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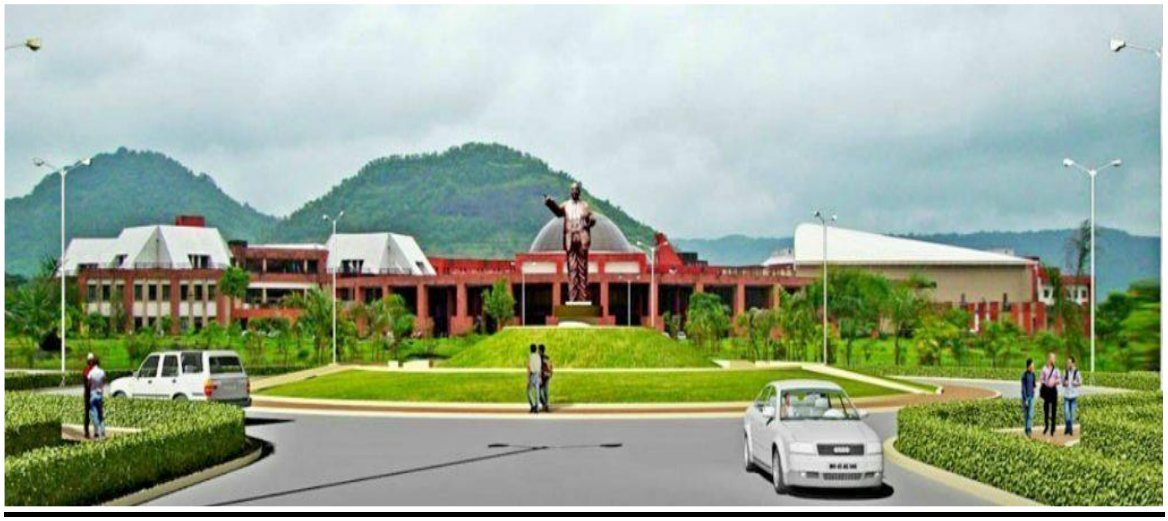
CURRICULUM FOR UNDER GRADUATE PROGRAMME

T.Y. B. TECH

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING/ ARTIFICIAL INTELLIGENCE & DATA SCIENCE/ ARTIFICIAL INTELLIGENCE

WITH EFFECT FROM THE ACADEMIC YEAR
TY: 2022-2023



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 the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.

4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination

(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

(c) Paid all required advance payments of the Institute and hostel for the current semester;

(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2020-21, 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 semester of B. Tech Program.

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

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

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

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

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

It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, 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 student remain **absent** for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

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

6. Evaluation of Performance:

6.1. 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:

$$\text{SGPA} = \frac{\text{CREDIT INDEX}}{\sum \text{CREDITS for a Semester}}$$

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 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 (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$\text{CGPA} = \frac{\sum \text{CREDIT INDEX of all Previous Semester}}{\sum \text{CREDITS of all Previous Semester}} \text{ upto a Semester}$$

Where

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

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

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

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

Award of Degree of Honours

Major Degree

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

A. Eligibility Criteria for Majors

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

Student complying with these criteria will be awarded B. Tech (Honors) 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 Artificial Intelligence & Data Science with Minor in Computer Engineering).

For applying for Honors 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.

a) If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
b) The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
c) In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

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

TRANSFER OF CREDITS

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

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

Category – wise total number of credits

Sr. No	Category	Suggested Breakup of Credits by AICTE	Credits awarded to First year	Credits awarded to Second year to Final Year	Total
1	Humanities and Social Sciences including Management courses	**12***	3	9	**12**
2	Basic Science courses	**25***	18	7	**25**
3	Engineering Science courses including workshop, drawing, basics of electrical / mechanical / computer etc.	**24***	15	6	**21**
4	Professional core courses	**48***	0	51	**51**
5	Professional Elective courses relevant to chosen specialization/branch	**18***	0	16	**16**
6	Open subjects – Electives from other technical and /or emerging subjects	**18***	0	12	**12**
7	Project work, seminar and internship in industry or elsewhere	**15***	1	22	**23**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	**NC**	--	--	**--**
	Total	**160***	**37**	**123**	**160**

**Minor variation is allowed as per need of the respective disciplines.*

Programme Educational Objectives (PEO)

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

Objective Identifier	Objectives
PEO1	To equip graduates with a strong foundation in engineering sciences and Artificial Intelligence and Data Science Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
PEO2	Perceive the limitation and impact of engineering solutions in social, legal, environmental, economic and multidisciplinary contexts.
PEO3	Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness

Programme Outcomes (PO)

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

Outcome Identifier	Outcomes
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Outcome Identifier	Outcomes
PSO1	Apply the fundamentals of science, mathematics and engineering knowledge to design, development, formulates and investigate complex engineering problems related to application area in Artificial Intelligence and Data Science.
PSO2	Provide exposure to latest tools and technologies and aware of the impact of professional engineering solution in environmental, societal, professional ethics and able to communicate effectively.
PSO3	To publish research paper and think, innovates in artificial intelligence, machine Learning and Data Science domain

Graduate Attributes / ABET's Criteria

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

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

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

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

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

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

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

(g) Communication: An ability to communicate effectively.

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

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

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

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

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

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

	A	B	C	D	E	F	G	H	I	J	K	L
PO1	X									X		
PO2		X			X							
PO3			X		X							
PO4			X		X							
PO5											X	
PO6					X					X		
PO7								X				
PO8						X						
PO9				X								
PO10							X					
PO11												X
PO12									X			

Course Structure for Third Year

B. Tech in CSE (Artificial Intelligence & Machine Learning/ Artificial Intelligence & Data Science/ Artificial Intelligence)

Semester V (Term 5)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC5	BTAIC501	Computer Network and Cloud Computing	3	1	-	20	20	60	100	4
PCC6	BTAIC502	Machine Learning	3	-	-	20	20	60	100	3
HSSMC4	BTAIHM503	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM503A	1. Economics and Management								
	BTAIHM503B	2. Business Communication								
	BTAIHM503C	3. Knowledge Reasoning and AI Ethics.								
PEC-2	BTAIPE504	Professional Elective Course (PEC) -II	3	1	-	20	20	60	100	4
	BTAIPE504A	1. Advanced Database System								
	BTAIPE504B	2. Soft Computing								
	BTAIPE504C	3. Sensors & Robotics Technology								
	BTAIPE504D	4. Advanced Java								
OEC-1	BTAIOE505	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE505A	1. Data Mining and Warehousing								
	BTAIOE505B	2. Digital Communication & Information Theory								
	BTAIOE505C	3. Software Engineering and Testing								
	BTAIOE505D	4. Virtual Reality								
LC3	BTAIL506	Machine Learning Lab and Competitive Programming Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM507	Mini Project I	-	-	4	60	-	40	100	2
Internship	BTAIP508	Internship –II (Evaluation)	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

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 Structure for Third Year

B. Tech in CSE (Artificial Intelligence & Machine Learning/ Artificial Intelligence & Data Science/ Artificial Intelligence)

Semester VI (Term 6)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC7	BTAIC601	Deep Learning	3	1	-	20	20	60	100	4
PCC8	BTAIC602	Advanced Machine Learning	3	-	-	20	20	60	100	3
PEC-3	BTAIPE603	Professional Elective Course (PEC) -III	3	1	-	20	20	60	100	4
	BTAIPE603A	1. Geographical Information Systems								
	BTAIPE603B	2. Recommender System								
	BTAIPE603C	3. Industry 4.0 & Automation								
	BTAIPE603D	4. Web Development								
OEC-2	BTAIOE604	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE604A	1. Big Data Analytics								
	BTAIOE604B	2. Cryptography & Network Security								
	BTAIOE604C	3. Agile Methodology								
	BTAIOE604D	4. Augmented Reality								
HSSMEC-5	BTAIHM605	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM605A	1. Development Engineering								
	BTAIHM605B	2. Employability and Skills Development								
	BTAIHM605C	3. Consumer Behavior								
LC4	BTAIL606	Deep Learning Lab and Advanced Machine Learning Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM607	Mini Project II	-	-	4	60	-	40	100	2
Internship	BTAIP608	Internship –III	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

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

Semester –V

Computer Network and Cloud Computing

BTAIC501	Computer Network and Cloud Computing	PCC5	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Computer Fundamentals, Fundamentals of Digital Communication

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Theoretical and practical base in computer networks issues
2. Outline the basic network configurations
3. Understand state-of-the-art in network protocols, architectures, and applications
1. Fundamental concepts of cloud computing
2. Implementation of virtualization and various cloud services

Course Outcomes:

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

CO1	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
CO2	Specify and identify deficiencies in existing protocols, and then go onto select new and better protocols.
CO3	Have a basic knowledge of installing and configuring networking applications
CO4	Understand the different cloud computing environments
CO5	Apply concepts of virtualization and various cloud services to design, develop and deploying cloud applications.

Course Contents:

Unit No 1: Introduction to Computer Networks [7 Hours]

Uses of computer networks, Types of computer networks, Network technology- from local to global, Examples of networks, Network protocols, Reference models, Standardization, policy, legal, and social issues.

