute triggers and procedures/functions.
6. Generate a simple report.

Part: II

Following exercise has been specified to give idea/prerequisite learning for the concept in defining the problem statement for a front end to RDBMS based system.

Front end tools support developments of the following concept:

1. Controls
2. Properties for every control of the form
3. Events
4. Programming components
5. Proper interface to the back end database

The desktop database can be chosen from MSSQL, ORACLE, mySQL or equivalent databases packages. The front end development tools can be chosen from .NET, JAVA or equivalent tools.

Part: III

The statement of the problem will be the mini project for the group. The design of the project shall follow the software development life cycle. It should prepare a report for each stage (this will be the part of project manual later).

The group should understand and prepare proper documentation in relation with following:

1. Problem definition in detail.
2. Literature survey.
3. Requirement analysis.
4. System analysis (Draw Level 2 DFD at least).
5. System design
6. Implementation
7. Use cases
8. Testing

While designing the project the care should be taken to follow the coding conventions, software project design standards, data dictionary, etc. Staff in-charge will frame the mini project specification to be performed by group of students. There will be different problem definition to each group. The students will prepare an installable CD for the mini projects; *README* file will have the project description, system requirements, development details, and installation instruction. *User manual* will have the interaction screens and the way to use the developed project.

Course Title:	**Embedded Systems Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Elective**
Prerequisite	**Microprocessor and Microcontroller**	**L – T – P**	**0 – 0 – 2**
Stream	**Software Application & Development**	**Credit**	**1**

Lab Experiments List:

1. Study of ARM evaluation system
2. Interfacing ADC and DAC
3. Interfacing LED and PWM
4. Interfacing real time clock and serial port
5. Interfacing keyboard and LCD
6. Interfacing EPROM and interrupt
7. Mailbox
8. Interrupt performance characteristics of ARM and FPGA
9. Flashing of LEDS
10. Implementing zigbee protocol with ARM

Course Title:	**IT Service Management Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure & Security Management**	**Credit**	**1**

Lab Experiments List:

1. To study the Information System Design Process.
2. To study the relationship of service level management with other service delivery processes.
3. To study the Problem, Change and Incident Management.
4. To study and demonstrate disaster recovery.
5. To study and demonstrate the various security techniques used to secure the data while transmitting over the internet.

Course Title:	**Information Storage Management Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Elective**
Prerequisite	**Computer Architecture & Organization**	**L - T - P**	**0- 0 - 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments List:

1. Data Center Environment
   a) Install the VNXe Simulator
   b) Discover the infrastructure
2. Intelligent storage system
   a) Navigate the storage system
   b) Create a block device
   c) Create a file device
3. FC SAN
   a) FC san configuration
   b) FC san trace
4. IP SAN
   a) IP SAN configuration
   b) ISCSI san trace
5. Host-based business continuity
   a) Multipath
6. Managing protection services
   a) Array-based protection
   b) Configuring LUN protection
7. Managing storage infrastructure
   a) Monitoring and reporting

Course Title:	**Network Management Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Elective**
Prerequisite	**Computer Architecture & Organization**	**L – T – P**	**0– 0 – 2**
Stream	**Network**	**Credit**	**1**

Lab Experiments List:

1. Network Monitoring tools
   a) Status b) Route c) Traffic Tools
2. Monitoring and management network using SNMP
   a) Basic SNMP b) Advanced SNMP v3 Authentication/Encryption and ACL
   c) SNMP Trap Daemon Implementation
3. Install and configure SNMP MIB browser
   a) qtmib b) snmpB c) OpManager MIB browser
4. Network Statistics and measurement
   a) LAN Traffic Monitoring b) Protocol statistics
5. LAN Troubleshooting using Wireshark.
6. To study log system using open source tools.
7. Study of commercial network management tools: HPOpenView, Orphanage, GFILanguard and IBM NMS.

Course Title:	**Data Visualization Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Data Science**	**Credit**	**1**

Instructions: It is proposed to use the various datasets from standard data repositories such as Kaggle, UCI, Git hub and stock market websites such as BSE. Minimum ten programs/notebooks are required to be completed by the students. Following are the model experiments. However, the course-in-charge can modify these experiments in order to cover all the topics of Data Visualization course.

Lab Experiments List:

1. Program/Notebook to demonstrate area plots and how to create them with Matplotlib, histograms with Matplotlib
2. Pandas Data Manipulation
   A) Pandas
   B) Series
   C) Timedelta
3. Program/Notebook to draw scatter plots, bubble plots, racing bar chart with Matplotlib.
4. Program/Notebook related to any dataset using Pandas DataFrame methods:
   Count ( ) Method, describe ( ) Method, drop_duplicated( ) Method, empty property, filter( ) Method, equals( ) Method
5. To learn about advanced visualization tools such as waffle charts and word clouds and how to create them.
6. To learn about seaborn, visualization library, and how to use it to generate attractive regression plots.
7. To learn about Folium, visualization library, designed especially for visualizing geospatial data.
8. To learn how to use Folium to create maps of different regions of the world and how to superimpose markers on top of a map, and how to create choropleth maps.
9. Minimum three case studies (such as Loan prediction, Counties population data analysis, COVID-19 and Stock market data analysis etc)
10. Program/Notebook case study using Seaborn and Scikit learn library

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Course Title:	**Virtual Reality Lab**	**Semester**	**V**
Course Code	**BTITL506**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**---**	**Credit**	**1**

Lab Experiments List:

1. Developing architecture of a house using Virtual Reality
2. Perform CRO based experiment using Virtual Reality
3. Undertaking qualitative analysis in Chemistry using Virtual Reality
4. Carry out assembly/disassembly of an engine using Virtual Reality
5. Explore human anatomy using Virtual Reality
6. Simulation of circulation of blood in heart
7. Simulation of Fight/Vehicle/Space Station
8. Building Electronic circuit using Virtual Reality, given basic electronic components
9. Developing concept of Virtual class room with multiplayer

Course Title:	**Operating Systems**	**Semester**	**VI**
Course Code	**BTITC601**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**3 – 1 – 0**
Stream	**Core**	**Credits**	**4**

Course Objectives:

1. To study the basic concepts and functions of operating systems.
2. To understand the structure of operating systems.
3. To learn about Processes, Threads and Scheduling algorithms.
4. To understand the principles of Concurrency and Deadlocks.
5. To learn various memory management schemes.
6. To study File systems.

Course Outcomes:

After learning the course, the students should be able:

1. To design various Scheduling algorithms.
2. To apply the principles of concurrency.
3. To design deadlock, prevention and avoidance algorithms.
4. To compare and contrast various memory management schemes.
5. To design and Implement a prototype file system.

Course Contents:

UNIT I

Operating System Structures: Definition, Types of operating system, System components, System services, Systems calls, System programs, System structure, Virtual machines, System design and implementation.

UNIT II

Processes and CPU scheduling: Process concept, Process scheduling, Operation on a process, Co-operating processes, Threads, Interprocess communication, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real-time scheduling, Scheduling algorithms and performance evaluation.

Process Synchronization: The critical-section problem, Critical regions, Synchronization hardware, Semaphores, Classical problems of synchronization, Monitors.

UNIT III

Deadlocks: Systems model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock, combined approach to deadlock handling.

UNIT IV

Memory Management and Virtual Memory: Logical versus physical address space, Swapping, Contiguous allocation, Paging, Segmentation with paging, Demand paging, Page replacement algorithms, Thrashing.

UNIT V

File Management: File system and secondary storage devices, Real-time operating systems.

Text Books:

1. A. Silberschatz, P. Galvin, ***"Operating System Concepts"***, Wiley Publication, 10th Edition, 2018.
2. A. S. Tanenbaum, H. Bos, ***"Modern Operating Systems"***, Pearson Education, 4th Edition, 2016.

Reference Books:

1. D.M. Dhamdhere,***"Systems Programming and Operating Systems"***, Tata McGraw Hill Publication, 2nd Edition, 2001.
2. G. Nutt, ***"Operating Systems Concepts"***, Addison Wesley Publication, 3rd Edition.
3. H. M. Deitel, ***"An Introduction to Operating Systems"***, Pearson education Publication, 3rd Edition, 2007.

Course Title:	**Database Management Systems**	**Semester**	**VI**
Course Code	**BTITC602**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**3 – 1– 0**
Stream	**Core**	**Credits**	**4**

Course Objectives:

1. To understand architecture and functioning of database management systems.
2. To learn relational model.
3. To use structured query language (SQL) and its syntax, transactions, database recovery and techniques for query optimization.
4. To acquaint with various normalization forms and query processing.
5. To learn indexing methods.

Course Outcomes:

After learning the course, the students should be able:

1. To explain need of database management.
2. To design and implement a database schema for a given problem-domain.
3. To normalize a database.
4. To create and query a database using SQL DML/DDL commands, stored procedures and functions.
5. To declare and enforce integrity constraints on a database.
6. To illustrate understanding of indexing methods.

Course Contents:

UNIT I

Introduction: Basic concepts, Advantages of DBMS over file-processing systems, Data abstraction, Data models and data independence, Components of DBMS and overall structure of DBMS, Data modeling, Entity, Attributes, Relationships, Constraints, Keys E-R diagrams, Components of E-R Model.

UNIT II

Relational Model: Basic concepts, Attributes and domains, Concept of integrity and referential constraints, Schema diagram, Relational query languages, Relational Algebra and Relational Calculus: Tuple relational and domain relational calculus.

Structured Query Language-I: Introduction, Characteristics and advantages, Data types and literals, DDL, Tables: creating, modifying, deleting.

UNIT III

Views: Creating, Dropping, Updation using views, DML, Operators, SQL DML queries, SELECT query and clauses.

Structured Query Language- II: Set operations, Predicates and joins, Set membership, Tuple variables, Set comparison, Ordering of tuples, Aggregate functions, Nested queries, Database modification using SQL Insert, Update and Delete queries, Dynamic and SQL and concept of stored procedures, Query-by-example.

UNIT IV

Relational Database Design: Notion of normalized relations, Functional dependency, Decomposition and properties of decomposition, Normalization using functional dependency, Multi-valued dependency and join dependency. Storage and File Systems: Secondary storage, RAID, File organization, Indices, Static and dynamic hashing, B-Trees and B+ Trees.

UNIT V

Query Processing and Transaction Management: Measures of query cost, Selection operation, Sorting and join operation, Transaction concept, Components of transaction management, Concurrency and recovery system, Different concurrency control protocols such as timestamps and locking, Validation, Multiple granularity, Deadlock handling, Different crash recovery methods such as log-based recovery, Shadow-paging, Buffer management and Remote backup system.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, *"Database System Concepts"*, McGraw Hill Education, 6th Edition, 2011.

2. RamezElmasri and Shamkant B. Navathe, *"Fundamental Database Systems"*,Pearson Education, 7th Edition, 2015.

3. Raghu Ramkrishnan, Johannes Gehrke, *"Database Management Systems"*, McGraw Hill Education, 3rd Edition, 2007.

Reference Books:

1. Carlos Coronel, Steven Morris ***"Database systems: Design Implementation andManagement"***, Cengage Learning Press, 11th Edition, 2014.
2. J. Murach, ***"Murach's MySQL"***, Shroff Publication, 2nd Edition, 2016.
3. J. Murach, ***"Murach's Oracle SQL and PL/SQL: Works with All Versions Through 11g"***, Shroff Publication, 2008.

Course Title:	**Software Testing**	**Semester**	**VI**
Course Code	**BTITPE603A**	**Course Type**	**Elective**
Prerequisite	**Software Engineering**	**L – T – P**	**3 – 0 – 0**
Stream	**Software Application & Development**	**Credits**	**3**

Course Objectives:

1. To study fundamental concepts in software testing, including software testing objectives, processes, criteria, strategies, and methods.
2. To learn planning of a test project, designing test cases and test data, conducting test operations, managing software problems and defects, and generating a test report.
3. To develop an understanding of the meaning and importance of quality in relation to software systems and the software development process.
4. To study issues and techniques for implementing and managing software quality assurance processes and procedures.

