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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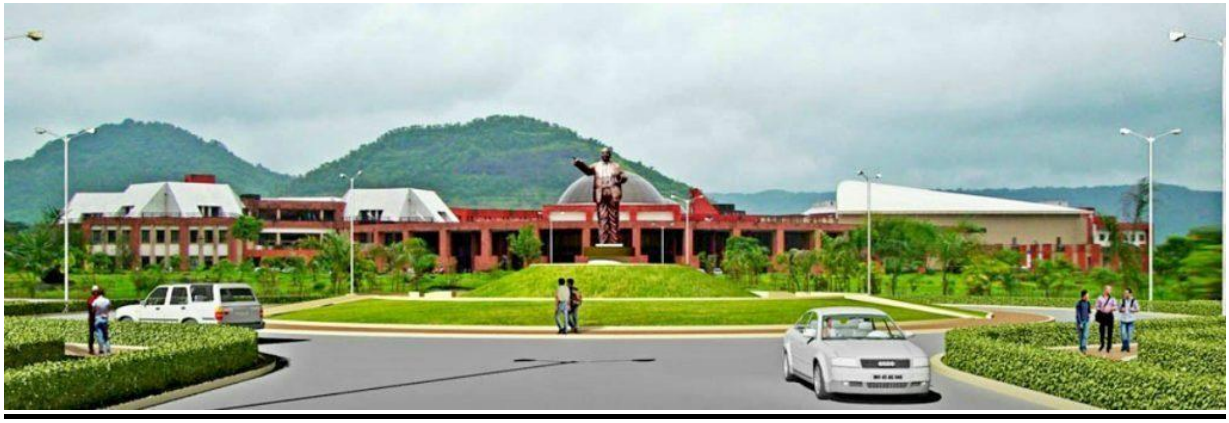
PROPOSED CURRICULUM UNDER GRADUATE PROGRAMME

B. TECH

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

Second Year

WITH EFFECT FROM THE ACADEMIC YEAR 2021-2022



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.

Different Categories of Courses and Credits for Degree Requirements

a) Humanities and Social Science including Management Courses

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

b) Basic Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTBS101	Engineering Mathematics – I	(3-1-0) 4
2	BTBS102	Engineering Physics	(3-1-0) 4
3	BTBS107L	Engineering Physics Laboratory	(0-0-2) 1
4	BTBS201	Engineering Mathematics-II	(3-1-0) 4
5	BTBS202	Engineering Chemistry	(3-1-0) 4
6	BTBS207L	Engineering Chemistry Laboratory	(0-0-2) 1
7	BTES301	Engineering Mathematics-III	(3-1-0) 4
8	BTBS404	Probability Theory and Random Processes	(3-0-0) 3
		TOTAL	**25**

c) Engineering Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES103	Engineering Graphics	(2-0-0) 2
2	BTES105	Energy and Environment Engineering	(2-0-0) 2
3	BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
4	BTES108L	Engineering Graphics Laboratory	(0-0-4) 2
5	BTES203	Engineering Mechanics	(2-1-0) 3
6	BTES204	Computer Programming	(2-0-0) 2
7	BTES205	Workshop Practices	(0-0-4) 2
8	BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
9	BTES208L	Engineering Mechanics Laboratory	(0-0-2) 1
10	BTES209L	Basic Computer Programming Laboratory	(0-0-2) 1
11	BTESC304	Computer Architecture & Operating Systems	(3-0-0) 3
12	BTESC305	Digital Logic & Signal Processing	(3-0-0) 3
		TOTAL	**21**

d) Professional Core Course

Sr. No.	Cours eCode	Course Name	(L-T-P) Credits
1	BTAIC302	An Introduction to Artificial Intelligence	(3-1-0) 4
2	BTAIC303	Data Structure and Algorithm using Python	(3-1-0) 4
3	BTAIC401	Data Analysis	(3-1-0) 4
4	BTAIC402	Database Management System	(3-1-0) 4
5	BTAIC501	Artificial Intelligence (Knowledge Representation and Reasoning) and its tools	(3-1-0) 4
6	BTAIC502	Machine Learning	(3-1-0) 4
7	BTAIC503	Software Engineering and Testing	(3-1-0) 4
8	BTAIC601	Deep Learning & Neural Network	(3-1-0) 4
9	BTAIC602	Data Engineering (Data Modeling & Visualization)	(3-1-0) 4
10	BTAIC701	Natural Language Processing	(3-1-0) 4
11	BTAIC702	Web Development Framework	(3-1-0) 4
12	BTAIL306	Artificial Intelligence Lab and Programming, Data Structure and Algorithm using Python Lab	(0-0-4) 2
13	BTAIL406	Data Analysis Lab and Database Management System Lab	(0-0-4) 2
14	BTAIL506	Machine Learning Lab and Software Engineering and Testing Lab	(0-0-4) 2
15	BTAIL606	Deep Learning & Neural Network Lab and Data Engineering Lab	(0-0-4) 2
16	BTAIL707	Natural Language Processing & Web Development Framework Lab	(0-0-4) 2
		TOTAL	**54**

e) Professional Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTAIPE405	Professional Elective Courses –I 1. Numerical Methods and Computer Programming 2. Image Processing & Computer Vision 3. Internet of Things & Embedded System 4. Programming in JAVA	(3-1-0) 4
2	BTAIPE504	Professional Elective Course (PEC) -II 1. Data Warehouse & Data Mining 2. Cloud Computing 3. Sensors & Robotics Technology 4. Advanced Java	(3-1-0) 4
3	BTAIPE603	Professional Elective Course (PEC) -III 1. Big Data Analytics 2. Pattern Recognition 3. Industry 4.0 & Automation 4. Virtual and Augmented Reality	(3-1-0) 4
4	BTAIPE703	Professional Elective Course (PEC) -IV 1. Big Data Framework (Apache Hadoop, Hive, Spark) 2. Recommendation System 3. Autonomous Vehicle 4. Virtual Reality in Game development	(3-0-0) 3
		TOTAL	**15**

f) Open Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTAIOE604	Open Elective Course (OEC) - I 1. Advance Machine Learning 2. Human Computer Interface & Information Retrieval 3. Computer Network and Security 4. Open Elective I	(3-1-0) 4
2	BTAIOE704	Open Elective Course (OEC) - III 1. AI Application Deployment 2. Information Retrieval 3. GPU Architecture and Programming 4. Open Elective II	(3-0-0) 3
3	BTAIOE705	Open Elective Course (OEC) -IV 1. Modern Application Development in AI 2. Quantum AI 3. Cyber Security and Block chain 5. Open Elective III	(3-0-0) 3
		TOTAL	**10**

g) Seminar / Mini Project / Internship

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES210S	Seminar	(0-0-2) 1
2	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	Audit
3	BTAIP408	Internship -II	Audit
4	BTAIP508	Internship –II (Evaluation)	Audit
5	BTAIP608	Internship -III	Audit
6	BTAIP709	Internship –III (Evaluation)	Audit
7	BTAIS307	Seminar-I	(0-0-4) 2
8	BTAIS407	Seminar-II	(0-0-4) 2
9	BTAIM507	Mini Project-I	(0-0-4) 2
10	BTAIM607	Mini Project-II	(0-0-4) 2
11	BTAIM708	Project Work	(0-0-4) 2
12	BTAIF801	Project Work / Internship	(0-0-24) 12
		TOTAL	**23**