Unit No 2: The Data Link Layer and Network Layer [8 Hours]

Data link layer design issues, Error detection and correction, Elementary data link protocols, The channel allocation problem, Multiple access protocols, Network layer design issues, Routing algorithms in a single network, Traffic management at the network layer,

internetworking, software-defined networking, The network layer in the internet.

Unit No 3: Transport and Application Layers [7 Hours]

The transport service, Elements of transport protocols, The internet transport protocols: UDP and TCP, The Domain Name System (DNS), Electronic mail, The world wide web, Streaming audio and video, Content delivery.

Unit No 4: Introduction to Cloud Computing [7 Hours]

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

Unit No 5: Virtualization and Cloud Services [7 Hours]

Communication-as-a-Service (CaaS), Infrastructure-as-a-Service (IaaS), Monitoring-as-a-Service (MaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS). Virtualization (CPU, Memory, I/O) Case Study: Amazon EC2.

Note: Hands-on practice of Computer Network and any cloud services (like Amazon Web Services (AWS Cloud) or Microsoft Azure or Google Cloud) should cover under Tutorial slots.

Text Books

1. A Tanenbaum, N Feamster, D Wetherall, Computer Networks, Sixth Edition, Pearson Education Limited. ISBN 10: 1-292-37406-3, 2021
2. John W. Rittinghouse, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press , Routledge Publisher, ISBN-10 : **2020 ,9781138627031**

Reference Books

1. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
2. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman
3. Publication, 5th Edition, 2012.Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
4. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH, 2010

Semester –V

Machine Learning

BTAIC502	Machine Learning	PCC6	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Data Analysis, Python Programming Language

Course Objectives:

After completion of the course, students will learn:-

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

Course Outcomes:

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

CO1	Develop a good understanding of fundamental principles of machine learning
CO2	Formulation of a Machine Learning problem
CO3	Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering
CO4	Evaluate performance of various machine learning algorithms on various data sets of a domain.
CO5	Design and Concrete implementations of various machine learning algorithms to solve a given problem using languages such as Python

Course Contents:

Unit No 1: Introduction to Machine Learning [7 Hours]

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

Unit No 2: Machine Learning - Performance Metrics [7 Hours]

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

Unit No 3: Linear and Logistic Regression [8 Hours]

Introduction to linear regression:
Introduction to Linear Regression, Optimal Coefficients, Cost function, Coefficient of Determination, Analysis of Linear Regression using dummy Data, Linear Regression Intuition.
Multivariable regression and gradient descent:
Generic Gradient Descent, Learning Rate, Complexity Analysis of Normal Equation Linear

Regression, How to find More Complex Boundaries, Variations of Gradient Descent.
Logistic regression:
Handling Classification Problems, Logistic Regression, Cost Function, Finding Optimal Values, Solving Derivatives, Multiclass Logistic Regression, Finding Complex Boundaries and Regularization, Using Logistic Regression from Sklearn.

Unit No 4: Decision Trees and Random Forests [7 Hours]

Decision trees:
Decision Trees, Decision Trees for Interview call, Building Decision Trees, Getting to Best Decision Tree, Deciding Feature to Split on, Continuous Valued Features
Code using Sklearn decision tree, information gain, Gain Ratio, Gini Index, Decision Trees & Overfitting, Pruning.
Random forests:
Introduction to Random Forests, Data Bagging and Feature Selection, Extra Trees, Regression using decision Trees and Random Forest, Random Forest in Sklearn

Unit No 5: Naive Bayes, KNN and SVM [7 Hours]

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

Text Books

1.Ethem Alpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203-5078-6

2.Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 0- 07-115467-1

3.Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1.

4.Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622

Reference Books

1.R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001

2. Shai shalev-Shwartz and Shai Ben-David, Understanding Machine Learning (From Theory to Algorithms), Cambridge University Press, First Edition, ISBN No. 978-1-107-51282-5.

3. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.

4. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

5. https://python-course.eu/machine-learning/

Semester –V
Economics and Management

BTAIHM503A	Economics and Management	HSSMEC4	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn to manage Economical things.

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

CO1	Study of Market Equilibrium
CO2	Understand Relevant Information and Decision Making
CO3	Aware Financial Statements
CO4	Study of Depreciation Accounting
CO5	Understand Product Development

Course Contents:

Unit No 1: Introduction: [7 Hours]
Market Equilibrium: Demand and Supply, Elasticity of Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System.

Unit No 2: Relevant Information and Decision Making [8 Hours]
Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

Unit No 3: Financial Statements [7 Hours]
Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

Unit No 4: Depreciation Accounting [7 Hours]
Evolution of Management Thoughts, Functions of Management Directing.

Unit No 5: Product Development [7 Hours]
Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

Text Books
1. R. Paneerselvam, Engineering Economics, PHI publication.
Reference Books
1. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
2. L. M. Prasad, Principles and Practices of Management.

3. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications.

Semester –V

Business Communication

BTAIHM503B	Business Communication	HSSMEC4	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn business Communication

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

CO1	Study of business
CO2	Understand Intercultural Communication
CO3	Aware Barriers to Communication
CO4	Study of Interpersonal Communication
CO5	Understand Negotiation and Conflict Management

Course Contents:

Unit No 1: Introduction: [7 Hours]
Introduction, Definitions & Concepts, Communicative Competence.

Unit No 2: Intercultural Communication [8 Hours]
Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as ProblematicDiscourse.

Unit No 3: Barriers to Communication [7 Hours]
Barriers to Communication, Listening, Communication Rules, Communication Style.

Unit No 4: Interpersonal Communication [7 Hours]
Interpersonal Communication, Relational Communication, Organizational Communication. Collaboration,Communication in Groups and Teams, Persuasive Communication.

Unit No 5: Negotiation and Conflict Management [7 Hours]
Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication,Ethics in Business Communication.

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

Reference Books
1.Bovee, Courtland, John Thill & Mukesh Chaturvedi, Business Communication Today: Dorling kindersley, Delhi.

2.Kaul, Asha, Business Communication, Prentice-Hall of India, Delhi.

3.Monippally, Matthukutty M. Business Communication Strategies. Tata McGraw-Hill Publishing Company Ltd., New Delhi.

4.Sharma, Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Pvt.

Ltd., New Delhi.

Semester –V
Knowledge reasoning and AI ethics

BTAIHM503C	Knowledge reasoning and AI ethics	HSSMC4	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of knowledge reasoning & AI Ethics
2. Demonstrate awareness and fundamental understanding of knowledge reasoning
3. To impart knowledge about AI ethics.

Course Outcomes:

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

CO1	Apply the knowledge and reasoning based concepts
CO2	Specify and identify the logical agents.
CO3	Apply Probabilistic Reasoning & Uncertainty along with rules.
CO4	Understand the human psychology and social ethics to use AI
CO5	Apply concepts of virtualization and various cloud services to design, develop and deploying cloud applications.

Unit 1: Knowledge & Reasoning **[7 Hours]**

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, semantic nets- frames and inheritance, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic

Unit 2: Logical Agents **[7 Hours]**

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.

First-order logic: Representation Revisited Syntax and Semantics of First-Order Logic, Knowledge Engineering in First-Order Logic Inference in first-order logic, propositional vs. first-order inference, unification & lifts forward chaining, Backward chaining, Resolution

Unit 3: Probabilistic Reasoning & Uncertainty **[7 Hours**]

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

Unit 4: Introduction to AI Ethics **[7 Hours]**

Artificial intelligence, ways of implementing AI, Advantages and disadvantages of AI, Definition of morality and ethics, Descriptive Ethics, Normative Ethics, Meta-ethics, Applied Ethics, Impact on society, Impact on human psychology, Impact on the legal system, impact on Environment and planet, impact on trust (privacy issues), challenges of AI and data governance, Ethical implications and responsibilities.

Unit 5: Ethical initiatives in the field of artificial intelligence **[7 Hours]**

International ethical initiatives, Autonomous systems, Ethical harms, Machine Ethics, Artificial moral agents Singularity, AI standard and regulation, IEEE 'human standards' with implications for AI, Ethics in military use of AI: use of weapons, regulations governing an AWS, Ethical Arguments for and Against AI for Military Purposes.

Text / Reference Book:

1. Knowledge Representation and Reasoning, by Hector Levesque and Ronald J. Brachman
2. Foundations of Knowledge Representation and Reasoning by Gerhard Lakemeyer, Bernhard Nebel
3. AI Ethics by Mark Coeckelbergh
4. An Introduction to Ethics in Robotics and AI by Christoph Bartneck, Christoph Lütge, Alan Wagner, Sean Welsh

Semester –V

Advanced Database Systems

BTAIPE504A	Advanced Database Systems	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Nil.

Course Objectives:
Upon completion of this course, the student should be able to study database management systems.

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

CO1	Summarize the basic concept of Data base System.
CO2	Understand relational database models.
CO3	Demonstrate working of advanced SQL.
CO4	Understand data warehousing and mining concepts.
CO5	Understand the advanced transaction processing.

Course Contents:

Unit 1: Introduction to Database System and E-R Models [8 Hours]

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

Unit 2: Relational Data Model, Relational Algebra and SQL [7 hours]

Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. SQL: Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization.