Course Outcomes:

After learning the course, the students should be able:

1. To apply software testing knowledge and its processes to software applications.
2. To identify various software testing problems.
3. To solve software testing problems by designing and selecting software test models, criteria, strategies and methods.
4. To apply the techniques learned to improve the quality of software development.
5. To prepare a software quality plan for a software project.

Course Contents:

UNIT I

Principles of Testing Software development life cycle model: Phases of software project, Quality, Quality assurance and quality control, Testing, Verification and validation, Process models to represent various phases, Life cycle models, Software testing life cycle.

White Box Testing (WBT) and Black Box Testing: Static testing, Structural testing, Challenges in WBT. Black box testing: Black box testing process.

UNIT II

Integration Testing: Definition, As a type of testing: Top-down integration, Bottom-up integration, Bi-directional integration, System integration, Choosing integration method, As a phase of testing, Scenario testing: System scenarios, Use case scenarios, Defect bash.

UNIT III

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

UNIT IV

Performance testing, Regression testing, Internationalization testing, Adhoc testing. Factors governing performance of testing, Methodology, tools and process for performance testing. Regression Testing: Introduction, Types of Regression testing, Regression testing process. Adhoc testing: Introduction, Buddy testing, Pair testing, Exploratory testing, Iterative testing, Agile and Extreme testing, XP work flow, Defect seeding.

UNIT V

Testing Object Oriented Software: Introduction, Comparison of object oriented and procedural software, System testing example, Unit testing of classes, Tools for testing object oriented software, Testing web applications.

Text Book:

1. Srinivasan Desikan, Gopalaswamy Ramesh, ***"Software Testing: Principles and Practices"***, Pearson publication, 2nd Edition, 2006.

Reference Books:

1. Louise Tamres, ***"Introducing Software Testing"***, Pearson publication, 2002.
2. Boris Beizer, ***"Software Testing Techniques"***, Dreamtech press, 2nd Edition, 2014.

Course Title:	**Data Storage Technologies & Networks**	**Semester**	**VI**
Course Code	**BTITPE603B**	**Course Type**	**Elective**
Prerequisite	**Computer Network & Internetworking Protocols, Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure & Security Management**	**Credits**	**3**

Course Objectives:

1. To gain knowledge and understand the design of a Data Centre.
2. To learn the options in the running of an efficient Data Centre.
3. To understand the value of data to a business, information lifecycle.
4. To understand the challenges in data storage and data management.
5. To learn solutions available for data storage.

Course Outcomes:

After learning the course, the students should be able:

1. To explain the design of a data center and storage requirements.
2. To discuss the various types of storage and their properties.
3. To explain physical and virtualization of storage.
4. To explain the backup, archiving with regard to recovery and business continuity.

Course Contents:

UNIT I

Data Centre: Introduction, Site Selection and Environmental Considerations, Hierarchical or Layered Architecture, Architect Roles, Goals and Skills, Architecture Precursors.

Data Centre Design: Architecture Design and Standards Recommendations, Raised Access Floor and Design Best Practices, Connecting the infrastructure with copper and fiber. IT Hardware, Cooling System Options and Environmental Control, Electrical Power Systems, Room Layout, Fire Protection and Security Systems, Building Automation and Energy Management Systems, Commissioning and Handover.

UNIT II

Storage Management: Introduction to Storage Technology, Storage Systems Architecture, Physical and logical components of a connectivity environment, Major physical components of a disk drive and their functions, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Integrated and Modular storage systems, high-level architecture and working of an intelligent storage systems.

UNIT III

Networked Storage: Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, Need for long-term archiving solutions and describe how CAS fulfill the need, Appropriateness of the different networked storage options for different application environments.

UNIT IV

Managing Data Center: Reasons for planned/unplanned outages, Impact of downtime, Difference between business continuity (BC) and disaster recovery (DR), RTO and RPO, Identification of single points of failure in a storage infrastructure and solutions to mitigate these failures, Architecture of backup/recovery and the different backup/recovery topologies, replication technologies and their role in ensuring information availability and business continuity Remote replication technologies and their role in providing disaster recovery and business continuity capabilities, Key areas to monitor in a data center, Industry standards for data center monitoring and Management Key metrics to monitor storage infrastructure.

UNIT V

Securing Storage and Storage Virtualization: Information Security, Critical security attributes for information systems, Storage security domains, Analyze the common threats in, each domain, Storage Virtualization: Forms, Configurations and Challenges, Types of Storage Virtualization: Block-level and File-Level.

Text Books:

1. Mauricio Arregoces, ***"Data Center Fundamentals"***, Cisco Press, 1st edition, 2003.
2. Robert Spalding, ***"Storage Networks: The Complete Reference"***, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, ***"Building Storage Networks"***, Tata McGraw Hill, Osborne. 2001.
4. Meeta Gupta, ***"Storage Area Network Fundamentals"***, Pearson Education Limited, 2002.

Reference Books:

1. G. Somasundaram, Alok Shrivastava, ***"Information Storage and Management"***, EMC Education Series, Wiley Publishing Inc., 2011.
2. Gustavo Santana, ***"Data Center Virtualization Fundamentals: Understanding Techniques and Designs for Highly Efficient Data Centers with Cisco Nexus, UCS, MDS, and Beyond"***, Cisco Press, 1st Edition, 2013.

Course Title:	**Service Oriented Architecture**	**Semester**	**VI**
Course Code	**BTITPE603C**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L - T - P**	**3 - 0 - 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

1. To gain understanding of the basic principles of service orientation.
2. To learn service oriented analysis techniques.
3. To learn technology underlying the service design.
4. To learn advanced concepts such as service composition, orchestration and choreography.
5. To know about various WS specification standards.

Course Outcomes:

After learning the course, the students should be able:

1. To build applications based on XML.
2. To develop web services using technology elements.
3. To build SOA-based applications for intra-enterprise and inter-enterprise applications.

Course Contents:

UNIT I

Introducing SOA: Fundamental SOA: Common Misperceptions about SOA, Common tangible benefits of SOA, Common pitfalls of adopting SOA, The Evolution of SOA: -from XML to Web services to SOA, The continuing evolution of SOA, The roots of SOA. Web Services and Primitive SOA: The Web services framework-Services, Service descriptions, Messaging with SOAP.

UNIT II

Web Services and Contemporary SOA: Message exchange patterns, Service activity, coordination, Atomic transactions, Business activities, Orchestration, Choreography- Web Services and Contemporary SOA: Addressing, Reliable messaging, Correlation.

Policies Metadata exchange: Security, Notification and eventing and Service-Orientation: principles of Service - Anatomy of a service-oriented architecture, Common principle of service orientation, Service Layers, Service orientation.

UNIT III

Building SOA: SOA Delivery Strategies, SOA delivery lifecycle phases. Service-Oriented Analysis: Introduction to service-oriented analysis-Benefits of a business centric SOA- Deriving business service, Service modeling, Service modeling guidelines, Classifying service model logic, Contrasting service modeling approaches.

UNIT IV

Service-Oriented Design: Introduction to service-oriented design, WSDL-related XML Schema language basics, WSDL language basics, SOAP language basics, Service interface, Design tools. SOA

Composition Guidelines: Steps to composing SOA, Considerations for choosing service layers and SOA standards, positioning of cores and SOA extensions.

UNIT V

SOA Service Design: - Overview-Service design of business service, Application service, Task centric service and guidelines, SOA Business Process Design: WS-BPEL language basics, WS Coordination,

SOA support in J2EE - Java API for XML-based web services (JAX-WS) , Java architecture for XML binding (JAXB) , Java API for XML Registries (JAXR) , Java API for XML based RPC (JAX-RPC), Web Services Interoperability Technologies (WSIT).

Text Books:

1. Thomas Erl, "***Service-Oriented Architecture: Concepts, Technology, and Design"***, Pearson Education, 2016.
2. Frank. P. Coyle, "***XML, Web Services and The Data Revolution"***, Pearson Education, 2002.
3. Sandeep Chatterjee, James Webber, "***Developing Enterprise Web Services. An Architect's Guide"***, Pearson Education, 2005.
4. Eric Newcomer, Greg Lomow, "***Understanding SOA with Web Services"***, Pearson Education, 2005.
5. Schmelzer et al., "***XML and Web Services"***, Pearson Education, 2002.

Reference Books:

1. Dan woods and Thomas Mattern, ***"Enterprise SOA: designing IT for Business Innovation"***, O'REILLY, 2008.
2. James McGovern, Sameer Tyagi, Michael E. Stevens, Sunil Mathew, "***Java Web Services Architecture"***, Morgan Kaufmann Publishers, 2003.
3. AtulKahate, "***XML and Related technologies"***, Pearson Education, 2008.
4. Kennard Scibner and Mark C. Stiver, "***Understanding SOAP"***, SAMS publishing.
5. B. V. Kumar, S. V. Subrahmanya, "***Web Services: An Introduction"***, TMH India, 2nd Edition, 2012.

Course Title:	**Network Programming**	**Semester**	**VI**
Course Code	**BTITPE603D**	**Course Type**	**Elective**
Prerequisite	**Computer Network & Internetworking Protocols, Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Network**	**Credits**	**3**

Course Objectives:

1. To learn the basics of socket programming using TCP Sockets.
2. To learn about Socket options.
3. To learn to develop Macros for including objects in MIB Structure.
4. To understand SNMP v1, v2 and v3 protocols & practical issues.

Course Outcomes:

After learning the course, the students should be able:

1. To analyze the requirements of a networked programming environment and identify the issues to be solved.
2. To create conceptual solutions to those issues and implement a programming solution.
3. To understand the key protocols that supports the Internet.
4. To apply several common programming interfaces to network communication.
5. To understand the use of TCP/UDP Sockets.
6. To apply advanced programming techniques such as Broadcasting, Multicasting.

Course Contents:

UNIT I

Socket and Application Development: Introduction to Socket Programming, System Calls, Address conversion functions, POSIX Signal Handling, Server with multiple clients, Boundary conditions, Server process Crashes, Server host Crashes, Server Crashes and reboots, Server Shutdown, I/O Multiplexing, I/O Models, TCP echo client/server with I/O Multiplexing.

UNIT II

Socket Option: Socket options, getsockopt and setsockopt functions, Generic socket options, IP socket options, ICMP socket options, TCP socket options, Multiplexing TCP and UDP sockets, SCTP Sockets, SCTP Client/server, Streaming Example, Domain name system, gethostbyname, gethostbyaddr, getservbyname and getservbyport functions, Protocol Independent functions in TCP Client/Server Scenario.

UNIT III

Advanced Socket: IPv4 and IPv6 interoperability, Threaded servers, Thread creation and termination, TCP echo server using threads, Mutex Condition variables, Raw sockets, Raw socket creation, Raw socket output, Raw socket input, ping program, traceroute program.

UNIT IV

Simple Network Management: SNMP network management concepts, SNMPv1 Management information, MIB Structure, Object syntax, Standard MIB's, MIB-II Groups, SNMPv1 protocol and Practical issues.

SNMPv2, SNMPv3 and RMON: Introduction to SNMPv2, SMI for SNMPv2 Protocol, SNMPv3 Architecture and applications, Security and access control model, Overview of RMON.

UNIT V

Protocols, Sessions, State, and Implementing Custom Protocols State vs. Stateless, Methods for Maintaining State, What is a Protocol? Designing a Custom Protocol, Our Chat Protocol, Protocol Registration, Elementary Name, Address Conversions and design decisions, Domain Name System, gethostbyname function, RES_USE_INET6 Resolver Option, gethostbyname2 function and IPv6 Support, gethostbyaddr function, uname function, gethostname function, getservbyname and getservbyport functions

Text Books:

1. W. Richard Stevens, ***"UNIX Network Programming Vol-I"***, Addison-Wesley Professional, 3rd Edition,2003.
2. William Stallings, ***"SNMP, SNMPv2, SNMPv3 and RMON 1 and 2"***, Pearson Edition, 3rd Edition, 2009.