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	54	**54**
5	Professional Elective courses relevant to chosen specialization/branch	**18***	0	15	**15**
6	Open subjects – Electives from other technical and /or emerging subjects	**18***	0	10	**10**
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.*

Suggested Plan of Study

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTES301	BTAIC401	BTAIC501	BTAIC601	BTAIC701	BTAIP801 (Project / Internship)
2	BTBS102	BTBS202	BTAIC302	BTAIC402	BTAIC502	BTAIC602	BTAIC702	--
3	BTES103	BTES203	BTAIC303	BTHM403	BTAIC503	BTAIPE603 **(Elective)**	BTAIPE703 **(Elective)**	--
4	BTHM104	BTES204	BTESC304	BTBS404	BTAIPE504 **(Elective)**	BTAIOE604 **(Elective)**	BTAIOE704 **(Elective)**	--
5	BTES105	BTES205	BTESC305	BTAIPE405 **(Elective)**	BTAIHM505 **(Elective)**	BTAIHM605 **(Elective)**	BTAIOE705 **(Elective)**	--
6	BTES106	BTES206	BTAIL306	BTAIL406	BTAIL506	BTAIL606	BTAIHM706 **(Elective)**	--
7	BTBS107L	BTBS207L	BTAIS307	BTAIS407	BTAIM507	BTAIM607	BTAIL707	--
8	BTES108L	BTES208L	BTES211P (Internship -1 Evaluation)	BTAIP408 (Internship –2)	BTAIP508 (Internship –2 Evaluation)	BTAIP608 (Internship –3)	BTAIM708	--
9	BTHM109L	BTES209S	--	--	--	--	BTAIP709 (Internship –3 Evaluation)	--
10	--	BTES211P (Internship -1)	--	--	--	--	--	--

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, economical, environmental and social context.

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

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

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

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester III (Term 3)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTES301	Engineering Mathematics-III	3	1	-	20	20	60	100	4
PCC1	BTAIC302	An Introduction to Artificial Intelligence	3	1	-	20	20	60	100	4
PCC2	BTAIC303	Data Structure and Algorithm using Python	3	1	-	20	20	60	100	4
ESC11	BTESC304	Computer Architecture & Operating Systems	3	-	-	20	20	60	100	3
ESC12	BTESC305	Digital Logic & Signal Processing	3	-	-	20	20	60	100	3
LC1	BTAIL306	Artificial Intelligence Lab & Data Structure and Algorithm using Python Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS307	Seminar-I	-	-	4	60	-	40	100	2
Internship	BTES211P	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
		Total	**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 Second Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester IV (Term 4)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC3	BTAIC401	Data Analysis	3	1	-	20	20	60	100	4
PCC4	BTAIC402	Database Management System	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC8	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC-1	BTAIPE405	Professional Elective Courses –I	3	1	-	20	20	60	100	4
	BTAIPE405A	1. Numerical Methods and Computer Programming								
	BTAIPE405B	2. Image Processing & Computer Vision								
	BTAIPE405C	3. Internet of Things & Embedded System								
	BTAIPE405D	4. Programming in JAVA								
LC2	BTAIL406	Data Analysis Lab and Database Management System Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS407	Seminar - II	-	-	4	60	-	40	100	2
Internship	BTAIP408	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit to be evaluated in V Sem.
		Total	**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 Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester V (Term 5)									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme			
			L	T	P	CA	MSE	ESE	Total	Credit
PCC5	BTAIC501	Artificial Intelligence (Knowledge Representation and Reasoning) and its tools	3	1	-	20	20	60	100	4
PCC6	BTAIC502	Machine Learning	3	1	-	20	20	60	100	4
PCC7	BTAIC503	Software Engineering and Testing	3	1	-	20	20	60	100	4
PEC-2	BTAIPE504	Professional Elective Course (PEC) -II	3	1	-	20	20	60	100	4
	BTAIPE504A	1. Data Warehouse & Data Mining								
	BTAIPE504B	2. Cloud Computing								
	BTAIPE504C	3. Sensors & Robotics Technology								
	BTAIPE504D	4. Advanced Java								
HSSMEC-4	BTAIHM505	Humanities and Social Sciences including Management Elective Course - I	3	-	-	20	20	60	100	3
	BTAIHM505A	1. Economics and Management								
	BTAIHM505B	2. Business Communication								
	BTAIHM505C	3. Professional Ethics and Values								
LC3	BTAIL506	Machine Learning Lab and Software Engineering and Testing Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM507	Mini Project I	-	-	4	60	-	40	100	2
Internship	BTAIP508	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
		Total	**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

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 Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester VI (Term 6)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC8	BTAIC601	Deep Learning & Neural Network	3	1	-	20	20	60	100	4
PCC9	BTAIC602	Data Engineering (Data Modeling & Visualization)	3	1	-	20	20	60	100	4
PEC-3	BTAIPE603	Professional Elective Course (PEC) -III	3	1	-	20	20	60	100	4
	BTAIPE603A	1. Big Data Analytics								
	BTAIPE603B	2. Pattern Recognition								
	BTAIPE603C	3. Industry 4.0 & Automation								
	BTAIPE603D	4. Virtual and Augmented Reality								
OEC-1	BTAIOE604	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE604A	1. Advance Machine Learning								
	BTAIOE604B	2. Human Computer Interface & Information Retrieval								
	BTAIOE604C	3. Computer Network and Security								
	BTAIOE604D	4. Open Elective I								
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 Skill Development								
	BTAIHM605C	3. Consumer Behaviour								
LC4	BTAIL606	Deep Learning & Neural Network Lab and Data Engineering Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM607	Mini Project II	-	-	4	60	-	40	100	2
Internship	BTAIP608	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit to be evaluated in VII Sem
		Total	**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