Unit 3: Advanced SQL, Relational Database Design and Data Normalization [7 hours]

Advanced SQL: Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers, Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.

Unit 4: Data Warehousing, Data Mining, and Information Retrieval [7 hours]

Database-System Architectures: Centralized and Client –Server Architectures, Parallel Systems, Distributed Systems. Data warehousing: Decision-Support Systems, Data Warehousing, Data Mining, Classification and Clustering, Association Rules, Other Forms of Data Mining and information retrieval.

Unit 5: Advanced Transaction Processing and Concurrency Control [7 hours]

Transaction Model Concepts, A Simple Transaction Model, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols.

Note: Hands-on practice should cover under Tutorial slots.

Text Books

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

Reference Books

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management S ystems, McGraw- HillPublication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.
4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2ndEdition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, ―Foundations of Databases‖, Reprint by Addison-Wesley.
7. Jiawei Han, Micheline Kamber, and Jian Pei, ― Data Mining: Concepts and techniques by Morgan Kaufmann Publishers (an imprint of Elsevier)

Semester –V
Soft Computing

BTAIPE504B	Soft Computing	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Knowledge of Data Structures, Python.

Course Objectives:
Upon completion of this course, the student should be able to:
1. Differentiate between soft computing and hard computing.
2. Understand Neural Networks, its architecture, functions and various algorithms involved.
3. Understand Fuzzy Logic and Genetic algorithms.

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

CO1	Summarize the basic concept of soft computing and Neural network.
CO2	Choose appropriate activation and loss functions for neural network.
CO3	Demonstrate working of Feedforward and Backpropagation learning propagation.
CO4	Implement simple neural network in python.
CO5	Understand the need of fuzzy logic and genetic algorithm.

Course Contents:

Unit 1: Introduction of soft computing and Artificial Neural Networks [7 Hours]

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

Unit 2: Activation Functions, Loss Functions and optimizers [7 hours]

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

Unit 3: Feedforward and Backpropagation learning [7 hours]

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

Unit 4: Introduction to Artificial Neural Networks with python [7 hours]

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

Unit 5: Introduction to Fuzzy logic and Genetic Algorithms [8 hours]

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

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

Note: Hands-on practice of Soft Computing Algorithms should cover under Tutorial slots.

Text Books

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

Reference Books

1. Francois Challot, "Deep Learning with Python",second edition.
2. B. Satish Kumar, "Neural Networks - A Classroom Approach", McGrawHill Publication

   S. Rajasekaran, VijaylakshmiPai, "Neural Networks, Fuzzy Logic and Genetic algorithmsSynthesis and Applications", PHI Publications.

Semester –V
Sensors and Robotics Technology

BTAIPE504C	Sensors and Robotics Technology	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Digital Electronics, Microcontrollers, Microprocessors, Computer Algorithms.

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Concepts of measurement technology.
2. Various sensors used in measuring various physical parameters.
3. Fundamentals of signal conditioning, data acquisition and communication systems used in Robotics system development
4. Mathematics manipulations of spatial coordinate representation and transformation. Able to solve basic robot forward and inverse kinematic problems
5. Design essentials of robots and End Effectors

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

CO1	**Classify** various robot essential transducers and **explain** their working principles with examples.
CO2	**Predict** the expected performance of various sensors
CO3	**Familiar** with the history, concept development and key components of robotics technologies.
CO4	**Implement** basic mathematics manipulations of spatial coordinate representation and transformation.
CO5	**Calculate** Gripping Force required for object manipulation by various robotic end effectors

Course Contents:

Unit No 1: Measurement and Sensors: [8 Hours]

Basics of Measurement, Classification of errors, Error analysis, Static and dynamic characteristics of transducers, Performance measures of sensors, Classification of sensors Sensor calibration techniques

Temperature: RTD, Thermocouple, Thermistor, Infrared, and LM35.

Humidity Sensors: Capacitive, Resistive, Thermal conductivity, and DHT11 Sensors.

Proximity sensors: Inductive, Capacitive, Magnetic, and optical proximity sensors.

Force and Pressure Sensors: Strain Gauge, Piezoelectric

Motion: Rotary and Linear motions, Gyroscope, Accelerometer, Magnetometer, MEMS

Chemical and Bio Sensors: Gas sensors, Nano Sensors

Vision Sensing: Digital Camera

Unit No 2: Data Acquisition and Actuators [7 Hours]

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Introduction to Actuators , Classification, **Linear Actuators:** Electrical- Relays, Pneumatic/ Hydraulic- Single and Double Acting Cylinders, **Rotary Actuators:** Electrical- AC and DC Motors, Stepper Motors, Servo Motors, Pneumatic/Hydraulic Motors.

Pneumatic/Hydraulic Control Valves: 3/2 Valves, 5/3 Valves etc.

Unit No 3: Introduction to Robotic [7 Hours]

Definition; History of Robotics, Laws of Robotics, anatomy of robot: Motion subsystem, Recognition subsystem, and Control subsystem. Robot Specifications: Number of Axes, Load Carrying Capacity, Reach, Stroke, Repeatability, Precision, Accuracy, etc. . Classification of robot based on Drive Technologies, Work Envelop Geometry and Motion Control Methods. Safety Measures in robotics. Block Diagram representation of various Industrial Applications of Robots viz. Medical, Mining, Space, Underwater, Defense, Security

Domestic, Entertainment.

Unit No 4: Robot Kinematics and Dynamics [7 Hours]

A brief overview of Robot Kinematics and Dynamics. Kinematics- coordinate transformations, DH parameters, Forward kinematics, Inverse Kinematics, Jacobians, Statics, Trajectory Planning. Robot Control – PWM, joint motion control, feedback control, Computed torque control.

Unit No 5: Robot End-Effectors and Robot Programming [7 Hours]

Different types of grippers- Mechanical, Magnetics, vacuum, Adhesive, Gripper force Analysis & Gripper Design, Perception, Localization and mapping, Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches, Simultaneous Localization and Mapping, Introduction to Reinforcement Learning.

Note: Practical should cover under Tutorial slots.

Text Books

1. Sawney A K and Puneet Sawney, ―A Course in Mechanical Measurements and Instrumentation and Control‖, 12th edition, Dhanpat Rai & Co
2. Introduction to Robotics By S.K.Saha , Tata McGraw Hill
3. KS Fu, RC Gonzalez, CSG Lee , Robotics Control ,Sensing ,Vision and Intelligence, Tata McGraw Hill

Reference Books

1. Richard Zurawski, ―Industrial Communication Technology Handbook‖ 2nd edition, CRC Press, 2015
2. Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india
3. J Hirchhorn, Kinematics and Dynamics of Machinery, McGraw Hill book co.

Semester –V
Advanced JAVA

BTAIPE504D	Advanced JAVA	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Core Java Programming

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Development of GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
2. Creating develop Web applications
3. Getting acquainted with enterprise based applications by encapsulating an application's business logic.
4. Designing applications using pre-built frameworks.

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

CO1	Design and develop GUI applications using Applets
CO2	Apply relevant AWT/ swing components to handle the given event.
CO3	Learn to access database through Java programs, using Java Database Connectivity (JDBC)
CO4	Invoke the remote methods in an application using Remote Method Invocation (RMI)
CO5	Develop program for client /server communication using Java Networking classes.

Course Contents:

Unit No 1: Applets and Event Handling [8 Hours]

Applet Basics Introduction, limitations of AWT, Applet architecture HTML APPLET tag Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels scroll pane, dialogs, menu bar, graphics, layout manager layout manager types boarder, grid, flow, card and grib bag.

Unit No 2: Advanced GUI Programming [7 Hours]

Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.

Unit No 3: Conventional Non-Conventional Database Programming using JDBC [7 Hours]

The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases. Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries.

Unit No 4: Remote Method Invocation (RMI) [7 Hours]

Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.

Unit No 5: Networking and Servlet [7 Hours]

The java.net package, Connection oriented transmission Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example. InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example. Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview the Java web server The Life Cycle of a Servlet, your first servlet.

Note: Hands-on practice of Advanced Java should cover under Tutorial slots.

Text Books

1. E Balagurusamy, Programming with Java, Tata Mc Graw Hill.
2. Herbert Schildt, The Complete Reference- Java2, (Seventh Edition), Tata Mc Graw Hill.
3. Steven Holzner, Java 2 Black Book, Dream Tech Press.

Reference Books

1. Java 6 Programming, Black Book, Dreamtech
2. Java Server Programming, Java EE6 (J2EE 1.6), Black Book, Dreamtech
3. M.T. Savaliya Advanced Java Technology, Dreamtech

Semester –V

Data Mining and Warehousing

BTAIOE505A	Data Mining and Warehousing	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Database Management Systems

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

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

Course Outcomes:

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

CO1	Apply basic, intermediate and advanced techniques to mine the data.
CO2	Analyze the output generated by the process of data mining.
CO3	Explore the hidden patterns in the data.
CO4	Adapt to new data mining tools.
CO5	Optimize the mining process by choosing best data mining technique.

Course Contents:

Unit No 1: Introduction **[8 Hours]**

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

Unit No 2: Data Warehouse **[7 Hours]**

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

Unit No 3: Measuring Data Similarity and Dissimilarity [7 Hours]

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

Unit No 4: Association Rules Mining [7 Hours]

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

Unit No 5: Classification [7 Hours]

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

Note: Hands-on practice should cover under Tutorial slots.