Reference Book:

1. D.E. Comer, ***"Internetworking with TCP/IP Vol- III: Client-Server Programming and Application BSD Sockets Version"***, Pearson Edition, 2nd Edition, 2003.

Course Title:	**Data Warehousing and Data Mining**	**Semester**	**VI**
Course Code	**BTITPE603E**	**Course Type**	**Elective**
Prerequisite	**Database Management Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. To introduce the concepts, techniques, design and applications of Data Warehousing and Data Mining.
2. To enable students to understand and implement classical algorithms in Data Warehousing and Data Mining.
3. To enable students to learn how to analyze the data, identify the problems and choose the relevant algorithms to apply.

Course Outcomes:

After learning the course, the student will be able:

1. To understand the functionality of the various Data Warehousing and Data Mining components.
2. To recognize the strengths and limitations of various Data Warehousing and Data Mining models.
3. To compare the various approaches to Data Warehousing and Data Mining implementations.
4. To describe and utilize a range of techniques for designing Data Warehousing and Data Mining systems for real-world applications.

Course Contents:

UNIT I

Introduction to data warehousing, Evolution of decision support systems, Modeling a data warehouse, Granularity in the data warehouse, Data warehouse life cycle, Building a data warehouse, Data Warehousing Components, Data Warehousing Architecture.

UNIT II

Online Analytical Processing, Categorization of OLAP Tools, Introduction to Data mining and knowledge discovery, Relation to Statistics, Databases, Data Mining Functionalities, Steps in Data Mining Process, Architecture of a Typical Data Mining Systems, Classification of Data Mining Systems.

UNIT III

Overview of Data Mining Techniques, Data Preprocessing, Data Cleaning, Data Integration, Data Transformation and Data Reduction, Data Generalization and Summarization Based Characterization, Mining Association Rules in Large Databases.

UNIT IV

Classification and Prediction, Issues regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Other Classification Methods.

Prediction, Clusters Analysis, Types of Data in Cluster Analysis, Categorization of Major Clustering Methods, Partitioning methods, Hierarchical methods.

UNIT V

Applications of Data Mining, Social Impacts of Data Mining, Case Studies, Mining WWW, Mining Text Databases, Mining Spatial Databases.

Text Books:

1. Adriaans, ***"Data mining"***, Addison- Wesley, 2009.
2. Margaret Dunham, ***"Data Mining: Introductory and Advanced Topics"***, Published by Prentice Hall.
3. Weiss, Sholom M., "***Predictive data mining: a practical guide",*** Kaufmann Publishers, 2008.

Reference Books:

1. Pang-Ning Tan, Michael Steinback, Vipin Kumar, ***"Introduction to Data Mining"***, Pearson Education, 2021.

2. M. Humphires, M. Hawkins, ***"Data Warehousing: Architecture and Implementation"***, Pearson Education, 2009.

3. Anahory, Murray, ***"Data Warehousing in the Real World"***, Pearson Education, 2008.

4. Kargupta, Joshi, et al., ***"Data Mining: Next Generation Challenges and Future Directions"***, Prentice Hall of India Pvt. Ltd, 2007.

Course Title:	**Compiler Design**	**Semester**	**VI**
Course Code	**BTITOE604A**	**Course Type**	**Elective**
Prerequisite	**Data Structures & Applications**	**L – T – P**	**3 – 0– 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To introduce the major concept areas of language translation and compiler design.
2. To develop an awareness of the function and complexity of modern compilers.
3. To provide practical, hands on experience in compiler design.

Course Outcomes:

After learning the course, the students should be able:

1. To understand the major concept areas of language translation and compiler design.
2. To develop an awareness of the function and complexity of compilers.
3. To identify the similarities and differences among various parsing techniques and grammar transformation techniques.

Course Contents:

UNIT I

Introduction to Compiling and Lexical Analysis: Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler-Construction tools, Role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

UNIT II

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 III

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 IV

Source language issues, parameter passing, symbol tables.
Intermediate Code Generation: Variants of syntax trees, Three address code, Types and declarations, Type checking, Control Flow and Backpatching, procedure calls.

UNIT V

Code Generation and Code Optimization: Code Generation: Issues in the design of code generation, The target language, Code Optimization: Need of code optimization, Principal sources of optimization, Basic blocks and flow graphs, Optimization of basic blocks, Peephole optimization.

Text Books:

1. Aho, Sethi, Ullman, ***"Compilers-Tools and Techniques"***, Pearson, 2nd Edition, 2015.
2. Tremblay, Sorenson, ***"Theory and Practice of Compiler Writing"***, McGraw Hill Publication.
3. Hopcroft, ***"Introduction to Automata Theory, Languages and Computation"***, Pearson Publication.

Reference Books:

1. Paul G. Sorenson, ***"Compiler Writing"***, Tata McGraw Hill.
2. Robin Hunter, ***"The Essence of Compilers"***, Pearson Publication, 2005.

Course Title:	**Enterprise Resource Planning**	**Semester**	**VI**
Course Code	**BTITOE604B**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0– 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To introduce to enterprise systems and show how organizations use enterprise systems to run their operations more efficiently and effectively.
2. To learn about the critical success factors and implementation strategies that lead to enterprise system success.
3. To learn about the informational, knowledge, and decision-making opportunities afforded by enterprise systems.
4. To examine typical Enterprise Systems modules: Materials Management (MM), Supply Chain Management (SCM), Customer Relationship Management (CRM), Human Resource Management (HRM).

Course Outcomes:

After learning the course, the students should be able:

1. To demonstrate a good understanding of basic issues in Enterprise Systems.
2. To explain the scope of common Enterprise Systems (e.g., MM, SCM, CRM, HRM, procurement).
3. To explain the challenges associated with implementing enterprise systems and their impacts on organizations.
4. To describe the selection, acquisition and implementation of enterprise systems.
5. To use one of the popular ERP packages to support business operations and decision-making.
6. To communicate and assess an organization's readiness for enterprise system implementation with a professional approach in written form.
7. To demonstrate an ability to work independently and in a group.

Course Contents:

UNIT I

Enterprise Resource Planning: Introduction, Disadvantages of non-ERP systems, What Is ERP? Need of ERP, Advantage of ERP, Risks of ERP, Growth of ERP.

ERP Modules: Finance, Production Planning, Control and Management, Sales and Distribution, Human Resource Management, Inventory Control System, Quality Management, Plant Maintenance.

UNIT II

ERP Implementation: ERP Implementation (Transition) strategies, ERP Implementation Life Cycle, Implementation Methodologies, Evaluation and selection of ERP package, ERP Project Team: Vendors, Employees, Consultants, Training & Education, Project management & Monitoring, Post Implementation Activities, Operation & maintenance of ERP system, Measuring the Performance of ERP System, Success & failure factors of an ERP, Implementation.

UNIT III

ERP Market and Vendors: ERP Marketplace and Marketplace Dynamics, Comparison of Current ERP Packages and Vendors, like; SAP, Oracle, PeopleSoft, BAAN etc.

UNIT IV

ERP and Related Technologies: Business Process Re-Engineering (BPR), Information Systems - Management Information System (MIS), Decision Support System (DSS), Executive Support System (ESS), Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Supply Chain Management, Customer Relationship Management.

UNIT V

ERP Case Studies: ERP systems implemented in: TISCO, SKF Automotive Bearings Co. Ltd, Qualcomm CDMA, California, Post Implementation review of ERP packages in Manufacturing, Services and Others Organizations, Customization of ERP for different types of Industries.

Text Books:

1. Alexis Leon, ***"ERP Demystified"***, TMH New Delhi, 3rd Edition.
2. V. K. Garg & N. K. Venkita Krishnan, ***"ERP Ware: ERP Implementation Framework"***, PHI.

Reference Book:

1. V. K. Garg & N. K. Venkita Krishna, ***"ERP Concepts & Planning"***, PHI, 2nd Edition.

Course Title:	**Decision Support Systems**	**Semester**	**VI**
Course Code	**BTITOE604C**	**Course Type**	**Elective**
Prerequisite	**Database Management Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To select appropriate modeling techniques for supporting semi-structured business decision making.
2. To identify and select appropriate decision support systems for generating innovative business solutions.
3. To design and implement decision support systems for generating innovative business solutions.

Course Outcomes:

After learning the course, the students should be able:

1. To recognize the relationship between business information needs and decision making.
2. To know the general nature and range of decision support systems.
3. To understand issues related to the development of DSS.
4. To select appropriate modeling techniques.
5. To analyze, design and implement a DSS.

Course Contents:

UNIT I

Basic Concepts: Decision making systems, Modeling and support, Basics and definitions, Systems models, Modeling process, Decision making, Intelligence phase, Design phase, Choice phase, Evaluation, Implementation phase, Alternative decision making models, Decision support systems, Decision makers, Case applications.

UNIT II

Decision Support System Development: Decision support system development, Basics, Life cycle, Methodologies, Prototype, Technology levels and tools, Development platforms, Tool selection, Developing DSS, Enterprise systems, Concepts and definition, Evolution of information systems, Information needs, Characteristics and capabilities, Comparing and integrating EIS and DSS, EIS data access, Data warehouse, OLAP, Multidimensional analysis, Presentation and the Web, Including soft information enterprise on systems, Organizational DSS, Supply and value chains, Decision support, Supply chain problems and solutions, Computerized systems. MRP, ERP, SCM, Frontline decision support systems.

UNIT III

Knowledge Management: Organizational learning and memory, Knowledge management, Development methods, Technologies and tools, Success , Knowledge management and artificial intelligence, Electronic Document Management, Knowledge Acquisition and Validation, Knowledge

Engineering – Scope, Acquisition Methods, Interviews, Tracking Methods, Observation and other Methods, Grid Analysis, Machine Learning, Rule Induction, Case-Based Reasoning, Neural Computing, Intelligent Agents, Selection of an appropriate Knowledge Acquisition Methods, Multiple Experts, Validation and Verification of the Knowledge Base-Analysis, Coding, Documenting, and Diagramming.

UNIT IV

Knowledge Acquisition, Knowledge Acquisition and the Internet/Intranets, Knowledge Representation Basics, Representation in Logic and other Schemas, Semantic Networks, Production Rules, Frames, Multiple Knowledge Representation, Experimental Knowledge Representations, Representing Uncertainty. Intelligent System Development: Inference Techniques, Reasoning in Artificial Intelligence, Inference with Rules, Inference Tree, Inference with Frames, Model Based and Case Based Reasoning, Explanation and Meta Knowledge, Inference with Uncertainty, Representing Uncertainty, Probabilities and Related Approaches, Theory of Certainty, Approximate Reasoning using Fuzzy Logic,Intelligent Systems Development, Prototyping, Project Initialization, System Analysis and Design, Software Classification.

UNIT V

Building Expert Systems with Tools, Shells and Environments, Software Selection, Hardware, Rapid Prototyping and a Demonstration Prototype, System Development, Implementation, Post Implementation, Management Support Systems: Implementing and Integrating Management Support Systems, Implementation, Major Issues, Strategies, System Integration, Generic Models MSS, DSS–ES, Integrating EIS, DSS and ES, Global Integration, Intelligent DSS, Intelligent Modeling and Model Management, Examples of Integrated Systems, Problems and Issues in Integration.

Text Book:

1. Efrain Turban and Jay E. Aronson, "***Decision Support Systems and Intelligent Systems"***, Pearson Education, 7th Edition, 2005.

Reference Books:

1. Ganesh Natarajan and SandhyaShekhar, ***"Knowledge Management Enabling Business Growth"***, Tata McGraw Hill, 2002.

2. George M. Marakas, ***"Decision Support System"***, Prentice Hall, India, 2003.

3. Efrem A. Mallach, ***"Decision Support and Data Warehouse Systems"***, Tata McGraw Hill, 2002.

4. Kimiz Dalkir, ***"Knowledge Management: Theory and Practice"***, Elsevier Science, 2005.

5. Becerra Fernandez and Laidener, ***"Knowledge Management: An Evolutionary View"***, PHI, 2009.

Course Title:	**Software Project Management**	**Semester**	**VI**
Course Code	**BTITOE604D**	**Course Type**	**Elective**
Prerequisite	**Software Engineering**	**L – T – P**	**3 – 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To gain knowledge about the concepts and methods required for construction of large software intensive system.
2. To gain knowledge on the principles and techniques of Software Project Management.
3. To gain knowledge about organizational behavior and general Management techniques used for Project Management.