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 Final Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester VII (Term 7)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC10	BTAIC701	Natural Language Processing	3	1	-	20	20	60	100	4
PCC11	BTAIC702	Web Development Framework	3	1	-	20	20	60	100	4
PEC-4	BTAIPE703	Professional Elective Course (PEC) -IV	3	-	-	20	20	60	100	3
	BTAIPE703A	1. Big Data Framework (Apache Hadoop, Hive, Spark)								
	BTAIPE703B	2. Recommendation System								
	BTAIPE703C	3. Autonomous Vehicle								
	BTAIPE703D	4. Virtual Reality in Game development								
OEC-2	BTAIOE704	Open Elective Course (OEC) - III	3	-	-	20	20	60	100	3
	BTAIOE704A	1. AI Application Deployment								
	BTAIOE704B	2. Information Retrieval								
	BTAIOE704C	3. GPU Architecture and Programming								
	BTAIOE704D	4. Open Elective II								
OEC-3	BTAIOE705	Open Elective Course (OEC) - IV	3	-	-	20	20	60	100	3
	BTAIOE705A	1. Modern Application Development in AI								
	BTAIOE705B	2. Quantum AI								
	BTAIOE705C	3. Cyber Security and Block chain								
	BTAIOE705D	4. Open Elective III								
HSSMEC -6	BTAIHM706	Humanities and Social Sciences including Management Elective Course (HSSMEC) - II	-	-	4	-	-	-	-	Audit
	BTAIOE706A	1. Foreign Language Studies								
	BTAIOE706B	2. Universal Human Value & Ethics								
	BTAIOE706C	3. Intellectual Property Rights								
LC5	BTAIL707	Natural Language Processing & Web Development Framework Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM708	Project Work	-	-	4	60	-	40	100	2
Internship	BTAIP709	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
		Total	**15**	**2**	**12**	**220**	**100**	**380**	**700**	**21**

Semester VIII (Term 8)										
Course Category	Couse Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
Project/ Internship	BTAIF801	Project Work/ Internship	-	-	24	60	-	40	100	12
Total			**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

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

Second Year (Semester –III)
Engineering Mathematics-III

BTES301	Engineering Mathematics-III	BSC	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. To study the concepts of vector calculus, used in various field of artificial intelligence and data science.
2. To study determinant and matrices apply it in computer and electronics engineering.
3. To use linear algebra in programming.
4. To get knowledge of diagonalization for population and economics.

Course Outcomes:

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

CO1	Understand the concept of vector calculus.
CO2	Solve problems related to matrices and applications to Deep Learning, Signal & Image processing.
CO3	Understand the concepts of linear algebra and apply Linear Programming, Computer Graphics and Cryptography.
CO4	Understand the concepts of determinant and apply it in data analysis.
CO5	Analyze Diagonalization and apply in Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.

Course Contents:

Unit 1: **[07 Hours]**

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

Unit 2: **[07 Hours]**

Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible

(Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.

Unit 3: **[07 Hours]**

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

Unit 4: **[07 Hours]**

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

Unit 5: **[07 Hours]**

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

Text Books

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

Reference Books

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

Second Year (Semester –III)

An Introduction to Artificial Intelligence

BTAIC302	An Introduction to Artificial Intelligence	PCC1	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. To provide a strong foundation of fundamental basics of Artificial Intelligence.
2. Demonstrate awareness and fundamental understanding of various applications of AI techniques.
3. Apply Artificial Intelligence techniques for problem solving.

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

CO1	Discuss Meaning, Scope and Stages of Artificial Intelligence
CO2	Understand and Implement Problem Space and Search Strategies for Solving problems.
CO3	Discuss the Search Techniques and Knowledge Representation.
CO4	Apply search for solving Constraint Satisfaction Problems and Game-playing.
CO5	Discover the Application of Artificial Intelligence and Analyze Impact of AI on Society

Course Contents:

Unit No 1: Introduction: [7 Hours]

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Introduction: Philosophy of AI, Definitions, AI Future. Stages of AI. (ANI, AGI ASI with examples).

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

Unit No 2: Search Methods [8 Hours]

State Space Search

Generate and test, simple search, Depth first search (DFS), Breadth First search (BFS), Comparison, Quality of Solution, Depth Bounded DFS, Depth First Iterative Deepening.

Heuristic Search:

Heuristic Functions, Search Techniques: Best-first search, Hill climbing, Local Maxima, Solution Space Search, Variable Neighbourhood Descent, Beam Search, Tabu Search, Peak to

peak method.

Randomized Search:

Population Based Methods: Escaping Local Optima, Iterated Hill Climbing, Simulated Annealing, Genetic Algorithms, Neural Network, Emergent Systems, Ant Colony Optimization.

Unit No 3: Optimal Path Finding [7 Hours]

Brute Force, Branch & Bound, Refinement Search, Dijkstra Algorithm, Algorithm A*, Admissible A*, Iterative Deepening A*, Recursive Best First Search, Pruding the CLOSED List, Pruning the OPEN List, Conquer Beam Stack Search.

Unit No 4: Game Playing & Automated Planning: [7 Hours]

Game Playing: Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and Algorithm SSS*, B* search.

Automated Planning: Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning

Unit No 5: Constraint Satisfaction [7 Hours]

N Queens, Constraint Propagation, Scene labelling, Higher order consistency, Algorithm backtracking, Look-head strategies, Strategic retreat.

Text Books

1. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw-Hill Education, 2013.
2. Eugene, Charniak, Drew Mcdermott, "Introduction to artificial intelligence", Addison Wesley, 1985.
3. Elaine Rich, Kevin Knight, Shivashankar B Nair:Artificial Intelligence, Tata CGraw Hill 3rd edition. 2013.
4. Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013.

Reference Books

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Herbert A. Simon, "The Sciences of the Artificial ", MIT Press, 3rd Edition (2nd Printing), 1995. 3. Tim Jones, "Artificial Intelligence Application Programming", Dreamtech Publication.
3. George F. Luger, “Artificial Intelligence-Structures and Strategies For Complex Problem Solving”, Pearson Education / PHI, 2002.
4. Prolog Programming for A.I. by Bratko, TMH

Semester –III

Data Structure and Algorithm Using Python

BTAIC303	Data Structure and Algorithm Using Python	PCC2	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. Introduce the fundamental concept of Python programming to the students
2. Understand various data structures in Python and write algorithms and programs using them
3. Compare alternative implementations of data structures with respect to performance
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

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

CO1	Write programs using basic concepts of Python Programming
CO2	Implement algorithms for arrays, linked structures, stacks, queues, trees, and graphs
CO3	Write programs that use arrays, linked structures, stacks, queues, trees, and graphs
CO4	Compare and contrast the benefits of dynamic and static data structures implementation
CO5	Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Contents:

Unit 1: Introduction to Programming **[07 Hours]**

Introduction to Programming, Why Programming, What is a Program? Problem Solving, Algorithms and Data Structure

Introduction to Programming, Variables, Data Types, Input-Output Statements, Indentation, Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Control Flow- if, if-elif-else, for, while break, continue, pass