Text Books

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques”, Elsevier Publishers, ISBN:9780123814791, 9780123814807.

2. Parag Kulkarni, “Reinforcement and Systemic Machine Learning for Decision Making” by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

Reference Books

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068

2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Semester –V

Digital Communication & Information Theory

BTAIOE505B	Digital Communication & Information Theory	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have an adequate background, conceptual clarity, and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of Digital communication & information theory.
2. Demonstrate awareness and fundamental understanding of various pulse modulation and digital modulation techniques.
3. To impart knowledge about information and entropy.

Course Outcomes:

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

CO1	Study basic digital modulation techniques.
CO2	Analyze the carrier modulation techniques.
CO3	Explore the the noise signals in digital communication.
CO4	Adapt to information theory.
CO5	Optimize the coding algorithms.

Unit 1: Digital Baseband Modulation Techniques and Waveform Coding Techniques [7 Hours]

Base Band System, Formatting Textual Data, Messages, Characters & Symbols, Formatting Analog Information, PCM, Bandwidth, SNR of PCM, DPCM, DM, ADM**.**

Unit 2: Carrier Modulation Techniques [7 Hours]

Introduction to Carrier Modulation, FSK, PSK, BPSK, DPSK, QPSK, Coherent Detection and Non-Coherent Detection, Error Performance for Binary Systems, Matched filter, SNR derivation

Unit 3: Noise in digital communication [7 Hours]

Matched filter, SNR derivation, impulse response, the output of the matched filter, BER, Generalized expression of BER, BER with matched filter, BER passband, BER baseband, Probability of error examples.

Unit 4: Information Theory **[7 Hours]**

The measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding, and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

Unit 5: Codes **[7 Hours]**

Linear Block Coding/Decoding, Matrix description of Linear block codes, Hamming codes, optimal linear codes, Maximum Distance Separable Cyclic Codes, Polynomials, Generation of Cyclic codes, matrix description of cyclic codes

Note: Hands-on practice should cover under Tutorial slots.

Text Books:

1. Ranjan Bose, “Information Theory coding and Cryptography”, McGraw-Hill Publication,
2. R. Avudaiammal, Information Coding Techniques” Second Edition. Tata McGraw-Hill 14
3. J C Moreira, P G Farrell, “Essentials of Error-Control Coding”, Wiley Student Edition.
4. Simon Haykin, “Communication Systems”, John Wiley & Sons, Fourth Edition
5. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

Reference Books:

1. Bernard Sklar, “Digital Communications fundamentals and Applications” Pearson Education, Second Edition.
2. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
3. Simon Haykin “Communication Systems”, John Wiley& Sons, Fourth Edition.
4. A.B Carlson, “Principles of communication systems”, TMH, Third Edition.
5. Taub Schilling, “Principles of Communication system”, TMH, Fourth Edition.

Semester –V
Software Engineering and Testing

BTAIOE505C	Software Engineering and Testing	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn:-

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

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

CO1	To use the techniques, skills, and modern engineering tools necessary for engineering practice.
CO2	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.
CO3	To apply software testing knowledge and its processes to software applications.
CO4	To identify various software testing problems and solving software testing problems by designing and selecting software test models, criteria, strategies and methods.
CO5	To apply the techniques learned to improve the quality of software development.

Course Contents:

Unit No 1: **[7 Hours]**

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

Unit No 2: **[7 Hours]**

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

Unit No 3: **[8 Hours]**

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

Unit No 4: **[7 Hours]**

Integration Testing: Definition, As a type of testing: Top-down integration, Bottom-up integration, Bidirectional integration, System integration, Choosing integration method, As a phase of testing, Scenario testing: System scenarios, Use case scenarios, Defect bash.
System and Acceptance Testing, Functional Vs non Functional, Functional system testing, Non- functional system testing, Acceptance testing.

Unit No 5: **[7 Hours]**

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

Note: Hands-on practice should cover under Tutorial slots.

Text Books

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

Reference Books

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

Semester –V
Virtual Reality

BTAIOE505D	Virtual Reality	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

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

CO1	Describe how VR systems work and list the applications of VR.
CO2	Understand the design and implementation of the hardware that enables VR systems tobe built.
CO3	Understand the system of human vision and its implication on perception and rendering.
CO4	Explain the concepts of motion and tracking in VR systems.
CO5	Describe the importance of interaction and audio in VR systems.

Course Contents:

Unit No 1: Introduction to Virtual Reality: [7 Hours]

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Unit No 2: Representing the Virtual World: [7 Hours]

Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Unit No 3: The Geometry of Virtual Worlds & The Physiology of Human Vision: [7 Hours]

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

Unit No 4: Visual Perception & Rendering: [8 Hours]

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information

Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.

Unit No 5: Motion & Tracking: [7 Hours]

Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection

Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies.

Note: Hands-on practice of Virtual Reality should cover under Tutorial slots.

Text Books

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016 2.
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
5. **http://lavalle.pl/vr/book.html**

Semester –V

Machine Learning Lab and Competitive Programming Lab

BTAIL506	Machine Learning Lab and Competitive Programming Lab	LC3	0L-0T-4P	2 Credits

Teaching Scheme	Examination Scheme
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Machine Learning Lab

List of practicals:

1. Python Libraries for Data Science-
    a. Pandas Library
    b. Numpy Library
    c. Scikit Learn Library
    d. Matplotlib
2. Evaluation Metrics-
    a. Accuracy
    b. Precision
    c. Recall
    d. F1-Score
3. Train and Test Sets by Splitting Learn and Test Data.
4. Linear Regression
5. Multivariable Regression
6. Decision Tree Algorithm implementation.
7. Random Forest Algorithm implementation.
8. Naive Bayes Classification Algorithm implementation.
9. K-Nearest Neighbor Algorithm implementation.
10. SVM Algorithm implementation.

Competitive Programming Lab

1. Problems on array
2. Problems on matrix
3. Problems on string
4. Problems on Searching & Sorting
5. Problems on LinkedList
6. Problems on Binary Trees
7. Problems on Binary Search Trees
8. Problems on Greedy
9. Problems on BackTracking
10. Problems on Stacks & Queues
11. Problems on Heap
12. Problems on Graph
13. Problems on Trie
14. Problems on Dynamic Programming
15. Problems on Bit Manipulation

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

OR
Competitive Programming Lab

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Applying Data Normalization, Procedures, Triggers and Cursors on databases.
6. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
7. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
8. Studying Large objects – CLOB, NCLOB, BLOB and BFILE.
9. Data warehousing and Association rule mining.
10. Distributed data base Management, creating web-page interfaces for database applications using servlet.

Semester –V
Mini Project -I

BTAIM507	**MINI PROJECT-I**	**Project**	**0L-0T-4P**	**2 Credits**

Guidelines for Mini Project

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

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

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

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

Continues Assessment:

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

Semester –V
Internship - II

BTAIP508	**Field Training / Internship / Industrial Training**	**Internship**	**Audit**

Guidelines for Internships

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

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

Semester –VI

Deep Learning

BTAIC601	Deep learning	PCC7	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Knowledge of Machine learning, Soft Computing, Data Structures, Python.

Course Objectives:
In this course, attendees will:

- Understand the context of neural networks and deep learning
- Have a working knowledge of neural networks and deep learning
- Explore the parameters for neural networks
- Use CNN and RNN for solving real world problem.

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

CO1	Implement deep learning models in Python using the Keras/PyTorch library and train them with real-world datasets.
CO2	Design convolution networks for image classification.
CO3	Perform regularization, training optimization, and hyperparameter selection on deep models.
CO4	Design Recurrent Neural Networks for text and sequence classification.
CO5	Apply Generative Deep Learning for Generating images

Course Contents:

Unit 1: Introduction to Neural Network [8 Hours]
Working Of Simple Artificial Neural Network, Multilayer Perceptron, Forward Propagation And Back Propagation Learning, Building Blocks of Deep Neural Networks, Optimization Techniques, Gradient Descent and its variants, Derivatives, Batch Optimization, Momentum Optimizer, RMSProp, Adam, Vectorization, Linear Regression and Logistic Regression with Deep Neural Network.

Unit 2: Convolutional Neural Network [7 Hours]
Introduction Convolutional Neural Network, Fully Connected Network vs Convolutional Neural Network **,** Building Blocks Of CNN: Filters, Convolution, Pooling, Activations Etc. Training Procedure of CNN, Feeding Images And Videos to CNN, Different CNN Architectures, Residual Networks, Skip Connections.

Unit 3: Transfer Learning and Effective training in Deep Net: [7 Hours]
Transfer Learning: Introduction To Transfer Learning, Need For Transfer Learning, Feature Extraction Using Transfer Learning, Fine Tuning.
Effective Training: Bias Variance Tradeoff, Dealing With Overfitting and Underfitting, Data Augmentation, Early Stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization, Regularization, Hyperparameter Tuning.