Course Outcomes:

After learning the course, the students should be able:

1. To apply the process to be followed in the software development life-cycle models.
2. To understand approaches for managing and optimizing the software development process.
3. To explain the quality management and different types of metrics used in software development.
4. To do the Project scheduling, Tracking, Risk Analysis, Quality Management and Project cost estimation using different techniques and tools.

Course Contents:

UNIT I

Project Evaluation and Planning - Activities in Software Project Management, Overview of Project Planning, Stepwise planning, Software processes and process models, Cost Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques, Risk Evaluation.
Software effort estimation, Activity Planning, Risk Management, Resource Allocation.

UNIT II

Monitoring and Control- Collecting Data, Visualizing Progress, Cost Monitoring, Review techniques, Project termination review, Earned Value analysis, Change Control, Software Configuration Management (SCM).

UNIT III

Managing Contracts: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Management and Acceptance.

UNIT IV

Quality Management and People Management- Introduction, Understanding Behavior, Organizational Behavior, Selecting The Right Person for the Job, Motivation, The Oldman – Hackman Job Characteristics Model, Working in Groups, Organization and team structures, Decision Making,

Leadership, Organizational Structures, Stress, Health and Safety. ISO and CMMI models, Testing, and Software reliability, Test automation.

UNIT V

Overview of Project Management Tools.

Text Book:

1. Bob Hughes, Mike Cotterell, ***"Software Project Management"***, Tata McGraw Hill, 6th Edition, 2017.

Reference Books:

1. Wakker Royce, ***"Software Project Management"***, Pearson Education, 2002.
2. Robert K. Wysocki, ***"Effective Software Project Management"***, Wiley, 2006.

Course Title:	**Introduction to Data Science**	**Semester**	**VI**
Course Code	**BTITOE604E**	**Course Type**	**Elective**
Prerequisite	**NIL**	**L – T – P**	**3 – 0 – 0**
Stream	**Open Elective**	**Credits**	**3**

Course Objectives:

1. To learn python data types (including list, tuple, set, and dictionary) and data cleaning methods.
2. To demonstrate an understanding of statistics and machine learning concepts that are vital for Data Science.
3. To learn to use data science libraries such asMatplotlib, NumPy, Scikit-learn, TensorFlow, Keras, Pandas etc. on the specific data set.

Course Outcomes:

After learning the course, the students should be able:

1. To understand Data Science Process.
2. To understand the mathematical foundations needed for Data Science.
3. To collect, explore, clean, munge and manipulate data.
4. To implement models such as linear regression, decisiontrees, and clustering.
5. To build Data Science applications using Python based toolkits.

Course Contents:

UNIT I

Introduction to Data Science: Concept of Data Science, Facets of Data,Overview of the data science process, Steps, Defining research goals and creating a project charter, Retrieving Data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, Presentation and automation. Data types, expressions, variables, and string operations; Data structures: lists and tuples and sets and dictionaries.

UNIT II

Mathematical Foundations:
Linear Algebra: Vectors, Matrices,Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation. Probability and Distributions: Binomial and Poisson, Exponential, Normal and Cumulative Probability Distribution. Variance analysis. Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, P-hacking, Bayesian Inference.

UNIT III

Machine Learning:
Linear Regression: Simple Linear Regression, Steps in Building a Regression Model, Building Simple Linear Regression Model, Model Diagnostics, Multiple Linear Regression, Classification Problems: Classification Overview, Binary Logistic Regression, Credit Classification, Gain Chart, and Lift Chart, Classification Tree (Decision Tree Learning), Gradient Descent Algorithm, Scikit-Learn Library for Machine Learning, Clustering, K-Means Clustering, Creating Product Segments Using Clustering,

Forecasting: Forecasting Overview, Components of Time-Series Data, Moving Average, Decomposing Time Series, Auto-Regressive Integrated Moving Average Models.

UNIT IV

Introduction to Programing tools for Data Science: Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK,TensorFlow,Keras,Pandas; Visualizing Data: Bar Charts, Line Charts, Scatter plots; Working with data: Reading Files, Dealing with Missing Values, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.

UNIT V

Case Studies of Data Science Applications: Predicting malicious URLs, Building a recommender system inside a database, Weather forecasting, Stock market prediction, Object recognition.

Text Books:

1. Joel Grus, "***Data Science from Scratch: First Principles with Python***", O'Reilly Media,2015.
2. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, **"Introducing Data Science",** Dreamtech Press,2022.
3. Manaranjan Pradhan, U Dinesh Kumar, ***"Machine Learning using Python",*** Wiley India Pvt Ltd,2018.

Reference Books:

1. Aurélien Géron, "***Hands-On Machine Learning with Scikit-Learn and Tensor Flow:Concepts, Tools, and Techniques to Build Intelligent Systems***", 1st Edition, O'Reilly Media,2017.
2. Jain V.K., "***Data Sciences***", Khanna Publishing House, Delhi,2019.
3. Jain V.K., "***Big Data and Hadoop***", Khanna Publishing House, Delhi,2017.
4. Jeeva Jose, "***Machine Learning***", Khanna Publishing House, Delhi,2020.
5. Chopra Rajiv, "***Machine Learning***", Khanna Publishing House, Delhi,2018.

Course Title:	**Database Management Systems Lab**	**Semester**	**VI**
Course Code	**BTITL605**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Core**	**Credit**	**1**

Lab Experiments List:

1. Creation of databases and use of SQL commands (DDL, DML and DCL).
2. Suitable exercises to practice SQL commands, may be given for Insert, Update and Delete.
3. Write SQL procedure for an application which uses exception handling.
4. Write SQL procedure for an application with cursors.
5. Write SQL for implementing Nested Queries.
6. Write SQL for implementing Join Queries.
7. Write a DBMS program to prepare reports for an application using functions.
8. Write SQL block containing triggers.
9. Write SQL block containing stored procedures.
10. Develop a menu driven, GUI-based database application in any one of the domains such as Banking, Billing, Library Management, Payroll, Insurance, Inventory, Healthcare etc. integrating all the features covered in the above exercises.

Course Title:	**Operating Systems Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L – T – P**	**0– 0 – 2**
Stream	**Core**	**Credit**	**1**

Lab Experiments List:

1. Basics of UNIX commands
2. Shell Programming
3. Implement the following CPU scheduling algorithms:
   Round Robin, SJF, FCFS, Priority scheduling
4. Implement all file allocation strategies:
   Sequential, Indexed, Linked
5. Implement Semaphores
6. Implement all File Organization Techniques:
   Single level directory, Two level, Hierarchical, DAG
7. Implement Bankers Algorithm for Dead Lock Avoidance
8. Implement an Algorithm for Dead Lock Detection
9. Implement all page replacement algorithms:
   FIFO, LRU, LFU
10. Implement Shared memory and IPC
11. Implement Paging Technique of memory management
12. Implement Threading & Synchronization Applications

Course Title:	**Software Testing Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Elective**
Prerequisite	**Software Engineering**	**L – T – P**	**0– 0 – 2**
Stream	**Software application & Development**	**Credit**	**1**

Lab Experiments List:

1. Design, develop, code and run the program in any suitable language to solve the commission problem, Analyze it from the perspective of data flow testing, derive at least 10 different test cases, execute these test cases and discuss the test results.

2. Design, develop, code and run the program in any suitable language to solve the Next Date problem, Analyze it from the perspective of decision table-based testing, derive at least 10 different test cases, execute these test cases and discuss the test results.

3. Design, develop, code and run the program in any suitable object-oriented language to solve the calendar problem. Analyze it from the perspective of OO testing, derive test cases to test the method that increment the date and the method that increments the month, execute these test cases and discuss the test results.

4. Design, develop, code and run the program in any suitable object-oriented language to solve the currency converter problem. Analyze it from the perspective of use case-based system testing, derive appropriate system test cases, execute these test cases and discuss the test results.

5. Design, develop, code and run the program in any suitable language to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them to derive different test cases, execute these test cases and discuss the test results.

6. Design, develop, code and run the program in any suitable language to implement the binary search algorithm. Determine the basis paths and using them to derive different test cases, execute these test cases and discuss the test results.

Course Title:	**Data Storage Technologies & Networks Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Elective**
Prerequisite	**Computer Networks & Internetworking Protocol, Operating Systems**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure & Security Management**	**Credit**	**1**

Lab Experiments List:

1. Install a hard disk on a Linux machine covering all the below activities:

   a) Connecting the disk to an HBA (Host Bus Adapter) and BIOS setup for the disk;
   b) Partitioning the disk;
   c) Creating file systems within disk partitions;
   d) Mounting the files systems;
   e) Setting up automatic mounting;
   f) Labelling disk partitions;
   g) Setting up swapping on swap partitions.

2. Use "smartmontools" to monitor the disk performance monitoring and testing:

   a) Use "smartctl" to enable S.M.A.R.T. support and offline data collection on the disk;
   b) Check the overall health of the disk;
   c) Run a self-test on the disk;
   d) Set up "smartd" to do tests automatically.

3. Use "hdparm", "iostat", and "iometer" tools to measure the performance of different storage devices, such as SATA drive, SCSI drive, and USB drives.
   Plot graphs to compare read/write and sequential/random access rates among different storage devices.

4. Use Navisphere Manager Simulator to perform management on SAN disk array systems:
   a) Configure storage pools and LUNs (Logical Unit Number) for storage groups;
   b) Configure snapshots and clones;
   c) Create SANCopy full and incremental sessions;
   d) Create MirrorView synchronous and asynchronous images;
   e) Expand a LUN to create metaLUNs;
   f) Migrate a LUN to another LUN.

5. Use Openfiler for network storage configuration management:

   a) Configure the Openfiler to support locally attached USB drives;
   b) Set up a NAS server to support NSF and CIFS protocols;
   c) Set up a SAN server to support an iSCSI protocol.

6. Configure Openfiler as a NAS Server:

   a) Configure access control rules and NFS/CIFS shares for the NAS server;
   b) Configure the Linux client machine to access the NFS shares on the NAS server;
   c) Configure a Windows VM on the Linux client machine to access the CIFS shares on the NAS server;

d) Use Openfiler to set up a SAN server, to supports iSCSI protocol for the block level data access;
e) Configure access control rules for the SAN server and configure iSCSI targets on the server.

7. a) Use VMware to create virtual disks, Virtual Machine File Systems and provisioning;
b) Use thin and thick provisioning concepts.

Course Title:	**Service Oriented Architecture Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Compulsory**
Prerequisite	**Nil**	**L - T - P**	**0- 0 - 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments List:

1. To create a web service for adding a few numbers using NetBeans.
2. To create a web service for adding few numbers using NetBeans and write client-side code to invoke the web service.
3. Creation of a Web Service with Database Connectivity.
4. Create a SOA project with BPEL Module to compose a web service.
5. To develop a web service program which can persist the records of a student in the exam table. It makes use of SOAP Request and SOAP Response.
6. To invoke EJB components as web services.
7. To create a web services in .NET.
8. To invoke J2EE web services from .NET clients.
9. To create components using .NET client.
10. To access .NET web services from J2EE client.
11. Develop a Service Orchestration Engine (workflow) using WS-BPEL and implement service composition (Study Experiment).

Course Title:	**Network Programming Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Network**	**Credit**	**1**

Lab Experiments List:

1. Getting started with Basics of Network configurations files and Networking Commands in Linux.
2. To familiarize and understand the use and functioning of system calls used for operating system and network programming in Linux.
3. Familiarization and implementation of programs related to process and thread.
4. Implement programs for Inter Process Communication using PIPE, Message Queue and Shared Memory.
5. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.
6. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.
7. Implement and simulate algorithm for distance vector routing protocol.
8. Implement and simulate algorithm for link state routing protocol.
9. Implement Simple Mail Transfer Protocol.
10. Using Wireshark, observe data transferred in client server communication using UDP and identify the UDP datagram.
11. Using Wireshark, observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP.
12. Develop a packet capturing and filtering application using raw sockets.