Collections- String, Lists, Tuples, Dictionaries, Sets, Map

Unit 2: Functions & Object Oriented Programming using Python [07 Hours]

Functions- Built-in and User defined functions, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables, Recursions

Need for OOP, Classes and Objects, OOP Concepts, Constructor, Class Diagram, Encapsulation, Statics, Relationship, Inheritance, and Abstract Classes, Exception Handling

Unit 3: Data Structures in Python [07 Hours]

ADT- Defining the ADT, Using the ADT, Pre conditions and post conditions

Introduction to Data Structures, Types of Data Structures, Arrays- Need for array, Array ADT, Implementing array, 2-D arrays,

Linked Structures- Singly Linked List & Operations with algorithms, Application- Polynomials, Doubly Linked Lists, Circular Linked List

Stacks- Stack ADT, Implementing the stack- using Python List and using a linked list, Stack Applications- Evaluating Postfix expressions

Queues- Queue ADT, Implementing the queue- using Python List and using a linked list, Priority Queue, Applications of Queues

Unit 4: Non-Linear Data Structures in Python [07 Hours]

Binary Trees- Tree Structure, Properties, Implementation, Tree Traversals, Heaps-Definition, Implementation, Heap Sort

Binary Search Trees- Operations and Algorithms (searching, insertion, deletion, min, max), AVL Tree-Insertions, deletions, implementation

Hash Tables- Hashing techniques, Hash functions, Applications

Unit 5: Searching & Sorting Algorithms and Analysis [08 Hours]

Search Algorithms- Linear Search Algorithm, Binary Search Algorithm,

Comparison Sort Algorithms- Introduction, Selection Sort, Insertion Sort, Bubble Sort, Merge Sort, Quick Sort

Algorithmic Techniques-Algorithm Technique- Greedy Approach, Dynamic Programming, Complexity Analysis of Algorithms- Introduction, Analysis of Algorithms, Big-O Notation, Evaluating the Python List.

Text Books / Reference Books

1. Data Structures and Algorithms Using Python, Rance D. Necaise
2. Python for Everybody, Exploring Data Using Python 3, Dr. Charles R. Severance

3. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.

Semester –III

Computer Architecture and Operation Systems

BTESC304	Computer Architecture and Operation Systems	ESC	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 understand the structure, function and characteristics of computer systems
2. To identify the elements of modern instructions sets and their impact on processor design
3. To understand the services provided by and the design of an operating system.
4. Understand the structure, organization memory management.

Course Outcomes:

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

CO1	Understand the theory and architecture of central processing unit & Analyze some of the design issues in terms of speed, technology, cost, performance
CO2	Use appropriate tools to design verify and test the CPU architecture & Learn the concepts of parallel processing, pipelining and inter processor communication.
CO3	Understand the architecture and functionality of central processing unit & Exemplify in a better way the I/O and memory organization, Memory management systems, Virtual Memory
CO4	Describe and explain the fundamental components of a computer operating system
CO5	Define, restate, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Contents:

Unit 1: Introduction, Arithmetic and Instruction Sets [07 Hours]

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

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

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

Unit 2: Memory Organization and Management [8 Hours]

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

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

Unit 3: Control Unit & Input/ Output Organization: [07 Hours]

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

Unit 4: Introduction OS & Processes and CPU Scheduling: [07 Hours]

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

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Cooperating processes. Threads, Inter-process Communication, Scheduling criteria, scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Scheduling Algorithms and performance evaluation.

Unit 5: Process Synchronization & Deadlocks [07 Hours]

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

Text Books

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.
2. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
3. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011
4. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.

Reference Books

1. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
2. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.

Semester –III

Digital Logic & Signal Processing

BTESC305	Digital Logic & Signal Processing	ESC	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 acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To classify signals and systems into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal and image processing, computer vision, Machine Learning and Deep Learning.

Course Outcomes:

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

CO1	Use the basic logic gates and various reduction techniques of digital logic circuit in detail
CO2	Understand mathematical description and representation of various signals and systems.
CO3	Develop input output relationship for linear shift invariant system and understand the convolution operator for discrete time system.
CO4	Understand use of different transforms and analyze the discrete time signals and systems.
CO5	Understand the concept of correlation, regression and spectral density.

Course Contents:

Unit 1: Number System and Boolean Algebra [07 Hours]

Digital Signal, Digital logic circuits: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR.

Boolean algebra and theorems.

Number System: Binary, Octal, Decimal, and Hexadecimal. Binary Arithmetic (addition, subtraction, multiplication, division), 1's & 2's compliment.

Codes: Binary, Gray, BCD, Excess-3, Octal, Hexadecimal code.

Unit 2: Introduction to Signals and Systems [8 Hours]

Signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-

deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. Sampling Process.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

Unit 3: Discrete Fourier Transform **[07 Hours]**

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, Convolution: circular convolution, linear convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm.

Unit 4: Z transform **[07 Hours]**

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Unit 5: Correlation and Spectral Density **[07 Hours]**

Introduction of correlation and correlogram, the correlation function: analogy between correlation and convolution, auto-correlation, properties of auto-correlation, Cross-correlation: properties of cross correlation

Introduction of Spectral density, ESD, Properties of ESD, PSD, Properties of PSD.

Text Books

1. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
2. Nagoor Kanni “Signals and Systems”, 2nd edition, McGrawHill.

Reference Books

1. R. P. Jain, Modern digital electronics. 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. Alan V. Oppenheim. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
3. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
4. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
5. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
6. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.

Semester –III

An Introduction to Artificial Intelligence Lab

BTAIL306	**Artificial Intelligence Lab and Data Structure and Algorithm Using Python Lab**	**LC**	**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

A) Artificial Intelligence Lab

List of Practical/Tutorial **[Minimum 8]**

Software Tools: Programming languages, namely Java, Python, C++, Lisp, and Prolog, is highly recommended for students to use when completing their assignments and/or practical's for this course.

1. Study of Java/Python/C++/ Lisp/ PROLOG.
2. Write a program to solve 8 queens problem.
3. Solve any problem using depth first search.
4. Solve any problem using breadth first search.
5. Solve 8-puzzle problem using best first search.
6. Write a program to solve map coloring problem using CSP.
7. Write a program to solve Tic-Tac-Toe using Min-Max search.
8. Solve traveling salesman problem.
9. Write a program for Alpha–Beta Pruning.

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Software Tools: Programming languages Python and Opens Source tools must and highly recommended for students to use when completing their assignments and/or practical's for this course.