Unit 4: Deep learning for text and Sequences [7 Hours]
Introduction To Sequential/Temporal Data, Sequential Models, Introduction to Recurrent Neural Network ,Working of RNN, Representing Sequential Data using RNN, Working With Text Data, Text Generation With LSTM, LSTM And GRU, Transformer Network.

Unit 5: Generative Deep Learning [7 Hours]
Neural Stryle Transfer ,Variational Autoencoder, Generative Adversarial Network , Classical Supervised Tasks With Deep Learning, Image Denoising, Semantic Segmentation, Object Detection Etc.

Text Books

1. Francois Challot, “Deep Learning with Python”, second edition.
2. Francois Challot, “Deep Learning with Pytorch”, second edition

Reference Books

1. 1 Michael Nielsen, Neural Networks and Deep Learning, 2016
2. Deep Learning- Ian Goodfelllow, Yoshua Benjio, Aaron Courville, The MIT Press
3. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

Semester –VI
Advanced Machine Learning

BTAIC602	Advanced Machine Learning	PCC8	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Machine Learning Basics, Python Programming Language.

Course Objectives:
After completion of the course, students will learn:-

- To understand fundamental concepts of unsupervised learning and its various algorithms
- To understand Association Rules Mining and Recommendation Systems
- To apply ML algorithms on given data and interpret the results obtained
- To design appropriate ML solution to solve real world problems in AI domain

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

CO1	Develop a good understanding of fundamental of unsupervised learning.
CO2	Formulation of Association Rules Mining and Recommendation Systems
CO3	Interpret a model using Reinforcement Learning.
CO4	Evaluate the time series data.
CO5	Design and Concrete implementations using boosting.

Course Contents:

Unit No 1: Unsupervised Learning [7 Hours]

Unsupervised Learning - 1

Introduction to Unsupervised Learning, Introduction to Clustering, Using K-means for Flat Clustering, KMeans Algorithm, Using KMeans from Sklearn, Implementing Fit & Predict Functions, Implementing K-Means Class

Unsupervised Learning - 2

How to choose Optimal K, Silhouette algorithm to choose K, Introduction to K Medoids, K Medoids Algorithm, Introduction to Hierarchical Clustering, Top down/Divisive Approach, Bottom up/Divisive Approach

Principal Component Analysis

PCA - 1

Intuition behind PCA, Applying PCA to 2D data, Applying PCA on 3D data, Math behind PCA, Finding Optimal Number of Features, Magic behind PCA, Dimensionality reduction

PCA - 2

PCA on Images, PCA on Olevitti Images, Reproducing Images, Eigenfaces, Classification of LFW Images

Unit No 2: Association Rules Mining and Recommendation Systems [7 Hours]

What are Association Rules, Association Rule Parameters, Calculating Association Rule Parameters, Recommendation Engines, Recommendation Engines working, Collaborative Filtering ,Content Based Filtering.

Unit No 3: Reinforcement Learning [8 Hours]

What is Reinforcement Learning, Why Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs Exploitation dilemma, Epsilon Greedy Algorithm, Markov Decision Process (MDP), Q values and V values, Q – Learning, α values.

Unit No 4: Time Series Analysis [7 Hours]

Time Series Analysis ,Importance of TSA ,Components of TSA,White Noise, AR model, MA model,ARMA model,ARIMA model,Stationarity,ACF & PACF

Unit No 5: Model Selection and Boosting [7 Hours]

Model Selection, Need of Model Selection, Cross – Validation, Boosting, Boosting Algorithms, Types of Boosting Algorithms, Adaptive Boosting.

Text Books:

1.Ethem Alpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203-5078-6

2.Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 0- 07-115467-1

3.Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1.

4.Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622

Reference Books:

1.R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001

2. Shai shalev-Shwartz and Shai Ben-David, Understanding Machine Learning(From Theory to Algorithms), Cambridge University Press, First Edition, ISBN No. 978-1-107-51282-5.

3. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.

4. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

Semester –VI

Geographic Information System

BTAIPE603A	Geographical Information System	PEC3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Nil.

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To understand the different components of GIS
2. To understand the different raster data file formats
3. To learn the Pre-processing of spatial datasets
4. To understand various GIS analysis

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

CO1	Understand Geographic Information Systems
CO2	Analyze advantages and disadvantages associated with vector
CO3	Identify Spatial interpolation techniques.
CO4	Demonstrate GIS analysis-1.
CO5	Understand the applications Errors in GIS Key elements

Course Contents:

Unit 1: Introduction **[7 Hours]**

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

Unit 2: Non Special Data **[7 Hours]**

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

Unit 3: Pre-processing of spatial datasets **[8 Hours]**

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

Unit 4: Quality Assessment **[7 Hours]**

Quality assessment of freely available DEMS GIS analysis-1

Unit 5: GIS Analysis **[7 Hours]**

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

Note: Hands-on practice should cover under Tutorial slots.

Text Books

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

Reference Books

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

Semester –VI
Recommended Systems

BTAIPE603B	Recommended Systems	PEC3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Knowledge of Machine learning, Python.

Course Objectives:
Upon completion of this course, the student should be able to:
1. Understand basics concepts of Recommended System.
2. Apply various types of recommendation system.
3. Evaluate recommendation system.

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

CO1	Understand the need and challenges of Recommended Systems**.**
CO2	Apply Collaborative Filtering for recommendation.
CO3	Develop content based recommendation system.
CO4	Develop time location based recommendation system.
CO5	Evaluate recommended system using different metric.

Course Contents:

Unit 1: Introduction to Recommended Systems [7 Hours]

Introduction ,Goals of Recommender Systems ,Basic Models/types of Recommender Systems, Challenges in Recommender Systems, The Cold-Start Problem in Recommender Systems ,Attack-Resistant Recommender Systems, Privacy in Recommender Systems.

Case study: Basic recommendation system using weighted average and popularity score.

Unit 2: Collaborative Filtering [7 Hours]

Types of Collaborative Filtering: Neighborhood/memory based vs Model based. Neighborhood based Collaborative Filtering: User based Collaborative Filtering, Item based Collaborative Filtering, cold-start problem.

Model based Collaborative Filtering: Naive Bayes Collaborative Filtering, Matrix Factorization, Singular Value Decomposition, Association rule mining.

Case study: Book Recommendation using Collaborative Filtering

Unit 3: Content-Based Recommender Systems [8 Hours]

Introduction, Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents,

Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity measures, ,Similarity based retrieval, Classification algorithms.
Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders
Case Study: 1.Content Based Recommendation System
2. Movie recommendation system (using K nearest Neighbor K-nearest neighbor method, using Pearson Correlation etc).

Unit 4: Time- and Location-Sensitive Recommender Systems [7 Hours]
Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, case study.

Unit 5: Evaluating Recommender Systems [7 Hours]
Introduction, Evaluation Paradigms, General Goals of Evaluation Design , Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures.

Note: Hands-on practice of Recommender System should cover under Tutorial slots.

Text Books
1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
2. Aggarwal, C. C. “Recommender Systems: The Textbook”. Springer 2016. ISBN 978-3-319-29657-9

Reference Books
1.Deepak K. Agarwal, Bee-Chung Chen, ,Statistical Methods for Recommender Systems, Cambridge University Press(2016).

Semester –VI

Industry 4.0 and Automation

BTAIPE603C	Industry 4.0 and Automation	PEC3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites:
1. Basics of Control Systems
2. Foundation of sensors and actuators
3. Fundamentals of Power Devices and Circuits

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:
1. Globalization and emerging issues of Industry 4.0
2. Internet of Things and Robotics as Pillars of Industry 4.0
3. Process control and Automation
4. Understand architecture of PLC, SCADA and DCS and their Importance in Industrial Automation

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

CO1	Define essential elements of Industry 4.0
CO2	Describe architecture of Industrial IoT
CO3	Explain Recent Technological Components of Robots
CO4	Understand and Recognize Industrial needs of Automation
CO5	Identify and interpret the functionality of PLC, SCADA and DCS.

Course Contents:

Unit No 1: Introduction: [8 Hours]
Introduction, core idea of Industry 4.0, Globalization and Emerging Issues, The Fourth Revolution, Smart and Connected Business Perspective, Smart Factories, Technology Roadmap of for Industry 4.0, A brief overview of pillars of Industry 4.0: Internet of Things, Cloud Computing, Cybersecurity, Big Data and Analytics, Additive Manufacturing, Virtual/Augmented Reality, and Robotics.

Unit No 2: Internet of Things in Industry 4.0 [7 Hours]
Introduction to Internet of things (IoT) and Industrial Internet of Things (IIoT), IIoT Business Model and Reference Architecture, IIOT Layers: Sensing, Processing, Communication, and Analytics. Software Defined Networks.

Unit No 3: Robotics in Industry 4.0 [7 Hours]

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

Unit No 4: Introduction to Automation [7 Hours]

Process control principles, Control System Evaluation, Analog control, Digital control, Architecture of Industrial Automation Systems(Automation Pyramid), Advantages and limitations of Automation, Concept and Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Concept of VFD, Energy conservation schemes through VFD.