Course Title:	**Data Warehousing & Data Mining Lab**	**Semester**	**VI**
Course Code	**BTITL606**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**0 – 0 – 2**
Stream	**Data Science**	**Credit**	**1**

Lab Experiments List:

1. Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects,etc.).
2. Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, Manufacturing, Automobiles, Sales etc.).
3. Write ETL scripts and implement them using data warehouse tools.
4. Perform Various OLAP operations such as slice, dice, roll up, drill up and pivot.
5. Explore visualization features of the tool for analysis like identifying trends etc.
6. Explore WEKA Data Mining/Machine Learning Toolkit.
7. Load each dataset into Weka and run the Apriori algorithm with different support and confidence values. Study the rules generated.
8. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated. Derive interesting insights and observe the effect of discretization in the rule generation process.
9. Load each dataset into Weka and run ID3, J48 classification algorithm, study the classifier output. Compute entropy values, Kappa statistics.
10. Extract if-then rules from the decision tree generated by classifier, observe the confusion matrix and derive Accuracy, F- measure, TPrate, FPrate, Precision and recall values. Apply a cross-validation strategy with various fold levels and compare the accuracy results.
11. Load each dataset into Weka and run a simple k-means clustering algorithm with different values of k(number of desired clusters). Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.

Dr. Babasaheb Ambedkar Technological University, Lonere

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Course Structure and Detailed Syllabus
for

Second Year B. Tech. Programme in Information Technology
(Effective from Academic Year 2021-22)

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 maximum 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 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 2020-21, starting from first 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 eight semesters of B. Tech Program.

CGPA for pass is minimum 5.0	
CGPA up to < 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, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B. Tech starting from Academic Year 2020-21

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 students remains 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. Students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

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

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

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

Where
'n' is the number of subjects for the semester,
'c_i' is the number of credits allotted to a particular subject
'g_i' is the grade-points awarded to the student for the subject based on his performance as per the above table and
-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 performance 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 s/he entered the Institute. CGPA is also calculated at the end of every semester (up to two decimal places) starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

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

Where
'm' is the total number of subjects from first semester onwards up to and including the semester S,
'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/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 (e.g. Representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.
3. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
4. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
5. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
6. 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.

7. 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) Credit's 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.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B. Tech. Programme in Information Technology

Second Year B. Tech. (With effect from 2021-22)

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	T	P	CA	MSE	ESE	Total	Credit
BSC	BTBS301	Engineering Mathematics - III	3	1	-	20	20	60	100	4
HSSMC	BTHM3402	Interpersonal Communication Skills and Self-Development for Engineers	2	-	-	20	20	60	100	2
PCC	BTITC303*	Computer Architecture and Organization	3	1	-	20	20	60	100	4
PCC	BTITC304	Object Oriented Paradigm with C++	3	1	-	20	20	60	100	4
PCC	BTITC305	Data Structures and Applications	3	1	-	20	20	60	100	4
LC	BTITL306	Object Oriented Paradigm with C ++ Lab	-	-	2	60	-	40	100	1
	BTITL307	Data Structures and Applications Lab	-	-	2	60	-	40	100	1
Seminar	BTITS308	Seminar – I	-	-	-	60	-	40	100	2
Internship	Internship - I	Internship - I Evaluation	-	-	-	-	-	-	-	Audit
			14	**4**	**4**	**280**	**100**	**420**	**800**	**22**
	Semester IV									
HSSMC	BTITHM401	Organizational Behavior	3	-	-	20	20	60	100	3
PCC	BTITC402	Probability and Statistics	3	1	-	20	20	60	100	4
PCC	BTITC403*	Discrete Mathematics	3	1	-	20	20	60	100	4
PCC	BTITC404	Design and Analysis of Algorithms	3	1	-	20	20	60	100	4
PEC	BTITPE405A BTITPE405B BTITPE405C	**Elective-I** Digital Logic and Microprocessor Web Technology Physics of Engineering Materials	2	1	-	20	20	60	100	3
HSSMC	BTITHM406	Constitution of India	2	-	-	-	-	50	50	Audit
LC	BTITL407	Design and Analysis of Algorithms Lab	-	-	2	60	-	40	100	1
	BTITL408	Elective- I Lab	-	-	2	60	-	40	100	1
Seminar	BTITS409	Seminar - II	-	-	-	60	-	40	100	2
Internship	Internship - II	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or at one time).	-	-	-	-	-	-	-	To be audited in V Sem.
			16	**4**	**4**	**280**	**100**	**470**	**850**	**22**

* *These courses are to be studied on self –study mode using SWAYAM/NPTEL/Any other source.*
BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Engineering Mathematics – III**	**Semester:**	**III**
Course Code:	**BTBS301**	**Course Type:**	**Compulsory**
Prerequisite:	**Engineering Mathematics – II**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Basic Science**	**Credits:**	**4**

Course Objectives:

1. To provide in depth knowledge of complex numbers.
2. To find the solution of differential equations.
3. To find an in-depth knowledge of Fourier series analysis of periodic function.

Course Outcomes:

After learning the course, the students should be able:

1. To develop an ability to use characteristics of complex numbers in problem pertaining to electric circuits.
2. To develop an acquaintance with the method of finding solution of differential equations.
3. To develop an in-depth knowledge of vector differentiation and vector integration.
4. To develop Fourier series expansion of different periodic functions.

Course Content:

UNIT I

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

UNIT II

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

UNIT III

Fourier Transform: Definitions – integral transforms, Fourier integral theorem (without proof), Fourier sine and cosine integrals, Complex form of Fourier integrals, Fourier sine and cosine transforms, Properties of Fourier transforms, Parseval's identity for Fourier Transforms.

UNIT IV

Partial Differential Equations and their Applications: Formation of Partial differential equations by eliminating arbitrary constants and functions, Equations solvable by direct integration, Linear equations of first order (Lagrange's linear equations), Method of separation of variables – applications to find

solutions of one-dimensional heat flow equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$, and one-dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

UNIT V

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

Text Books:

1. B. S. Grewal, **"*Higher Engineering Mathematics*"**, Khanna Publishers, New Delhi.
2. H. K. Das, Er. Rajnish Verma, **"*Higher Engineering Mathematics*"**, S. Chand & CO. Pvt. Ltd., New Delhi.
3. Dr. B. B. Singh, **"*A course in Engineering Mathematics (Volume-III)*"**, Synergy Knowledge ware, Mumbai.
4. B. V. Ramana, **"*Higher Engineering Mathematics"***, Tata McGraw-Hill Publications, New Delhi.

Reference Books:

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

General Instructions:

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

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Interpersonal Communication Skills and Self-Development for Engineers**	**Semester:**	**III**
Course Code:	**BTHM3402**	**Course Type:**	**Compulsory**
Prerequisite:	**Nil**	**L – T – P:**	**2 - 0 - 0**
Stream:	**Humanities, Social Science and Management**	**Credits:**	**2**

Course Objectives:

1. To build the skills like team building so that they can work efficiently in groups.
2. To provide knowledge of conflict management while working in large organizations.
3. To develop management skills required in routine work environment.
4. To polish the personality of the learners in order to make them good leaders and employees.
5. To imbibe qualities like manners & etiquettes coordination, mutual understanding for their colleague while working in group.

Course Outcomes:

After learning the course, the students should be able:

1. To acquire interpersonal communication skills.
2. To develop the ability to work independently.
3. To develop the qualities like self-discipline, self-criticism and self-management.
4. To have the qualities of time management and discipline.
5. To present themselves as an inspiration for others.

Course Content:

UNIT I

Development of Proficiency in English: Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups), 5 Ws & 1 H & 7 Cs for effective Communication, Imbibing Etiquettes and manners, Study of different pictorial expressions of non-verbal communication and their analysis.

UNIT II

Self-Management: Self-Management, Self-Evaluation, Self-discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency etc., Self-Awareness, Self-Management, Identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, Ego, Pride, Leadership & Team Dynamics.

UNIT III

Time Management Techniques: Practice by game playing and other learning strategies to achieve the set targets, Time Management Concept, Attendance, Discipline & Punctuality.

UNIT IV

Motivation/ Inspiration: Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation, Motivation techniques: Motivation techniques based on needs and field situations.

UNIT V

Interpersonal Skills Development: Positive Relationship, Positive Attitudes, and Empathies: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills,
Effective Computing Skills: Designing an effective Presentation: Contents, appearance, themes in a presentation, Tone and Language in a presentation, Role and Importance of different tools for effective presentation.

Text Book:

1. Minakshi Raman, Sangeeta Sharma, ***Technical Communication: Principles and Practice***, Oxford University Press, 3rd edition, 2017.

Reference Books:

1. Mitra, Barun, ***"Personality Development and Soft Skills"***, Oxford University Press, 2016.
2. Ramesh, Gopalswamy, ***"The Ace of Soft Skills: Attitude, Communication and Etiquette for Success"***, Pearson Education, 2013.
3. Covey, Stephen R., ***"Seven Habits of Highly Effective People: Powerful Lessons in Personal Change"***.
4. Rosenberg Marshall B., ***"Nonviolent Communication: A Language of Life"***, Puddle Dancer Press, 3rd edition.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Computer Architecture and Organization**	**Semester:**	**III**
Course Code:	**BTITC303**	**Course Type:**	**Compulsory**
Prerequisite:	**Nil**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To understand the structure, functions and characteristics of computer systems.
2. To learn basics of Computer Architecture.
3. To study hierarchical memory system including cache memories and virtual memory.
4. To identify input / output devices and their data transfer mechanisms.

Course Outcomes:

After learning the course, the students should be able:

1. To identify components of a computer system including CPU, memory and input/output units.
2. To explain instruction types, its execution and interrupt mechanism.
3. To illustrate numerical and character representations in digital logic and floating-point arithmetic.

Course Content:

UNIT I

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

UNIT II

Instruction Sets: 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.

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

UNIT III

Memory Organization: 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 IV

Control Unit: 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.

UNIT V

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 Books:

1. William Stalling, ***"Computer Organization and Architecture: Designing for Performance"***, Prentice Hall Publication, 8th edition, 2009.
2. Hayes, ***"Computer Architecture and Organization"***, McGraw-Hill Publication, 3rd edition, 2012.
3. Zaky, **"*Computer Organization"***, McGraw-Hill Publication, 5th edition, 2011.

Reference Books:

1. Morgan, Hennessy, Patterson, ***"Computer Architecture: A Quantitative Approach"***, Kaufman Publication, 4th edition, 2007.
2. Morris Mano, ***"Computer System Architecture"***, Pearson Education India, 3rd edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, ***"Fundamentals of Computer Organization and Architecture"***, Wiley Publication, 1st edition, 2004.
4. Miles J. Murdocca, Vincent P. Heuring, ***"Computer Architecture and Organization: An Integrated Approach"***, Wiley Publication, 1st edition, 2007.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Object Oriented Paradigm with C++**	**Semester:**	**III**
Course Code:	**BTITC304**	**Course Type:**	**Compulsory**
Prerequisite:	**Computer Programming in C**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To understand object oriented programming paradigm.
2. To develop programming skills in C++.

Course Outcomes:

After learning the course, the students should be able:

1. To draw the control flow of a program.
2. To understand the storage concepts in a simple program.
3. To program using basic concepts of OO languages i.e., objects, encapsulation, data hiding, polymorphism etc.
4. To program using advanced concepts of OO languages such as exception handling etc.
5. To work with files and its different mode.

Course Content:

UNIT I

Object Oriented Programming Paradigm: Basic concepts, Benefits, Object oriented languages, Applications, Object Oriented Systems Development: Object oriented analysis, Object oriented design.