B) Data Structure and Algorithm Using Python Lab

List of Practical

Downloading and installing Python gcd in Python as start of lab for hands on laboratory

1) Write code and understand the concept Variable, Data Type and Data Object in python.
2) Write code and understand the concept List, Tuple, and Array in python.
3) Write code and understand the concept Loop and Function in python.
4) Write code and understand the concept Classes and Objects in python.
5) Write code and understand the concept Constructor and Relationship
6) Write code and understand the concept Inheritance and Exception Handling in python.
7) Write code and understand the concept List in data Structure
8) Write code and understand the concept Queue in data Structure
9) Write code and understand the concept Array in data Structure
10) Write code and understand the concept Graphs, Trees in data Structure
11) Write code and understand the concept Hashing, Hast Tables in data Structure
12) Write code and understand the concept Search Algorithms (Any two)
13) Write code and understand the concept Sorting Algorithms (Any two)
14) Write code and understand the concept Algorithm Technique on Greedy Approach

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Semester –III
Seminar-I

BTAIS307	**SEMINAR- I**	**Seminar**	**0L-0T-4P**	**2 Credits**

Guidelines for Seminar

The students shall study in group of two or three members 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. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal 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 presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –III
Internship - I

BTES211P	**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 –IV

Data Analysis

BTAIC401	Data Analysis	PCC3	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: Basics of Linear Algebra, Introduction, Probability and Statistics.

Course Objectives:

After completion of the course, students will learn:-

1. To obtain a Comprehensive knowledge of various tools and techniques for Data transformation and visualization
2. To learn the probability and probabilistic models of data science
3. To learn the basic statistics and testing hypothesis for specific problems
4. To learn about the prediction models
5. To give a hands-on experience with real-world data analysis

Course Outcomes:

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

CO1	Apply preprocessing techniques to convert raw data so as to enable further analysis
CO2	Apply exploratory data analysis and create insightful visualizations to identify patterns
CO3	Understand how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions
CO4	Understand the statistical foundations of data science and analyze the degree of certainty of predictions using statistical test and models
CO5	Introduce machine learning algorithms for prediction and to derive insights

Course Contents:

Unit 1: Statistical data and Concepts [07 Hours]

The statistical Methods, Misuse, Misinterpretation and bias, Sampling and sampling size, Data preparation and cleaning, Missing data and data errors, Statistical error, Statistical Modeling, Computational Statistics, Inference, Bias, Cofounding, Hypothesis testing, Types of error, Statistical significance, Confidence Interval, Power and robustness, Degrees of freedom, Non parametric analysis.

Unit 2: Descriptive Statistics [07 Hours]

Counts and specific values, Measure of central tendency, Measure of spread, Measure of distribution shape, Statistical indices, Moments, Key functions, Measures of complexity and

model selection.

Unit 3: Data transformation and standardization [07 Hours]

Box-Cox and power transforms, Freeman-Tukey (square root and arcsine) transforms, Log and Exponential transforms, Logit transforms, Normal transform.

Unit 4: Classical Tests and Contingency Tables [8 Hours]

Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors; Z- test: test of single mean, standard deviation known, Test of the difference between two means, standard deviation known, test for proportions, P; T-tests: test of single mean, standard deviation not known, Test of the difference between two means, standard deviation not known, test of regression coefficients; Variance test: Chi square test of single variable, F-test of two variables, test of homogeneity; Wilcoxon rank-sum/Mann-Whitney U test; Sign test.

Contingency Tables: Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test.

Unit 5: Analysis of Variance and Covariance [07 Hours]

ANOVA: Single factor or one way ANOVA, Two factor or two-way and higher-way ANOVA, MANOVA, ANCOVA; Non Parametric ANOVA: Kruskal Wallis ANOVA, Friedam ANOVA test, Mood's median

Text Books

1. Dr. Michael J de Smith, Statistical Analysis Handbook, A Comprehensive guide to statistical concepts methods and tools, The Winchelsea Press, Drumlin Security Ltd, Edinburgh 2018 edition. https://www.statsref.com/HTML/index.html
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013
3. Dr.J.Ravichandran, Probability And Statistics For Engineers, First Edition, Wiley, 2010 Scientists

Reference Books

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
4. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

Semester –IV

Database Management System

BTAIC402	Database Management System	PCC4	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 Database Management Systems and types of DBMS used in data analysis
2. Understand various ways to organize, maintain and retrieve - efficiently, and effectively – information from different DBMS
3. Design and maintenance of the database systems
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

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

CO1	Master the basic concepts of relational DBMS and its types.
CO2	Perform various types of operations on relational databases using DDL, DML, DCL in SQL
CO3	Understand the concept of how non-relational databases differ from relational databases from a practical perspective.
CO4	Master the basic concepts of designing NoSQL database management system.
CO5	Able to Identify what type of NoSQL database to implement based on business requirements

Course Contents:

Unit 1: Introduction to Databases **[06 Hours]**

Introduction to Data and Database, Significance of Database Management System, Various Types of DBMS- relational & non-relational, Data Independence - The Three Levels Of

Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema

Unit 2: Relational Database Management System [07 Hours]

Data Models & Types, ER to Relational Mapping , Structure Of Relational Databases, Creation and Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)

Normalization –Anomalies- Functional Dependency, Normal forms- 1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit 3: Non-Relational Database Management System [07 Hours]

NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, CAP theorem, Types of NoSQL Databases,

Key-value database-Key values database, More elements of key values database, Properties of Key-value store

Unit 4: Columnar & Document Databases [8 Hours]

Columnar Databases with Apache Cassandra- Characteristics of a columnar database, Concepts of columnar databases, Cassandra Introduction and its use-cases, Implement a columnar database using Apache Cassandra

Introduction to Document databases, Document databases with MongoDB - Implement a document database with MongoDB

Unit 5: Graph and Future databases [8 Hours]

Graph Databases - Graph databases, graph traversal and graph problems, graph data structures edge list, adjacency matrix, properties of graph model.