Unit No 5: PLC, SCADA and DCS [7 Hours]

Introduction to Programmable Logic Controllers (PLC), Generalized Block Diagram, and Essential components of PLC, Typical Specifications of PLC. Concept of SCADA, Architecture of SCADA, Components of SCADA Systems, human-machine interface (HMI) Basic Concept of DCS, History and Hierarchy of DCS, Basic Components of DCS as Operator Station, Control Module, and I/O module , Types of DCS, Comparison of PLC, DCS and SCADA

Note: Consider practical approach of Robotics under Practical slots.

Text Books

1.Alp Ustundag, Emre Cevikacan, Industry 4.0 : Managing the Digital Transformation, Springer

2.Curtis Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson Education.

3.Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation", Penram International Publishing India Pvt. Ltd

Reference Books

1. Kilian, "Modern control technology: components & systems", Delmar 2nd edition.
2. R.G. Jamkar, "Industrial Automation Using PLC SCADA & DCS" Global Education Limited
3. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Pres

Semester –VI
Web Development

BTAIPE603D	Web Development	PEC3	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:
1.Fundamentals of web essentials and markup languages
2.Use of the Client-side technologies in web development
3.Use of the Server-side technologies in web development
4.Understand the web services and frameworks

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

CO1	Implement and analyze behavior of web pages using HTML and CSS
CO2	Apply the client-side technologies for web development
CO3	Analyze the concepts of Servlet and JSP
CO4	Analyze the Web services and frameworks
CO5	Apply the server side technologies for web development

Course Contents:

Unit No 1: Introduction to Web Essentials [7 Hours]
The internet, basic internet protocols, the world wide web, HTTP Request message, HTTP response message, web clients, web servers. **HTML**: Introduction, history and versions. **HTML Elements**: heading, paragraphs, line break, colors and fonts, links, frames, list, tables, images and forms. Difference between HTML and HTML5. **CSS:** Introduction to style sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap

Unit No 2: Client-Side Technologies: JavaScript and DOM [7 Hours]
JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. DOM: Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

Unit No 3: Java Servlets and XML [7 Hours]

Servlet: Servlet architecture overview, A "Hello World" servlet, Servlet generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. XML: XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. AJAX: Introduction, Working of AJAX.

Unit No 4: JSP and Web Services [8 Hours]

JSP: Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. Web Services: Web Service concepts, writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.

Unit No 5: Server Side Scripting Languages [7 Hours]

PHP: Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. Introduction to ASP.NET: Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS.

Note: Hands-on practice of Web Development should cover under Tutorial slots.

Text Books

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
2. Robert W Sebesta, "Programming the World Wide Web , 4th Edition, Pearson education, 2008
3. Marty Hall, Larry, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.

Reference Books

1. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
2. Chris Bates, "Web Programming Building Internet Applications , 3rd Edition, Wiley India, 2006.
3. Xue Bai et al, "The web Warrior Guide to Web Programming , Thomson, 2003.

Semester –VI
Big Data Analytics

BTAIOE604A	Big Data Analytics	OEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment

Course Objectives:

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

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide hands on Hodoop Eco System
6. Apply analytics on Structured, Unstructured Data.

Course Outcomes:

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

CO1	Identify Big Data and its Business Implications.
CO2	List the components of Hadoop and Hadoop Eco-System
CO3	Access and Process Data on Distributed File System
CO4	Develop Big Data Solutions using Hadoop Eco System
CO5	Use Big data Framework, security and governance.

Course Contents:

Unit No 1: Introduction to Big Data and Hadoop [7 Hours]

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with UNIX tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Unit No 2: HDFS (Hadoop Distributed File System): [7 Hours]

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Unit No 3: Map Reduce: [7 Hours]

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features, Hadoop cluster.

Unit No 4: Hadoop Eco System: [8 Hours]

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Big SQL : Introduction

Unit No 5: Big Data Framework and security: [7 Hours]

Apache kafka: Feature, concept, architecture, components

Apache Spark: Feature, concept, architecture, components.

Kerberos authentication: Feature, concept, architecture, components

Note: Hands-on practice of to deploy Big Data systems should cover under Tutorial slots.

Text Books

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
6. Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
7. Pete Warden, "Big Data Glossary", O'Reily, 2011.
8. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.

Semester –VI
Cryptography & Network Security

BTAIOE604B	Cryptography & Network Security	OEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. The objectives of information security
2. Explain the importance and application of each of confidentiality, integrity, authentication and availability
3. Understand various cryptographic algorithms.
4. Understand the basic categories of threats to computers and networks
5. Describe public-key cryptosystem.
6. Describe the enhancements made to IPv4 by IPSec
7. Understand Intrusions and intrusion detection
8. Discuss the fundamental ideas of public-key cryptography.
9. Generate and distribute a PGP key pair and use the PGP package to send an encrypted email message.
10. Discuss Web security and Firewalls

Course Outcomes:

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

CO1	Understand basic cryptographic algorithms, message and web authentication and security issues.
CO2	Ability to identify information system requirements for both of them such as client and server.
CO3	Ability to understand the current legal issues towards information security.
CO4	Develop transport level security.
CO5	Apply knowledge for develop model.

Unit No 1: Security Concepts: [7 Hours]

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

Unit No 2: Symmetric key Ciphers: [7 Hours]

Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

Unit No 3: Cryptographic Hash Functions, key management and distribution: [8 Hours]

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric, Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

Unit No 4: Transport-level Security: [7 Hours]

Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH)

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.

Unit No 5: Case Study: [7 Hours]

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability

Note: Hands-on practice should cover under Practical slots.

Text Book:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

Semester –VI
Agile Methodology

BTAIOE604C	Agile Methodology	OEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn:-

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of agile development and testing techniques.
- To understand the benefits and pitfalls of working in an agile team.
- To understand agile development and testing.

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

CO1	Realize the importance of interacting with business stakeholders in determining the requirements for a software system
CO2	Perform iterative software development processes: how to plan them, how to execute them.
CO3	Point out the impact of social aspects on software development success.
CO4	Develop techniques and tools for improving team collaboration and software quality.
CO5	Perform Software process improvement as an ongoing task for development teams and show agile approaches can be scaled up to the enterprise level.

Course Contents:

Unit No 1: AGILE METHODOLOGY [7 Hours]

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

Unit No 2: AGILE PROCESSES [8 Hours]

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

Unit No 3: AGILITY AND KNOWLEDGE MANAGEMENT [7 Hours]

Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

Unit No 4: AGILITY AND REQUIREMENTS ENGINEERING [7 Hours]

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

Unit No 5: AGILITY AND QUALITY ASSURANCE [7 Hours]

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Text Books

1. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results‖, Prentice Hall, 2003.
2. Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science‖, Springer, 2009.

Reference Books

1. Craig Larman, ―Agile and Iterative Development: A Manager_s Guide‖, Addison-Wesley, 2004.
2. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management‖, Butterworth-Heinemann, 2007.

Semester –VI
Augmented Reality

BTAIOE604C	Augmented Reality	OEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
The objective of this course is to provide a foundation to the fast growing field of AR and make the students aware of the various AR devices

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

CO1	Describe how AR systems work and list the applications of AR.
CO2	Understand and analyse the hardware requirement of AR.
CO3	Use computer vision concepts for AR and describe AR techniques.
CO4	Analyse and understand the working of various state of the art AR devices .
CO5	Acquire knowledge of mixed reality .

Course Contents:

Unit No 1: Introduction to Augmented Reality: [7 Hours]

What Is Augmented Reality - Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality

Augmented Reality Concepts- Augmented Reality Working, Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

Unit No 2: Augmented Reality Hardware: [7 Hours]

Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception , Requirements and Characteristics, Spatial Display Model.

Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Unit No 3: Computer Vision for Augmented Reality & A.R. Software: [7 Hours]

Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking

Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

Unit No 4: AR Techniques- Marker based & Markerless tracking: [8 Hours]

Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication Marker types- Template markers, 2D barcode markers, imperceptible markers.

Marker-less approach- Localization based augmentation, real world examples

Tracking methods- Visual tracking, feature based tracking, hybrid tracking, and initialization and recovery.

Unit No 5: AR Devices & Components: [7 Hours]

AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, Video see-through systems.

Note: Hands-on practice of Augmented Reality should cover under Tutorial slots.

Text Books

2. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
3. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494.

Reference Books

1. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381
2. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
3. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
4. https://docs.microsoft.com/en-us/windows/mixed-reality/
5. https://docs.microsoft.com/en-us/archive/msdn-magazine/2016/november/hololens introduction-to-the-hololens

Semester –VI
Development Engineering

BTAIHM605A	Development Engineering	HSSMEC5	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn:-

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

CO1	Improve the skills of development engineering
CO2	Get the knowledge of world poverty and development
CO3	Aware about social justice
CO4	Apply development strategies
CO5	Understand engineering for sustainable community development

Course Contents:

Unit No 1: Introduction [7 Hours]
Introduction, Various Definitions of Development Engineering.

Unit No 2: World Poverty and Development [8 Hours]
World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer‘s Role.

Unit No 3: Social Justice [7 Hours]
Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

Unit No 4: Development Strategies [7 Hours]
Development Strategies: Society, Technological Change, and Development, Development Economists‘ Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

Unit No 5: Engineering for Sustainable Community Development [7 Hours]
The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education. ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

Text Books

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

Semester –VI
Employability and Skill Development

BTAIHM605B	Employability and Skill Development	HSSMEC5	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn:-

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

CO1	Improve the soft skills and communication.
CO2	Empower Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability
CO3	Use of grammar.
CO4	Development in interview skills.
CO5	Develop problem solving techniques.