UNIT II

Beginning with C++: Tokens, Data types, Operators, Expressions and Control structures, Array, Functions, Structures and Unions, Class and Objects, specifying a class, Defining member functions, Private member functions, Static data and member functions, Arrays of objects, Friend functions.

UNIT III

Constructors and Destructors: Constructor, Parameterized constructors, Multiple constructors in a class, Copy constructors, Dynamic constructors, Destructors, Inheritance: Single inheritance, Multilevel inheritance, Multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes.

UNIT IV

Polymorphism: Operator overloading, Function overloading, Virtual functions, Pure virtual functions, Abstract class, Working with Files: Classes for file stream operations and I/O stream operations, Opening and closing a file, Detecting end-of-file, More about Open (): File Modes, Sequential input and output operations.

UNIT V

Exception Handling: Basics, Mechanism, Types of exceptions, Catching exceptions, Multiple catching, Nested try statements, Throwing, Rethrowing, Specifying exceptions.

Text Books:

1. E. Balagurusamy, ***"Object Oriented Programming with C++"***, McGraw Hill publication, 7th edition, 2017.
2. Robert Lafore, ***"Object Oriented Programming in C++"***, Pearson India, 4th edition, 2008.

Reference Books:

1. J. R. Hubbard, ***"Programming with C++: Schaum's Outlines"***, McGraw-Hill education, 3rd edition, 2009.
2. P. J. Deitel, H.M. Deitel, ***"C++ How to Program"***, Pearson Education, 10th edition, 2016.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Data Structures and Applications**	**Semester:**	**III**
Course Code:	**BTITC305**	**Course Type:**	**Compulsory**
Prerequisite:	**Computer Programming in C**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To choose the appropriate data structure and algorithm design method for a specified application.
2. To assess how the choice of data structures and algorithm design methods affects the performance of programs.
3. To solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps, binary search trees, graphs and writing programs for these solutions.

Course Outcomes:

After learning the course, the students should be able:

1. To write neat code by selecting appropriate data structure and demonstrate a working solution for a given problem.
2. To think of all possible inputs to an application and handle all possible errors properly.
3. To analyze clearly different possible solutions to a program and select the most efficient one.
4. To write an application to demonstrate a good working solution.
5. To demonstrate the ability to write reusable code and abstract data types with object based approach.

Course Content:

UNIT I

Introduction to Data Structures and Analysis of Algorithms: Need of data structures, Types of data structures, Recursion, ADT (Abstract Data Types), Basics of algorithm, Analysis of algorithm through time complexity and space complexity, Asymptotic notations.

UNIT II

Stack and Queue: Stack representation, Stack operation, Application, Queue representation, Queue operation, Circular and priority queue, Linked list: Operation on linked list, Linked stacks and Queues, Array implementation of linked list, doubly linked list, Circular linked list.

UNIT III

Binary Tree: Basic tree concept, Binary tree operations, Binary tree representation, Binary tree traversals, Binary search tree and operations, Applications of binary trees.

UNIT IV

Graphs: Basics concepts of graphs, Representation of graphs, Graph traversals BFS and DFS, Minimum spanning tree algorithms: Kruskal's algorithm and Prim's algorithm, Application of graph.

UNIT V

Searching and Sorting Techniques: Linear search and binary search, Sorting techniques: Various sorting methods and their time complexity: Insertion sort, Selection sort, Merge sort, Quick sort, Heap sort.

Text Books:

1. E. Horowitz, D. Mehta, S. Sahni, ***"Fundamentals of Data Structures in C++"***, Silicon Press, 2nd edition, 2008.
2. Semour Lipschutz, ***"Data Structures with C"***, Tata McGraw-Hill, 1st edition, 2010.
3. R.S. Bichkar, ***"Programming with C and Data structures"***, Universities Press, 1st edition, 2014.

Reference Books:

1. Goodrich, Tamassia, "***Data Structures and Algorithm in Java***", Wiley publication, 6th edition, 2014.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "***Introduction to Algorithms***", MIT Press, 3rd edition, 2009.
3. V. Goyal, L. Goyal, P. Kumar, "***A Simplified Approach to Data Structures***", Shroff Publishers, 1st edition, 2014.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Object Oriented Paradigm with C++ Lab**	**Semester:**	**III**
Course Code:	**BTITL306**	**Course Type:**	**Compulsory**
Prerequisite:	**Computer Programming in C**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Core**	**Credits:**	**1**

Lab Experiments List:

1. Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power () that takes a double value for n and an int value for p, and returns the result as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main () function that gets values from the user to test this function.
2. A point on the two-dimensional plane can be represented by two numbers: An X coordinate and a Y coordinates. For example, (4, 5) represents point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates. Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Then set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this:
   Enter coordinates for P1: 3 4
   Enter coordinates for P2: 5 7
   Coordinates of P1 + P2 are: 8, 11
   Create the equivalent of a four-function calculator. The program should request the user to enter a number, an operator and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying or dividing the two numbers (It should use a switch statement to select the operation). Finally, it should display the result. When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be Y or N. Some sample interaction with the program might look like this:
   Enter first number, operator, second number: 10/ 3
   Answer = 3.333333
   Do another (Y/ N)? Y
   Enter first number, operator, second number 12 + 100
   Answer = 112
   Do another (Y/ N)? N
3. A phone number, such as (212) 767-8900 can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one and have the user input a number for the other one. Then display both numbers. The interaction might look like this:
   Enter your area code, exchange and number: 415 555 1212
   My number is (212) 767-8900
   Your number is (415) 555-1212

4. Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.
5. Create a class rational which represents a numerical value by two double values- NUMERATOR and DENOMINATOR. Include the following public member functions:
   constructor with no arguments (default), constructor with two arguments, void reduce () that reduces the rational number by eliminating the highest common factor between the numerator and denominator.
   Overload + operator to add two rational numbers
   Overload - operator to enable input through cin
   Overload * operator to enable output through cout
   Write a main ( ) to test all the functions in the class.
6. Consider the following class definition:

```
class father {
protected age;
public;
father (int x) {age = x;}
virtual void iam()
{
cout<<“I AM THE FATHER ” ;
cout<< “My age is:” <<age<<endl;
}
};
```

   Derive the two classes son and daughter from the above class and for each, define iam () to write similar but appropriate messages. You should also define suitable constructors for these classes. Now, write a main () that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam () through the pointer to demonstrate polymorphism in action.
7. Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll number, name (a string of 30 or less number of characters) and marks.
8. A hospital wants to create a database regarding its indoor patients. The information to store includes:
   Name of the patient
   Date of admission
   Disease
   Date of discharge

Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the patients to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).

9. Imagine a tollbooth with a class called tollbooth. The two data items are a type unsigned int to hold the total number of cars and a type double to hold the total amount of money collected. A constructor initializes both these to 0. A member function called payingCar () increments the car total and adds 0.50 to the cash total. Another function called nopayCar (), increments the car total but adds nothing to the cash total. Finally, a member function called display () displays the two totals i.e., total cars and total cash. Write a program to test this class. This program should allow the user to push one key to count a paying car and another to count a nonpaying car. Pushing the ESC key should cause the program to print out the total cars and total cash and then exit.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Data Structures and Applications Lab**	**Semester:**	**III**
Course Code:	**BTITL307**	**Course Type:**	**Compulsory**
Prerequisite:	**Computer Programming in C**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Core**	**Credits:**	**1**

Lab Experiments List:

1. Implementation of Stacks, Queues (using both arrays and linked lists).
2. Implementation of circular queue using arrays.
3. Implementation of recursive and non-recursive functions to perform the following searching operations for a key value in a given list of integers: i) Linear search ii) Binary search.
4. Implement a program to evaluate a given postfix expression using stacks.
5. Implement a program to convert a given infix expression to postfix form using stacks.
6. Implement the following operations on singly linked list:
   i) Creation ii) Insertion iii) Deletion iv) Traversal.
7. Implementation of Polynomial arithmetic using linked list.
8. Implement the following operations on circular linked list:
   i) Creation ii) Insertion iii) Deletion iv) Traversal.
9. Implementation of recursive and iterative traversals on binary tree.
10. Implementation of the following operations on binary search tree (BST):
    (a) Minimum key (b) Maximum key (c) Search for a given key (d) Delete a node with given key.
11. Implementation of graph traversals by applying: (a) BFS (b) DFS.
12. Implement the following sorting algorithms:
    (a) Bubble sort (b) Insertion sort (c) Quick sort (d) Heap sort.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Organizational Behavior**	**Semester:**	**IV**
Course Code:	**BTITHM401**	**Course Type:**	**Compulsory**
Pre-requisite:	**Nil**	**L – T – P:**	**3 – 0 – 0**
Stream:	**Humanities, Social Science and Management**	**Credits:**	**3**

Course Objective:

1. To explore the organization as a micro-social system, a medium to facilitate and improve the interpersonal relationships in the context of organizational functioning.

Course Outcomes:

After learning the course, the students should be able:

1. To become more self-aware and have identified areas of development for long term effectiveness.
2. To understand the role that individuals play collectively to perform in organizations.

Course Content:

UNIT I

Introduction to Organizational Behavior: Management and organizational behavior, Complementing intuition with systematic study, Disciplines and opportunities for OB, Developing an OB Model, Diversity in organizations: Diversity, Discrimination, Biographical characteristics, Other differentiating characteristics, Ability, Implementing diverging managements strategies.

UNIT II

Attitudes and job satisfaction: Attitudes, Attitudes and behavior, Measuring job satisfaction, What causes job satisfaction?, Outcomes of job satisfaction, The impact of job dissatisfaction, Emotions and moods, Sources of emotions and moods, Emotional labor, Affective events theory, Emotional intelligence, Emotion regulation, OB application of emotions and moods, Personality and values: personality, Personality frameworks, Other personality attributes relevant to OB, Personality and situation, Values, Linking an individual's personality and values to the workplace, Cultural values.

UNIT III

Perception and individual decision, What is person perception?, Perception: Making judgments about others, the link between perception and individual decision making, Decision making in organizations, Influences on decision making: individual differences and organizational constraints, Ethics in decision making, Creativity: creative decision making and innovation in organizations, Motivation concepts, Early theories of motivation, Contemporary theories of motivation, Job engagement, Integrating contemporary theories of motivation, Motivation: from concepts to application, Motivating by job design: the Job Characteristic Model (JCM) using job redesign to motivate employees using alternative work arrangements to motivate employees, using Employees Involvements and Participation (EIP) to motivate employees, using extrinsic and intrinsic rewards to motivate employees, using benefits to motivate employees, Motivating employees through company culture.

UNIT IV

Foundation of group behavior: Group and group identity, Stages of group development, Group, differences between group and teams, Types of teams, Creating effective teams, Turning individuals into team players, Communication, Direction of communication, Modes of communication, Choice of communication, Persuasive communication, Cultural factors, Rewards, Competency-based rewards, Performance-based rewards, Empowerment and self-managed teams.

UNIT V

Leadership, Trait theories of leadership, Behavioral theories, Contingency theories, Contemporary theories of leadership, Responsible leadership, Positive leadership, Challenges of leadership, Power and leadership: bases of power, Power tactics, How power affects people?, Politics: power in action, Causes and consequences of political behavior, Conflict: definition, the conflict process, Negotiation, the negotiation process, Third party negotiation, Foundations of organization structure, Common organizational frameworks structures, Alternate design options, Organizational designs and employees behavior, Organizational culture, Creating and sustaining culture, Organizational change and stress management, Resistance to change, Approaches to managing organizational change.

Text Books:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, ***"Organizational Behaviour"***, Pearson Publication, 15th edition, 2014.
2. Uma Sekaran, **"*Organizational Behavior"***, McGraw Hill Company, New Delhi, 2011.
3. L. M. Prasad, ***"Organizational Behavior"***, S. Chand and Co. Ltd, New Delhi, 2008.
4. Nair, Banerjee, Agarwal, **"*Organization Behavior"***, Pragati Prakashan, New Delhi, 2006.