Implementation and systems - Reliable, maintainable and scalable, Different information systems

Future databases: Data Models and Storage- SQL- NoSQL, APIs- Return SQL, Advance Databases- PostgreSQL, RiakCouchDB, NEO4J, Redis, Future Databases— Revolution Revisited, Counter revolutionaries, Oracle HQ- Other Convergent Databases, Disruptive Database Technologies

Text Books

1. Abraham Silberchatz, Henry K.Forth, Sudharshan, “Database system Concepts” – (6th edition), McGraw Hill, 2010.
2. Guy Harrison, “Next Generation Databases”, Apress, 2015.
3. Eric Redmond, Jim R Wilson, “Seven Databases in Seven Weeks”, LLC. 2012

Reference Books

1. K. Pakhira, “Database Management System”, Phi Learning Pvt. Ltd., 2012
2. MongoDB: The Definitive Guide, 2nd Edition , Powerful and Scalable Data Storage, By Kristina Chodorow, Publisher: O'Reilly Media
3. MongoDB Basics - EelDavid Hows,Peter Membrey,coPlugge, Publisher Apress - Ebook(free) https://it-ebooks.info/book/4527/

Semester –IV

Basic Human Rights

BTHM403	Basic Human Rights	HSSMC	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:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

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

CO1	Students will be able to understand the history of human rights.
CO2	Students will learn to respect others caste, religion, region and culture.
CO3	Students will be aware of their rights as Indian citizen.
CO4	Students will be able to understand the importance of groups and communities in the society.
CO5	Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Course Contents:

UNIT 1: The Basic Concepts: **[08 Hours]**

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

UNIT 2 Fundamental rights and economic programme: [07 Hours]

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

UNIT 3: Migrant workers: [07 Hours]

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

UNIT 4: Human rights in Indian constitution and law [07 Hours]

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT 5: Universal declaration: [07 Hours]

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

Text / Reference Books

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

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

Semester –IV

Probability Theory and Random Processes

BTBS404	**Probability Theory and Random Processes**	**BSC**	**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:

1. To develop basic of statistics, probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

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

CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
CO2	Understand the basic concepts of one and two dimensional random variables and apply in engineering applications
CO3	Apply the concept random processes in engineering disciplines
CO4	Understand and apply the concept of correlation and spectral densities
CO5	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems

Course Contents:

UNIT 1: Probability Theory **[07 Hours]**

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

UNIT 2: Random Variable and Mathematical Expectation **[07 Hours]**

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial

distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

UNIT 3: Correlation **[07 Hours]**

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

UNIT 4: Linear Regression Analysis **[07 Hours]**

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

UNIT 5: Estimation and Hypothesis **[07 Hours]**

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

Text Books

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

Reference Books

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

8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition,Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics forengineers & scientists, 9th edition, Prentice Hall.

Semester –IV

Numerical Methods and Computer Programming

BTAIPE405A	Numerical Methods and Computer Programming	PEC1	3L- 1T -0P	4 Credits

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

Pre-Requisites: None

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

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

CO1	Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem
CO2	Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques
CO3	Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values
CO4	Prepare them to write computer programs for the numerical computational techniques
CO5	Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.

Course Contents:

UNIT 1: Introduction to Computational Methods and Errors : **[07 Hours]**

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques.

Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT 2: Solution of Transcendental / Polynomial Equations and System of Linear Equation: [07 Hours]

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT 3: Interpolation and Polynomial Approximation: [07 Hours]

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange‟sinterpolation polynomials, Spline interpolation, Least square approximation.

UNIT 4: Numerical Integration and Differentiation [07 Hours]

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, RungeKutta 2ndand 4th order, Stability analysis of abovemethods.

UNIT 5: Object Oriented Programming: [07 Hours]

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor,Destructors..

Text / Reference Books

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rdedition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rdEdition.

3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi,1996.

4. D. Ravichandran, "Programming with C++",TMH

5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2ndEdition

6. YeshwantKanetkar, "Let us C++, BPB Pub.", Delhi, 2002,4thEdition.

7. StroupstrupBjarne, "C++ Programming Language", Addison Wesley, 1997, 3rdEdition.

8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai,1998.

Semester –IV

Image Processing and Computer Vision

BTAIPE405B	Image Processing and Computer Vision	PEC1	3L-1T-0P	4 Credits

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

Prerequisites: Nil

Course Objectives:

1. To let the students learn the fundamental principles on the aspects of interdisciplinary research including acquiring, processing, analyzing, understanding and utilizing high-dimensional visual data from the real world;
2. To equip the students with the knowledge of how to develop artificial intelligent systems which automate tasks that the human visual system can do;
3. To guide the students to understand the relevant state of art technologies and gain experience throughout a variety of case studies.

Course Outcomes:

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

CO1	To implement fundamental image processing techniques required for computer vision
CO2	Understand Image formation process
CO3	To perform morphological operations on image.
CO4	Extract features form Images and do analysis of Images
CO5	To develop applications using computer vision techniques

Course Contents:

Unit 1: Introduction to Digital Image Processing **[07 Hours]**

Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image Processing, Image digitization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Image operation on pixel basis, Image geometry.

Unit 2: Image Enhancement and Transformation [8 Hours]

Image Enhancement: Basic Intensity Transformation: Image Negatives, Log transformation, Power law Transformation, Histogram processing, Histogram Equalization. Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Image Transforms: Discrete Fourier transform(DFT), FFT, DCT, Walsh, Hadamard, Haar, Slant Transform.

Unit 3: Morphological operations and segmentation [07 Hours]

Introduction, erosion, dilation, opening, closing, Hit or Miss, boundary extraction, hole filling, thinning, thickening, skeletonization, region growing, region splitting, region merging, region splitting and merging, segmentation by thresholding, watershed segmentation.

Unit 4: Local Image Features [07 Hours]

Computing the Image Gradient: Derivative of Gaussian Filters; Representing the Image Gradient: Gradient-Based Edge Detectors, Orientations; Finding Corners and Building Neighborhoods: Finding Corners, Using Scale and Orientation to Build a Neighborhood; Describing Neighborhoods with SIFT and HOG Features.

Unit 5: Object Recognition [07 Hours]

Pattern and pattern classes, Decision theoretic method: Matching, optimum statistical classifier, Object recognition methods, Shape correspondence and shape matching.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.

3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.

4. Dhananjay K. Theckedath, Image Processing using MATLAB codes, Nandu Printers and Publishers Pvt. Ltd, Third edition.

Reference Books:

1. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

2. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010

3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.

4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012

5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

6. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

Semester –IV

Internet of Things & Embedded System

BTAIPE405C	Internet of Things & Embedded System	PEC1	3L-1T-0P	4 Credits

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

Prerequisites: Basics if microprocessor, microcontroller, C language

Course Objectives:

4. To get the understanding of the concepts of Internet of Things
5. To enable the students to build IoT applications.
6. To understand the various protocols in IoT and Networking.
7. To develop the essential programming skill required

Course Outcomes:

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

CO1	The use of concepts of IoT and its areas.
CO2	Understand the basics of C and NodeMCU
CO3	Understand the basics of Python & Raspberry Pi
CO4	Interacting with Web Services and IoT protocol
CO5	Apply the IoT in various applications.

Course Contents:

Unit-1: Introduction to IoT **[07 Hours]**

Definition, characteristics of IoT, logical design of IoT, IoT communication models, IoT communication APIs: REST, Websocket, IoT Enabling Technologies: Wireless sensor networks, Cloud computing, Big data analytics, communication protocols, Embedded systems, IoT vs M2M.