Course Contents:

Unit No 1: Soft Skills & Communication basics: [7 Hours]
Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

Unit No 2: Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability [8 Hours]
Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).
Matching, Selection, Arrangement, Verifications (Exercises on each of these types).
Verbal aptitude (Synonym, Antonym, Analogy).

Unit No 3: Grammar and Comprehension [7 Hours]
English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

Unit No 4: Skills for interviews **[7 Hours]**

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

Unit No 5: Problem Solving Techniques **[7 Hours]**

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.
Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

Text Books

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

Reference Books

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

Semester –VI
Consumer Behavior

BTAIHM605C	Consumer Behavior	HSSMEC5	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will learn:-

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

CO1	Study of Consumer Behavior
CO2	Get Market Segmentation and Positioning
CO3	Develop Models of Consumer Behavior
CO4	Analyze Psychological Influences on Consumer Decision Making
CO5	Study Diffusion of innovation Diffusion Process

Course Contents:

Unit No 1: Introduction to the Study of Consumer Behavior: [7 Hours]
Defining Consumer Behavior, Scope and Application of Consumer Behavior, Why Study Consumer Behavior, Evolution of Consumer Behavior as a Field Of Study and its relationship with Marketing: Behavioral Dimension, The Interdisciplinary Nature of Consumer Behavior. Market Research and Consumer Behavior, Relevance of Market Research with Consumer Behavior, Approaches to Consumer Behavior Research, Quantitative Research, Qualitative Research.

Unit No 2: Market Segmentation and Positioning [8 Hours]
Market Segmentation, Basis for Segmentation, Alternatives available for Segmentation, Positioning. The Consumer Decision Making Process: Buying Motives, Buying Roles, Consumer Decision Making Process, Levels of Consumer Decision Making, Perspectives to Consumer Decision Making, Consumer Decision Making Process.

Unit No 3: Models of Consumer Behavior [7 Hours]
The Economic model, Learning model, Psychoanalytic model, The sociological model. The Howard Sheth model of Buying Behaviour, The Nicosia model, The Engel - Kollat - Blackwell Model, Engel, Blackwell and Miniard (EBM) model.

Unit No 4: Psychological Influences on Consumer Decision Making [7 Hours]

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

Unit No 5: Diffusion of innovation Diffusion Process [7 Hours]

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

Text Books

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

Reference Books

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

Semester –VI

Deep Learning and Advanced Machine Learning Lab

BTAIL606	Deep Learning and Advanced Machine Learning Lab	LC4	0L-0T-4P	2 Credits

Teaching Scheme	Examination Scheme
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Deep Learning Lab

Practical List

1. Loading dataset into keras/pytorch, creating training and testing splits.
2. Creating functions to compute various losses.
3. Feeding data to pretrained neural network and making predictions.
4. Implementing regression using deep neural network.
5. Classifying IMDB movie review dataset using deep neural network-binary classification problem.
6. Classifying Reuters dataset using deep neural network-multiclass classification problem.
7. Classifying MNIST Dataset using CNN.
8. Classifying data using pretrained models/transfer learning.
9. Training various popular neural networks (Resnet, VGGNet,InceptionV3 etc) on custom Dataset.
10. Tempreture forecasting using RNN.
11. Implementation of GAN on any suitable dataset.

Advanced Machine Learning Lab

1. Implementing K-means Clustering.
2. Implementing Hierarchical Clustering.
3. Implementation of Apriori Algorithm.
4. Implementation of Market Basket Analysis.
5. Reinforcement Learning-
    a. Calculating Reward
    b. Discounted Reward
    c. Calculating Optimal quantities
    d. Implementing Q Learning
    e. Setting up an Optimal Action
6. Time Series Analysis-
    a. Checking Stationary
    b. Converting a non-stationary data to stationary
    c. Implementing Dickey Fuller Test
    d. Plot ACF and PACF
    e. Generating the ARIMA plot
    f. TSA Forecasting
7. Boosting
    a. Cross Validation
    b. AdaBoost

Semester –VI

Mini Project -II

BTAIM607	**MINI PROJECT-II**	**Project**	**0L-0T-4P**	**2 Credits**

Guidelines for Mini Project

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

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

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

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

Continues Assessment:

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

Semester –VI

Internship - III

BTAIP608	**Field Training / Internship / Industrial Training**	**Internship**	**Audit**

Guidelines for Internships

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

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing https://onlinecourses.nptel.ac.in/noc22_cs87/preview Computer Networks and Internet Protocol https://onlinecourses.nptel.ac.in/noc22_cs19/preview	IIT Kharagpur	60 %	12 weeks
2	Machine Learning	BTAIC502	V	Introduction to machine learning https://onlinecourses.nptel.ac.in/noc22_cs97/preview	IIT Kharagpur	80 %	8 weeks
3	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning https://nptel.ac.in/courses/106106140	IIT Madras	60 %	12 weeks
4	Virtual Reality	BTAIPE504A	V	Virtual reality engineering https://nptel.ac.in/courses/121106013	IIT Madras	70 %	12Weeks
5	Soft computing	BTAIPE504B	V	Introduction to soft computing https://onlinecourses.nptel.ac.in/noc22_cs54/preview	IIT Kharagpur	40 %	8 Weeks
6				Neural networks and applications https://archive.nptel.ac.in/courses/117/105/117105084/	IIT Kharagpur	40 %	37 lectures
7	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics https://onlinecourses.nptel.ac.in/noc22_de11/preview Introduction to robotics https://archive.nptel.ac.in/courses/107/106/107106090/	IIT Madras	70 %	12 weeks
8	Advanced Java	BTAIPE504D	V	Programming in Java https://onlinecourses.nptel.ac.in/noc22_cs47/preview	IIT Kharagpur	50 %	12 weeks
9	Data mining and warehousing	BTAIOE505A	V	Data mining https://onlinecourses.swayam2.ac.in/cec19_cs01/preview		60 %	12 weeks
10				Data mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview	IIT Kharagpur	40 %	8 weeks
11	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory https://onlinecourses.nptel.ac.in/noc22_ee108/preview	IIT Kanpur	80 %	12 weeks
12				Principles of Digital communication https://nptel.ac.in/courses/108101113	IIT Bombay	90 %	12 weeks
13	Software engineering and testing	BTAIOE505C	V	Software engineering https://onlinecourses.nptel.ac.in/noc22_cs106/preview	IIT Kharagpur	60 %	12 weeks
14				Software testing https://onlinecourses.nptel.ac.in/noc19_cs71/preview	IIT Bangalore	60 %	12 weeks
15				Software testing https://onlinecourses.nptel.ac.in/noc20_cs19/preview	IIT Kharagpur	40 %	4 weeks
16	Deep learning	BTAIC601	VI	Deep learning https://onlinecourses.nptel.ac.in/noc20_cs62/preview	IIT Kharagpur	80 %	12 week
17				Deep learning https://onlinecourses.nptel.ac.in/noc22_cs124/preview	IIT Ropar	70 %	12 weeks
18	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application https://onlinecourses.nptel.ac.in/noc19_cs82/preview	IIT Madras	50 %	12 Weeks
19	Augmented reality	BTAIPE603A	VI	-			
20	Recommender system	BTAIPE603B	VI	-			
21	Industry 4.0 & automation	BTAIPE603C	VI	Introduction to industry 4.0 and industrial internet of things https://onlinecourses.nptel.ac.in/noc22_cs95/preview	IIT Kharagpur	50 %	12 weeks
22	Web Development	BTAIPE603D	VI	Modern application development https://nptel.ac.in/courses/106106156	IIT Madras	40 %	8 weeks

23	Big Data Analytics	BTAIOE604 A	VI	-			
24	Cryptography and network security	BTAIOE604 B	VI	Cryptography and network security https://onlinecourses.nptel.ac.in/noc22_cs90/preview	IIT Kharagpur	60 %	12 weeks
25	Agile Methodology	BTAIOE604 C	VI	-			
26	Development Engineering	BTAIHM605 A	VI	Developing soft skill and personality https://archive.nptel.ac.in/courses/109/104/109104107/ Educational leadership https://archive.nptel.ac.in/courses/109/105/109105122/	IIT Kharagpur & Kanpur	40 %	8 weeks
27	Employability and Skills Development	BTAIHM605 B	VI	Soft skills https://onlinecourses.nptel.ac.in/noc21_hs76/preview	IIT Roorkee	70 %	12 weeks
28	Consumer Behavior	BTAIHM605 C	VI	Introduction to consumer behavior https://nptel.ac.in/courses/110105029	IIT Kharagpur	50 %	8 weeks
29	Economics and management	BTAIHM605 D	VI	Economics / Management / Entrepreneurship https://nptel.ac.in/courses/110105067	IIT Kharagpur	60 %	12 weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Computer Network and Cloud Computing	BTAIC501	V	The Bits and Bytes of Computer Networking https://www.coursera.org/learn/computer-networking	Google Career Certificate	80%	6 Weeks
2				Introduction to Cloud Computing https://www.coursera.org/learn/introduction-to-cloud	IBM Cloud	75%	5 Weeks
3	Machine Learning	BTAIC502	V	Machine Learning for All https://www.coursera.org/learn/uol-machine-learning-for-all	University of London	90%	4 Weeks
4	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial Intelligence Ethics in Action https://www.coursera.org/learn/ai-ethics-analysis	LearnQuest	75%	3 Weeks
5	Virtual Reality	BTAIPE504A	V	Intro to AR/VR/MR/XR: Technologies, Applications & Issues https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues	University of Michigan	78%	4 Weeks
6	Soft computing	BTAIPE504B	V	Neural Networks and Deep Learning https://www.coursera.org/learn/neural-networks-deep-learning	DeepLearning.AI	65%	4 Weeks
7	Sensors and Robotics Technology	BTAIPE504C	V	AI For Everyone https://www.coursera.org/learn/ai-for-everyone	DeepLearning.AI	65%	4 Weeks
8	Advanced Java	BTAIPE504D	V	Object Oriented Programming in Java https://www.coursera.org/learn/object-oriented-java	UC San Diego	75%	6 Weeks