Reference Books:

1. Rosy Joshi, Shashi K Gupta, **"*Organisational Behaviour"***, Kalyani publishers, New Delhi, 2005.
2. S. S. Khanka, **"*Organizational Behavior"***, S. Chand and Co. Ltd, New Delhi, 2008.
3. Fred Luthans, **"*Organizational Behavior"*,** McGraw Hill International Edition, 11th edition.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Probability and Statistics**	**Semester:**	**IV**
Course Code:	**BTITC402**	**Course Type:**	**Compulsory**
Pre-requisite:	**Engineering Mathematics III**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To understand probability concepts.
2. To acquire knowledge of probability distributions.
3. To get exposer to hypothesis testing using distributions.
4. To understand principles of queuing theory.
5. To be exposed to discrete time Markov chain.

Course Outcome:

After learning the course, the students should be able:

1. To acquire analytical ability in solving mathematical problems as applied to the respective branches of engineering.

Course Content:

UNIT I

Probability Theory: 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, Random Variable and Mathematical Expectation: Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs.

UNIT II

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 III

Correlation: 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, Linear Regression Analysis: 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 IV

Testing of Hypothesis: Introduction to Sampling Distributions, Population and Sample, Null Hypothesis and Alternative Hypothesis, Single and Two Tailed Test, Testing of Hypothesis, Level of Significance, Critical Region, Procedure for Testing of Hypothesis Large Sample Test- Test for Single Proportion,

Two Sample Proportions, Large Sample Test- Test for Single Mean, Two Sample Means, Small Sample Tests – "t" Test For a Single Mean, "t" Test for the difference of Means, Paired "t" Test, F Test – Test of Significance of the Difference between Two Population Variances, Chi Square Test for Goodness of Fit, Independence of Attributes.

UNIT V

Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines, Second degree parabolas and more general curves, Markov Chains: Introduction to Stochastic process, Markov process, Markov chain one step & n-step Transition Probability, Classification of states of a Markov chain – Applications.

Text Books:

1. Veerarajan T., ***"Probability, Statistics and Random Processes"***, Tata McGraw Hill, 1st reprint, 2004.
2. S. C. Gupta and V.K. Kapoor, ***"Fundamentals of Mathematical Statistics"***, Sultan Chand & Sons, 9th extensively revised edition, 1999.
3. G. V. Kumbhojkar, "***Probability and Random Processes"***, C. Jamnadas and Co., 14th edition, 2010.
4. Erwin Kreyszig, ***"Advanced Engineering Mathematics***", John Wiley & Sons, 9th edition, 2006.
5. Veerarajan T., ***"Engineering Mathematics (for semester III)***", Tata McGraw-Hill, New Delhi, 2010.
6. G. Haribaskaran, "***Probability, Queuing Theory and Reliability Engineering***", Laxmi Publications, 2nd edition, 2009.
7. Murray Spiegel, John Schiller, R. ALU Srinivasan, ***"Probability and Statistics***", Schaum's Outlines, 4th edition, 2013.

Reference Books:

1. Trivedi K. S., ***"Probability and Statistics with reliability, Queueing and Computer Science Applications***", Prentice Hall of India, New Delhi, 1984.
2. Gross.D, Harris.C.M., ***"Fundamentals of Queuing Theory"***, John Wiley and Sons, 1985.
3. Allen. A. O., ***"Probability Statistics and Queuing Theory"***, Academic Press, 1981.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Discrete Mathematics**	**Semester:**	**IV**
Course Code:	**BTITC403**	**Course Type:**	**Compulsory**
Prerequisite:	**Nil**	**L – T – P:**	**3 – 1 – 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To develop a foundation of set theory concepts, notation and applications.
2. To inculcate the habit of logical and mathematical thinking and its application to Information Technology.
3. To understand logic, basic counting principles, relations, induction, sequences and summations.
4. To be able to present a coherent and mathematically accurate argument.
5. To understand the theory of graphs and algebraic structures and their applications.

Course Outcomes:

After learning the course, the students should be able:

1. To perform operations on various discrete structures such as sets functions, relations and sequences.
2. To solve problems using counting techniques, permutation and combination, recursion and generating functions.
3. To use graphs as tools to visualize and simplify problems.
4. To solve problems using algebraic structures (Rings, Monoids and Groups).

Course Content:

UNIT I

The Foundations: Sets theory and its applications, Set operations, Laws of set theory, Power sets, Partitions, Multi-sets, Cardinality, Principle of inclusion and exclusion, Applications of sets: Problems on set operations and principle of inclusion-exclusion, Propositional logic, Propositional equivalences, Propositional algebra, Basic logical operations, De Morgan's laws, Predicates and quantifiers, Nested quantifiers, Rules of inference, Proof methods and strategy, Applications of logic: Translating English statements into propositions, Boolean searches in web pages, Bit operations.

UNIT II

Induction and recursion: Mathematical induction, Strong induction, Recursive definitions, Re-cursive algorithms, Applications: Proofs using mathematical induction, Functions: Definition and types of functions: Injective, Subjective and bijective, Composition, Identity and inverse of function, Re-cursively defined functions, Applications of functions, Job scheduling problem.

UNIT III

Basic Counting Principles: Permutations, Combinations, Binomial coefficients, Generalized permutations and combinations, Combinations and permutations with repetition, Generating permutations and combinations, Recurrence relation, Solving linear recurrence relations with constant coefficients, Applications of counting principles, Pigeonhole principle and its applications.

UNIT IV

Relations: Properties of binary relations, Closure of relations, Warshall's algorithm, Equivalence relations and partitions, Partial ordering relations and lattice application of relations: N-ary relations and their applications, Databases and relations. Algebraic Structures: Algebraic systems, Groups, Semi groups, Monoid, Subgroups, Permutation groups, Codes and group codes, Isomorphism and automorphisms, Homomorphism, Fermat's little theorem, Polynomial rings, Applications of groups, Ring, Field.

UNIT V

Graph Theory: Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path in weighted graph, Hamiltonian and Euler paths and circuits, Factors of a graph, Shortest path algorithm, Traveling salesman problem, Planar graph and Kuratowsk is graph and theorem, Independent sets, Graph coloring, Trees, Rooted trees, Path length in rooted trees, Binary search trees, Spanning trees and cut set, Theorems on spanning trees, Cut sets, Circuits, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

Text Books:

1. K. H. Rosen, ***"Discrete Mathematics and Its Applications"***, Tata McGraw Hill Publication, 8th edition, 2018.
2. J. P. Tremblay, R. Manohar, ***"Discrete Mathematical Structures with Applications to Computer Science"***, McGraw Hill Publication, 1st edition, 2001.
3. C. L. Liu, "***Elements of Discrete Mathematics"***, McGraw-Hill Publication, 3rd edition, 2008.

Reference Books:

1. B. Kolman, R. Busby, S. Ross, ***"Discrete Mathematical Structures"***, Pearson Education, 6th edition, 2009.
2. R. K. Bisht, H. S. Dhami, ***"Discrete Mathematics"***, Oxford University Press, 2015.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Design and Analysis of Algorithms**	**Semester:**	**IV**
Course Code:	**BTITC404**	**Course Type:**	**Compulsory**
Pre-requisite:	**Data Structures and Applications**	**L – T – P:**	**3 – 1– 0**
Stream:	**Core**	**Credits:**	**4**

Course Objectives:

1. To learn fundamentals of algorithms design techniques.
2. To understand basic knowledge of computational complexity, selection of the best algorithm to solve a problem.
3. To analyze the performance of algorithms and compare them with respect to time and space complexity.
4. To develop proficiency in problem solving and programming.

Course Outcomes:

After learning the course, the students should be able:

1. To develop efficient algorithms for simple computational tasks.
2. To understand concepts of time and space complexity, worst case, average case and best case complexities.
3. To design algorithms such as sorting, searching and problems involving graphs.
4. To compute complexity measures of recursive algorithms using recurrence relations.

Course Content:

UNIT I

Introduction: Instruction counts, Growth functions, Necessity of time and space analysis of algorithms, Order notations (O, Θ, Ω notations), Problem instance size, Frequently occurring recurrence relations in analysis of algorithms.

UNIT II

Divide and Conquer: Binary search, Finding maximum and minimum, Merge sort, Quick sort, Strassen's matrix multiplication, Greedy Algorithms: Knapsack problem, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge pattern, Single source shortest paths.

UNIT III

Dynamic Programming: Multistage graphs, All pairs shortest paths, Knapsack problem, Travelling salesman problem.

UNIT IV

Graph Theory: Elementary Algorithms: DFS, BFS, Topological Sort, Minimum spanning trees (Kruskal and Prim's algorithms).

UNIT V

Introduction to Backtracking and Branch and bound strategy, NP Hard and NP complete problems.

Text Books:

1. Thomas Cormen, Charles Leiserson, Ronald Rivest and Cliford Stein, ***"Introduction to Algorithms"***, MIT Press, 3rd edition, 2010.
2. E. Horowitz, S. Sahni and S. Rajsekaran, ***"Computer Algorithms"***, Silicon Press, 2nd edition, 2008.

Reference Books:

1. B. K. Joshi, ***"Data Structures and Algorithms in C++"***, Tata McGraw Hill Education, 2010.
2. G. T. Heineman, Gary Pollice, Stanley Selkow, ***"Algorithms in a Nutshell"***, Shroff Publication, 2nd edition, 2016.
3. Kyle Loudon, ***"Mastering Algorithms with C"***, O' Reilly Publication, 1st edition, 2009.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Digital Logic and Microprocessor**	**Semester:**	**IV**
Course Code:	**BTITPE405A**	**Course Type:**	**Elective**
Prerequisite:	**Nil**	**L – T – P:**	**2 – 1 – 0**
Stream:	**Professional Core**	**Credits:**	**3**

Course Objectives:

1. To learn Boolean algebra, logic gates, logic families, realization of Boolean expressions and minimization techniques.
2. To study the sequential logic circuits design used in synchronous and asynchronous modes.
3. To understand 8086 microprocessor Architecture.
4. To understand design aspects of I/O and Memory Interfacing circuits.
5. To acquaint with instruction set and logic required to build assembly language programs.

Course Outcomes:

After learning the course, students should be able:

1. To apply the knowledge of number systems and codes in problem solving related to code conversion and number system and optimize circuit design.
2. To explain the fundamental concepts of combinational and sequential logic devices and design them.
3. To explain 8086 architecture and its instruction set.
4. To develop assembly language programs for the X86 microprocessor.
5. To interface peripheral chips and describe the role of interrupt in microprocessor family.

Course Content:

UNIT I

Switching Theory**:** Boolean algebra, Logic gates and switching functions, Truth tables and switching expressions, Minimization of completely and incompletely specified switching functions, Karnaugh map and Quine-McCluskey method, Multiple output minimization, Representation and manipulation of functions using BDDs, Two-level and multi-level logic circuit synthesis.

UNIT II

Combinational Logic Circuits: Realizing logical expressions using different logic gates, Realization of adders and subtractors, Design of multiplexers, Demultiplexers, Design of combinational circuits using combinational IC's, Design of code converters, Comparators and decoders.

UNIT III

Sequential Circuits: Clocks, Flip-flops, Latches, Counters and shift registers, Finite-state machine model, Synthesis of synchronous sequential circuits, Minimization and state assignment, Asynchronous sequential circuit synthesis.

UNIT IV

Introduction of 8086 Microprocessor: Evolution of Microprocessor, Architecture, Pin diagram, Minimum and maximum mode bus configuration, Memory interfacing, Memory Map, Address decoding

logic. Instruction Set, Addressing modes, Assembly language programming, Assembler directives, Stacks and subroutines. Bus cycle, wait state, Timing diagrams, Interrupt structure, ISR. 8087 Math Co-processor: Study of architecture of 8087.

UNIT V

I/O Interfacing: Memory mapped I/O, I/O mapped I/O, Polled I/O, PPI 8255, Various operating modes of 8255, Interfacing, and programming, 4x4 key matrix interfacing, Study of Interrupt Controller 8259A. Introduction to Microcontroller: Architecture of 8051, Instruction Set, Pin Diagram, Introduction to PIC microcontroller.