Unit-2: Introduction to C and Node Mcu **[07 Hours]**

C: Introduction, Data types, variable, operator, branches, loops, functions, Debugging and Optimization of C programs.

NodeMCU: 8266 Wi-Fimodule, hardware and pin diagram, Interface with Arduino IDE. Interfacing of analog and digital sensors.

Unit-3: Introduction to Python and Raspberry Pi **[08 Hours]**

Python: Python IDE, Data types, variable, operator, branches, loops, functions, List, Dictionary, Writing to a File, Reading from a File, handling exceptions.

Raspberry Pi: Models of Raspberry pi, R Pi 3 hardware, GPIO pins, operating system for R pi3, Basic of Linux commands, configuring R pi3, Interfacing of Digital and Analog sensors.

Unit-4 : **Interacting with Web Services** **[07 Hours]**

Configuring NodeMCU to connecting to server, NodeMCU interfacing with web services, configuring R pi 3 Wi-Fi and Ethernet, publishing and subscribing data from web using R pi3, interfacing R Pi 3 with twitter and whatsapp.

Unit-5: IoT Protocols **[07 Hours]**

UART, Wi-Fi, Ethernet, Bluetooth Low Energy (BLE), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Service (DDS), Advanced Message Queuing Protocol (AMQP).

Text Books:

1. Get Started With ESP8266 Programming NodeMCU Using Arduino, Up skill Learning.
2. Internet of Things with Raspberry Pi 3, ManeeshRao, pack
3. Internet of Things with ESP8266, Marco Schwartz
4. Internet of Things with Arduino Cookbook, Marco Schwartz

Reference Books:

1. Internet of Things: A Hands-On Approach- Arsheep Bahga,Vijay Madisetti
2. Raspberry Pi Cookbook for Python Programmers by Tim Cox
3. Learning Internet of Things, Peter Waher

Semester –IV

Programming in JAVA

BTAIP405D	Programming in JAVA	PEC1	3L-1T-0P	4 Credits

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

Pre-Requisites: Basics of programming languages and Concepts of Object Oriented Programming languages.

Course Objectives:

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

1. Apply object oriented features to real time entities.
2. Handle exceptions & implement multithreaded programs.
3. Implement database programming.
4. Design & implement GUI with event handling
5. Develop I/O & networking programs.

Course Outcomes:

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

CO1	To understand basics of JAVA
CO2	To use Packages & interfaces
CO3	To apply Exception Handling & Multithreaded Programming
CO4	To acquire Java Database Connectivity
CO5	To recognize Applet, Event Handling and AWT

Course Contents:

Unit 1: Introduction, Packages & interfaces [8 Hours]

Features of Java, Java Virtual Machine, Byte Code, JIT Compiler, Class fundamentals, Declaring objects, Nested and Inner Classes, Introducing Methods, Constructors, Garbage

Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Access Control, Understanding static & final keyword, Inheritance Basics, Using Super, Method Overriding, Abstract Classes, Using final keyword with inheritance, Arrays, Vectors, Strings, Wrapper classes, Using Command-Line Arguments.
Packages: Defining a Package, Finding Packages and CLASSPATH, A Short Package Example, Access Protection, Importing Packages, Study of java.lang & java.util packages, Interfaces: Defining an Interface, Implementing Interfaces, Variables in Interfaces, Extending Interfaces, Multiple Inheritance.

Unit 2: Exception Handling & Multithreaded Programming [07 Hours]
Exception handling fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, creating your own exception subclasses, The Java Thread Model, The Main Thread, Creating a Thread , Creating Multiple Threads, Using isAlive( ) and join( ), Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads

Unit 3: Applet, Event Handling and AWT [07 Hours]
Applet: Applet Basics, An Applet Skeleton, Simple Applet Display Methods, Using the Status, Window, The HTML APPLET Tag, Passing Parameters to Applets, Event Handling: The Delegation Event Model, Event Classes, Sources of Events, Event, Listener Interfaces, Handling Mouse and Keyboard Events, Adapter Classes, Introduction to AWT , AWT classes, Window, Creating a Frame Window in an Applet, Working with Graphics, swing.

Unit 4: Input /Output & Networking [07 Hours]
Input /Output: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, The Stream Classes, The Byte Streams, The Character Streams, Object Serialization & deserialization, Networking: Networking Basics, The Networking Classes and Interfaces, TCP/IP Client, Sockets, TCP/IP Server Sockets, Datagrams

Unit 5: Java Database Connectivity [07 Hours]
Introduction, Types of JDBC Drivers, Driver interface & DriverManager class, Connection Interface, Statement Interface, PreparedStatement , ResultSet, JDBC Program for executing Statements & processing ResultSet, Using PreparedStatement.

Text / Reference Books:
1. Herbert Schildt, The Complete Reference- Java2, (Seventh Edition), Tata Mc Graw Hill.
2. Steven Holzner, Java 2 Black Book, Dream Tech Press.
3. Deitel & Deitel, Java: How to Program, PHI.
4. Bert Bates, Kathy Sierra, Head First Java, O'Reilly Media, Inc.
5. E Balagurusamy, Programming with Java, Tata Mc Graw Hill.

Semester –IV

Data Analysis Lab and Database Management System Lab

BTAIL406	**Data Analysis Lab and Database Management System Lab**	**LC**	**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

Data Analysis Lab

List of practicals:

1. Installing R and R Studio
2. Data types, mathematical operators and functions in R.
3. Vectors, Factors, Lists, Matrix, Data Frames in R.
4. Measurement of Central Tendency Mean, Median and Mode.
5. Measurement of Variation - Range, IQR and Standard Deviation.
6. Descriptive Statistics Using psych Package.
7. One & two Sample z Test Using R
8. One & two Sample t Test Using R
9. Goodness of Fit Test Using R
10. Contingency Table Using R
11. Analysis of Variance (ANOVA) Using R
12. Central Limit Theorem Demonstration Using R
13. R Functions for Normal Distribution - rnorm, pnorm, qnorm and dnorm
14. R Functions for Binomial Distribution - rbinom, pbinom, qbinom and dbinom
15. R Functions for Poisson Distribution - rpois, ppois, qpois and dpois

Database Management System Lab

List of practical:

1. Draw E-R diagram and convert entities and relationships to relation table for a college database.
2. Perform the following:
   a) Viewing all databases,
   b) Creating a Database,
   c) Viewing all Tables in a Database,
   d) Creating Tables (With and Without Constraints),
   e) Inserting/Updating/Deleting Records in a Table,
3. Perform the following:
   a) Altering a Table,
   b) Dropping/Truncating/Renaming Tables,
   c) Backing up / restoring a Database.
4. For a given set of relation schemes, create tables and perform the following-
   a) Simple Queries,
   b) Simple Queries with Aggregate functions,
   c) Queries with Aggregate functions (group by and having clause),
5. Perform queries with Date functions and String Functions
6. Perform queries with Math Functions, Join Queries- Inner Join, Outer Join and Subqueries- With IN clause, With EXISTS clause
7. Implement a columnar database using Apache Cassandra
8. Implement a document database with MongoDB
9. Design and Implement any 5 query using MongoDB
10. Write a case study for various types of NoSQL databases.