9	Data mining and warehousing	BTAIOE 505A	V	Data Mining Pipeline https://www.coursera.org/learn/data-mining-pipeline	University of Colorado Boulder	85%	4 Weeks
10				Fundamentals of Data Warehousing https://www.coursera.org/learn/fundamentals-of-data-warehousing	LearnQuest	80%	3 Weeks
11	Digital communication and information theory	BTAIOE 505B	V	Fundamentals of Network Communication https://www.coursera.org/learn/fundamentals-network-communications	University of Colorado	76%	5 Weeks
12				Cryptography and Information Theory https://www.coursera.org/learn/crypto-info-theory	University of Colorado	80%	4 Weeks
13	Software engineering and testing	BTAIOE 505C	V	Software Engineering: Implementation and Testing https://www.coursera.org/learn/software-engineering-implementation-and-testing	The Hong Kong University of Science and Technology	90%	7 Weeks
14	Deep learning	BTAIC601	VI	Neural Networks and Deep Learning https://www.coursera.org/learn/neural-networks-deep-learning	DeepLearning.AI	80%	4 Weeks
15	Advanced Machine Learning	BTAIC602	VI	Advanced Machine Learning and Signal Processing https://www.coursera.org/learn/advanced-machine-learning-signal-processing	IBM Skills Network	80%	4 Weeks
16	Augmented reality	BTAIPE 603A	VI	Introduction to Augmented Reality and ARCore https://www.coursera.org/learn/ar	Daydream	85%	4 Weeks
17	Recommender system	BTAIPE603B	VI	Basic Recommender Systems https://www.coursera.org/learn/basic-recommender-systems	EIT Digital	70%	4 Weeks
18	Industry 4.0 & automation	BTAIPE 603C	VI	Industrial Internet of Things (IIoT) https://www.coursera.org/learn/industrial-internet-of-things	University of Michigan	80%	4 Weeks
19	Web Development	BTAIPE 603D	VI	Web Application Development: Basic Concepts https://www.coursera.org/learn/web-app	University of New Mexico	80%	5 Weeks
20	Big Data Analytics	BTAIOE 604A	VI	Fundamentals of Software Architecture for Big Data https://www.coursera.org/learn/software-architecture-for-big-data-fundamentals	University of Colorado Boulder	75%	4 Weeks
21	Cryptography and network security	BTAIOE 604B	VI	Cryptography and Hashing Overview https://www.coursera.org/learn/crypto-hashing	University of California, Irvine	75%	4 Weeks
22	Agile Methodology	BTAIOE 604C	VI	Combining Scrum with Other Agile Methodologies https://www.coursera.org/learn/combining-scrum-with-other-methodologies	LearnQuest	85%	2 Weeks
23	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIHM605	VI	People and Soft Skills Assessment https://www.coursera.org/learn/people-soft-skills-assessment	IBM	65%	1 Week

24	Development Engineering	BTAIH M605A	VI	Developing a Systems Mindset https://www.coursera.org/learn/systems-mindset	University of Colorado Boulder	60%	3 Weeks
25	Employability and Skills Development	BTAIH M605B	VI	Learning How to Learn: Powerful mental tools to help you master tough subjects https://www.coursera.org/learn/learning-how-to-learn	Deep Teaching Solutions	65%	4 Weeks
26	Consumer Behavior	BTAIH M605C	VI	Market Research and Consumer Behavior https://www.coursera.org/learn/market-research	IE Business School	70%	4 Weeks
27	Economics and management	BTAIH M605D	VI	The Strategist's Challenge https://www.coursera.org/learn/strategists-challenge	University of Virginia Darden School Foundation	75%	4 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Edx Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing https://onlinecourses.nptel.ac.in/noc22_cs87/preview 11Computer Networks and Internet Protocol https://onlinecourses.nptel.ac.in/noc22_cs19/preview	IIT Kharagpur	40%	12 weeks
2	Machine Learning	BTAIC502	V	Introduction to machine learning https://onlinecourses.nptel.ac.in/noc22_cs97/preview	IIT Kharagpur	80%	8 weeks
3	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning https://nptel.ac.in/courses/106106140	IIT Madras	60%	12 weeks
4	Virtual Reality	BTAIPE504A	V	Virtual reality engineering https://nptel.ac.in/courses/121106013	IIT Madras	70%	12Weeks
5	Soft computing	BTAIPE504B	V	Introduction to soft computing https://onlinecourses.nptel.ac.in/noc22_cs54/preview	IIT Kharagpur	40%	8 Weeks
				Neural networks and applications https://archive.nptel.ac.in/courses/117/105/117105084/	IIT Kharagpur	40%	37 lectures
6	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics https://onlinecourses.nptel.ac.in/noc22_de11/preview Introduction to robotics https://archive.nptel.ac.in/courses/107/106/107106090/	IIT Madras	70%	12 weeks
7	Advanced Java	BTAIPE504D	V	Programming in Java https://onlinecourses.nptel.ac.in/noc22_cs47/preview	IIT Kharagpur	50%	12 weeks
8	Data mining and warehousing	BTAIOE505A	V	Data mining https://onlinecourses.swayam2.ac.in/cec19_cs01/preview		60%	12 weeks
				Data mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview	IIT Kharagpur	40%	8 weeks
9	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory https://onlinecourses.nptel.ac.in/noc22_ee108/preview	IIT Kanpur	80%	12 weeks
				Principles of Digital communication https://nptel.ac.in/courses/108101113	IIT Bombay	90%	12 weeks
10	Software engineering and testing	BTAIOE505C	V	Software engineering https://onlinecourses.nptel.ac.in/noc22_cs106/preview	IIT Kharagpur	60%	12 weeks

				Software testing https://onlinecourses.nptel.ac.in/noc19_cs71/preview	IIT Bangalore	60%	12 weeks
				Software testing https://onlinecourses.nptel.ac.in/noc20_cs19/preview	IIT Kharagpur	40%	4 weeks
11	Deep learning	BTAIC601	VI	Deep learning https://onlinecourses.nptel.ac.in/noc20_cs62/preview	IIT Kharagpur	80%	12 week
				Deep learning https://onlinecourses.nptel.ac.in/noc22_cs124/preview	IIT Ropar	70%	12 weeks
12	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application https://onlinecourses.nptel.ac.in/noc19_cs82/preview	IIT Madras	50%	12 Weeks
13	Augmented reality	BTAIPE603A	VI	-			
14	Recommender system	BTAIPE603B	VI	-			
15	Industry 4.0 & automation	BTAIPE 603C	VI	Introduction to industry 4.0 and industrial internet of things https://onlinecourses.nptel.ac.in/noc22_cs95/preview	IIT Kharagpur	50%	12 weeks
16	Web Development	BTAIPE 603D	VI	Modern application development https://nptel.ac.in/courses/106106156	IIT Madras	40%	8 weeks
17	Big Data Analytics	BTAIOE 604A	VI	-			
18	Cryptography and network security	BTAIOE 604B	VI	Cryptography and network security https://onlinecourses.nptel.ac.in/noc22_cs90/preview	IIT Kharagpur	60%	12 weeks
19	Agile Methodology	BTAIOE 604C	VI	-			
20	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIH M605	VI	Developing soft skill and personality https://archive.nptel.ac.in/courses/109/104/109104107/ Educational leadership https://archive.nptel.ac.in/courses/109/105/109105122/	IIT Kharagpur & Kanpur	40%	8 weeks
21	Development Engineering	BTAIH M605A	VI	-			
22	Employability and Skills Development	BTAIH M605B	VI	Soft skills https://onlinecourses.nptel.ac.in/noc21_hs76/preview	IIT Roorkee	70%	12 weeks
23	Consumer Behavior	BTAIH M605C	VI	Introduction to consumer behavior https://nptel.ac.in/courses/110105029	IIT Kharagpur	50%	8 weeks
24	Economics and management	BTAIH M605D	VI	Economics / Management / Entrepreneurship https://nptel.ac.in/courses/110105067	IIT Kharagpur	60%	12 weeks