Text Books:

1. R. P. Jain, ***"Modern Digital Electronics",*** Tata McGraw Hill Publication, 4th edition, 2010.
2. A. Nagoor Kani, ***"Microprocessor and Microcontroller"***, Tata McGraw Hill Publication, 2nd edition, 2012.

Reference Books:

1. D. P. Leach, A. P. Malvino, G. Saha, ***"Digital Principles and Applications"***, McGraw Hill Publication, 8th edition, 2014.
2. Yu- Cheng Liu, Glenn A. Gibson, ***"Microcomputer systems: 8086/88 family architecture, Programming and Design"***, Pearson Publication, 2nd edition, 2015.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Web Technology**	**Semester:**	**IV**
Course Code:	**BTITPE405B**	**Course Type:**	**Elective**
Prerequisite:	**Nil**	**L – T – P:**	**2 – 1– 0**
Stream:	**Professional Core**	**Credits:**	**3**

Course Objectives:

1. To become familiar with modern web technologies.
2. To use different web scripting technology.
3. To understand web hosting, server type, debugging, and performance driven application development.
4. To understand user interface and be aware of real world scenario.

Course Outcomes:

After learning the course, the students should be able:

1. To understand World Wide Web and latest trends in web development.
2. To obtain real world knowledge of design and development.
3. To design and develop web application with all industrial standards.
4. To understand web hosting, server types and debugging.

Course Content:

UNIT I

Introduction to World Wide Web, Features of web, HTTP, Web Servers, Introduction to Scripting Language, Browser, Integrated Development Environment.

UNIT II

HTML: Introduction to HTML, Basics of HTML, Formatting and fonts, Commenting code, HTML heading, Block element, Inline element, Comment, Attributes, Hyperlink, Lists, Tables, Images, Forms, Meta tags, Character entities, Frames sets.

UNIT III

Advance HTML: Overview and features of HTML5, Includes External File, Responsive Layout with Media Queries, Marquee, Semantic Tags, HTML Symbol, URL Encode, Cashing, Video Tags, Audio Tags, Image Maps.CSS: Introduction to CSS, Selector, Basic syntax and structure, Padding, Margin, Manipulating Texts, Display, Height, Width, Border, Color, Fonts, Positioning Using CSS, Overview and features of CSS3.

UNIT IV

PHP**:** Introduction to PHP, Features of PHP, Basics of PHP, Syntax, Variable, Printing Output, Array, String, Function, Data types, Operator, Loops, Conditional Statement, Introduction to Advance PHP, Form Processing, Files, PHP Cookies, PHP Sessions, Constant, PHP Magic Function, PHP Global Variable, Error Handling, Exception, Connection with Database, Curd Operation in PHP.

UNIT V

Web Hosting, Debugging and Unit Testing, Browser Compatibility.

Text Books:

1. Thomas Powell, **"*HTML & CSS: The Complete Reference*"**, McGraw Hill Publication, 5th edition, 2017.
2. Snehal Joglekar, **"*HTML and CSS- Web Technologies*"**, Nirali Prakashan, 2016.

Reference Book:

1. Steven Holzner, **"*PHP: The Complete Reference*"**, McGraw Hill Publication, Study edition, 2017.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Physics of Engineering Materials**	**Semester:**	**IV**
Course Code:	**BTITPE405C**	**Course Type:**	**Elective**
Prerequisite:	**Engineering Physics**	**L – T – P:**	**2 – 1– 0**
Stream:	**Professional Core**	**Credits:**	**3**

Course Objective:

1. To understand and apply the Physics principles behind the development of Engineering Materials.

Course Outcome:

After learning the course, the students should be able:

1. To understand fundamentals of Electrodynamics, Crystal structure, Semiconductors, Dielectrics, Nano materials, Magnetic and superconducting materials.
2. To understand the basics of advanced devices and technology.

Course Content:

UNIT I

Crystallography: Crystal direction and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and volume defects, Structure properties relationship, Structure determination by X-ray diffraction.

UNIT II

Magnetic Materials: Origin of magnetization using atomic theory classification of magnetic materials and properties, Langevin's theory and Dia, Para and ferromagnetism, Soft and Hard Magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Anti-ferromagnetic and Ferromagnetic materials, Ferrites and Garnets, Magnetic bubbles, Magnetic recording.

UNIT III

Conducting and Superconducting Materials: Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductor, Application of superconductors (Cryotron, magnetic levitation).

UNIT IV

Semiconducting Material: Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductor, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell.

UNIT V

Dielectric Materials: Dielectric constant and polarizability, Types of polarization, Temperature and frequency dependences of Dielectric parameter, Internal fields in solids, Clausius-Mosotti equation, Dielectric loss, Dielectric breakdown, Ferroelectric, Pyroelectric and piezoelectric materials, applications of dielectric materials,

Nanomaterials: Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes,

Characterization techniques of nano materials- SEM, TEM, EDAX, FMR, XRD. Applications of nanomaterials.

Text Books:

1. C. Kittle, ***"Introduction to Solid state Physics"***, Wiley Publication, 8th edition, 2012.
2. C.M. Srivastava and C. Srinivasan, ***"Science of Engineering Materials and Carbon Nanotubes"***, New Age International Publishers, 3rd edition, 2010.
3. A. J. Dekker, ***"Solid State Physics",*** Laxmi Publication, 2008.

Reference Books:

1. V. Raghavan, "***Material Science and Engineering: A First Course***", PHI Learning Publication, 6th edition, 2015.
2. A.J. Dekker, ***"Electrical Engineering Material",*** PHI Publication, 1970.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Constitution of India**	**Semester:**	**IV**
Course Code:	**BTITHM406**	**Course Type:**	**Compulsory**
Pre-requisite:	**Nil**	**L – T – P:**	**2 – 0 – 0**
Stream:	**Humanities, Social Science and Management**	**Credits:**	**Audit**

Course Objectives:

1. To enable the student to understand the importance of constitution.
2. To study public administration.
3. To understand the structure of executive, legislature and judiciary.
4. To understand the autonomous nature of constitutional bodies like Supreme Court and high court, controller and auditor general of India and election commission of India.

Course Outcomes:

After learning the course, the students should be able:

1. To know salient features of the Indian Constitution.
2. To understand directive principles of state policy, its nature and importance.
3. To understand structure, function and powers of Election Commission of India.
4. To be aware of structure of Indian Judiciary, types of court, characteristics of Indian Judiciary.

Course Content:

UNIT I

Introduction to Indian Constitution:
Historical background, Philosophy of Indian Constitution, Preamble of Constitution- its forms and Importance, Features of Indian Constitution, The nature of Indian Federation.

UNIT II

Fundamental Rights and Directive Principles:
Fundamental Rights- its forms and importance, Fundamental rights in Constitution, Evaluation of Fundamental rights, Fundamental duties, Directive Principles of State Policies (Meaning, Objectives and Source), Classification of Directive Principles, Implementation of Directive Principles.

UNIT III

Composition and Structure of Parliament:
Function of Parliament, Law making Procedure, Executive Council structure and Role, State assembly, Changing Trends of Parliament.

UNIT IV

Judiciary and Election Commission:
Forms of Judiciary, Power, Function and Role of Supreme Court, Judicial Review, Judicial Activism, Structure, Function and Role of Election Commission, Electoral System and Reforms in it.

UNIT V

Socialism of Constitution:
Provision for Women Empowerment, Protection of Rights of Backward Class, Special Provision for Scheduled Tribes, Protection of Rights of workers, Socialistic democracy,
Democracy in India: Challenges, Constitutional Institutions and their role, Lokpal and Lokayukt, State Central Relation, Important Amendments, Nationalism, Criminalisation of Politics.

Text Books:

1. D. Basu, ***"Introduction to the Constitution of India"***, Lexis Nexis Publishers, 23rd edition, 2018.
2. B. Shiva Rao (Editor), ***"Framing of Indian's Constitution, Select Documents"***, Vol. 1, 2015.

Reference Books:

1. T. K. Tope, ***"Constitutional Law of India"***, Sujata V. Manohar (Editor), Eastern Book Company, 3rd edition, 2010.
2. Sir Ivor Jennings, ***"Some Characteristics of Indian Constitution"***, Geoffrey Cumberlege Publishers, 1953.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Design and Analysis of Algorithms Lab**	**Semester:**	**IV**
Course Code:	**BTITL407**	**Course Type:**	**Compulsory**
Pre-requisite:	**Data Structures and Applications Lab**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Core**	**Credits:**	**1**

Lab Experiments List:

1. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n and record the time taken to sort.
   The elements can be read from a file or can be generated using the random number generator. Demonstrate how the divide and conquer method works along with its time complexity analysis: worst case, average case and best case.
2. Implement the Knapsack problem using Greedy method.
3. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm. Write the program.
4. Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
5. Find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
6. Write programs to Implement All-Pairs Shortest Paths problem using Floyd's algorithm
7. Design and implement a program to find a subset of a given set S = Sl, S2,.....,Sn of n positive integers whose SUM is equal to a given positive integer d. For example, if S = 1, 2, 5, 6, 8 and d = 9, there are two solutions 1,2,6 and 1, 8. Display a suitable message, if the given problem instance doesn't have a solution.
8. Write a program to implement string matching algorithm.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Digital Logic and Microprocessor Lab**	**Semester:**	**IV**
Course Code:	**BTITL408**	**Course Type:**	**Elective**
Prerequisite:	**Nil**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Professional Core**	**Credits:**	**1**

Lab Experiments List for Digital Logic:

1. Verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, EX-OR, & EX-NOR).
2. Design and implement following code conversion:
   (a) Binary to Gray (b) Gray to Binary (c) Excess 3 codes to BCD (d) BCD to Excess 3 codes.
3. Design and verify a half adder and full adder.
4. Implementation of Multiplexer, Demultiplexer, Encoder and Decoder.
5. Study of flip flops:
   (a) RS flip flop (b) JK flip flop **(**c) D flip flop (d) T flip flop and applications of flip flop for counter design.

Lab Experiments List for Microprocessor:

1. 8085 and 8086 kit familiarization and basic experiments.
2. Arithmetic operation of 16-bit binary numbers.
3. Programming exercise: sorting, searching and string.
4. 8255 interfaces to 8086.
5. Assembly language programming of 8051.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Web Technology Lab**	**Semester:**	**IV**
Course Code:	**BTITL408**	**Course Type:**	**Elective**
Prerequisite:	**Nil**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Professional Core**	**Credits:**	**1**

Lab Experiments List:

1. Download XAMPP or WAMPP server, IDE, browsers to run HTML program.
2. Develop page to display fruits list with different color with heading on top of the page and link each fruit with fruit description page.
3. Develop using semantic element, page having menu bar in header section.
4. Develop user personal info form using HTML5 input control and decorate with CSS.
5. Develop responsive page layout using media queries.
6. Write a PHP program to print list of user info using array.
7. Write a PHP program to fetch user info from MYSQL database.
8. Write a PHP program to perform crud operation.
9. Write a PHP function to check palindrome string.
10. Write a PHP program using for loop to add all the integers between 0 and 30 and display the total.
11. Create a script to construct the pyramid of asterisk ('*') using nested for loop.
12. Write a program to calculate factorial of a number using for loop.
13. Write a program which will count the specific characters in the text.
14. Debug web site using developer tools, inspect element.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Course Title:	**Physics of Engineering Materials Lab**	**Semester:**	**IV**
Course Code:	**BTITL408**	**Course Type:**	**Elective**
Prerequisite:	**Engineering Physics Lab**	**L – T – P:**	**0 – 0 – 2**
Stream:	**Professional Core**	**Credits:**	**1**

Lab Experiments List:

1. Crystallite size of nanomaterial's using XRD.
2. B-H loop experiment.
3. Susceptibility measurement.
4. Resistivity of materials by four probe method.
5. Hall effect- determination of carrier concentration.
6. G.M. Counter: Study of Nuclear Counting Statistics.
7. Dielectric constant measurement.