Note:

1. Lab should be in scope of hands of experience and practice related program must
2. Add case study and Live project experience if any related contents

Semester –IV
Seminar-II

BTAIS407	**SEMINAR-II**	**Seminar**	**0L-0T-4P**	**2 Credits**

Guidelines for Seminar

The students shall study in group of two or three members 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. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal 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 presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –IV
Internship - II

BTAIP408	**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	Engineering Mathematics -III	BTBS301	III	Linear Algebra https://nptel.ac.in/courses/111/ 106/111106051/	IIT, Madras	90%	12 weeks
2	An Introduction to Artificial Intelligence	BTAIC302	III	Artificial Intelligence : Search Methods For Problem solving	IIT Madras	90%	12 weeks
				An Introduction to Artificial Intelligence	IIT Delhi	90%	12 weeks
3	Data Structure and Algorithm using Python	BTAIC303	III	Programming, Data Structures And Algorithms Using Python https://onlinecourses.nptel.ac.in/noc21_cs67/preview	Chennai Mathematical Institute	90%	8 week
4	Computer Architecture & Operating System	BTAIC304	III	Computer architecture and organization https://onlinecourses.nptel.ac.in/noc21_cs61/preview	IIT KHARAGPUR	100 %	12Weeks
5	Digital Logic & Signal Processing	BTESC305	III	PRINCIPLES OF SIGNALS AND SYSTEMS https://nptel.ac.in/courses/108/104/108104100/	IIT KANPUR	60%	12Weeks
				Digital Signal Processing https://nptel.ac.in/courses/117/102/117102060/	IIT Delhi	60%	12Weeks
6	Data Analysis	BTAI401	IV	Data Science for Engineers https://onlinecourses.nptel.ac.in/noc21_cs69/preview	IIT Madras	60%	8 week
7	Database Management System	BTAI402	IV	Database Management System https://onlinecourses.nptel.ac.in/noc19_cs46/preview	IIT Kharagpur	50%	8 week
8	Basic Human Rights	BTHM403	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT KANPUR	50%	8 week
9	Probability Theory and Random Processes	BTBS404	IV	Introduction to Probability Theory and Stochastic Processes https://onlinecourses.nptel.ac.in/noc21_ma66/preview	IIT Delhi	90%	12 weeks
10	Numerical Methods and Computer Programming	BTSE405A	IV	Numerical methods and programing https://nptel.ac.in/courses/122/106/122106033/	IIT Madras	70%	12 week
11	Image Processing & Computer Vision	BTSE405B	IV	Computer Vision and Image Processing - Fundamentals and Applications https://onlinecourses.nptel.ac.in/noc21_ee23/preview	IIT Guwahati	80%	12 week
12	Internet of Things & Embedded System	BTSE405C	IV	INTRODUCTION TO INTERNET OF THINGS https://nptel.ac.in/courses/106/105/106105166/	IIT Kharagpur	70%	12 Weeks
				Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Banglore	40%	8Weeks
13	Programming in JAVA	BTSE405D	IV	Programming In Java https://onlinecourses.nptel.ac.in/noc19_cs84/preview	IIT Kharagpur	100 %	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	Engineering Mathematics-III	BTBS301	III	Mathematics for Machine Learning: Linear Algebra	Imperial College Landon	25%	5 week
2	An Introduction to Artificial Intelligence	BTAIC302	III	AI For Everyone	DeepLearning.AI	50%	4 week
3	Programming, Data Structure and Algorithm using Python	BTAIC303	III	Python Data Structures https://www.coursera.org/learn/python-data	University of Michigan	70%	7 weeks
4	Computer Architecture& Operating System	BTAIC304	III	Computer Architecture	Princeton University, US	25	4 Weeks
6	Data Analysis	BTAI401	IV	Statistics with R Specialization	Duke University	50%	5 Weeks
7	Database Management System	BTAI402	IV	Database Management Essentials https://www.coursera.org/learn/database-management	University of Colorado	40%	4 weeks
9	Probability Theory and Random Processes	BTBS404	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
11	Image Processing & Computer Vision	BTSE405B	IV	1) Fundamentals of Digital Image and Video Processing 2)Computer Vision Basics	1)Northwestern University 2) University at Buffalo The State University of New York	1)25 2)25	1)4 Weeks 2)4 Weeks
10	Internet of Things & Embedded System	BTSE405C	IV	Hands-on Internet of Things Specialization(4 courses included in it)	University of Illinois at Urbana-Champaign	70	4 week per course

13	Programming in JAVA	BTSE405D	IV	Core Java Specialization https://www.coursera.org/specializations/core-java#courses	Learn Quest	70%	6 week

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

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	An Introduction to Artificial Intelligence	BTAIC302	III	Artificial Intelligence (AI)	Colambia University	80%	12 Week
2	Data Structure and Algorithm using Python	BTAIC303	III	1) Foundations of Data Structures	1) IIT Bombay	1) 70%	1) 6 Weeks
				2) Algorithms and Data Structures	2) UCSan Diego	2) 60%	2) 4 Weeks
3	Computer Architecture& Operating System	BTAIC304	III	1. Computer Organization	1. MITx	1. 20%	10 Weeks
				2. Computer Architecture	2. MITx	2. 20%	
4	Data Analysis	BTAI401	IV	StaStatistics and Data	MITx	60%	1 Year
5	Database Management System	BTAI402	IV	Databases: SQL	Stanford Online	50	8 Weeks
6	Probability Theory and Random Processes	BTBS404	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Image Processing & Computer Vision			Image Processing and Analysis for Life Scientists	EPFLx	50	7 Weeks
8	Internet of Things & Embedded System	BTSE405B	IV	Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Banglore	40	8Weeks
				IoT: from hardware to practice	ITMOx University	40	17 Weeks
9	Programming in JAVA	BTSE405D	IV	Introduction to Object-Oriented Programming with Java II: Object-Oriented Programming and Algorithms https://www.edx.org/course/introduction-to-java-programming-ii-object-oriented-programming	Georgia Institute of Technology	100 %	6 week
				Introduction to Object-Oriented Programming with Java III: Exceptions, Data Structures, Recursion, and GUIs https://www.edx.org/course/introduction-to-java-programming-iii-interfaces-polymorphism-and-complexity			6 week

				Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics			6 week