

**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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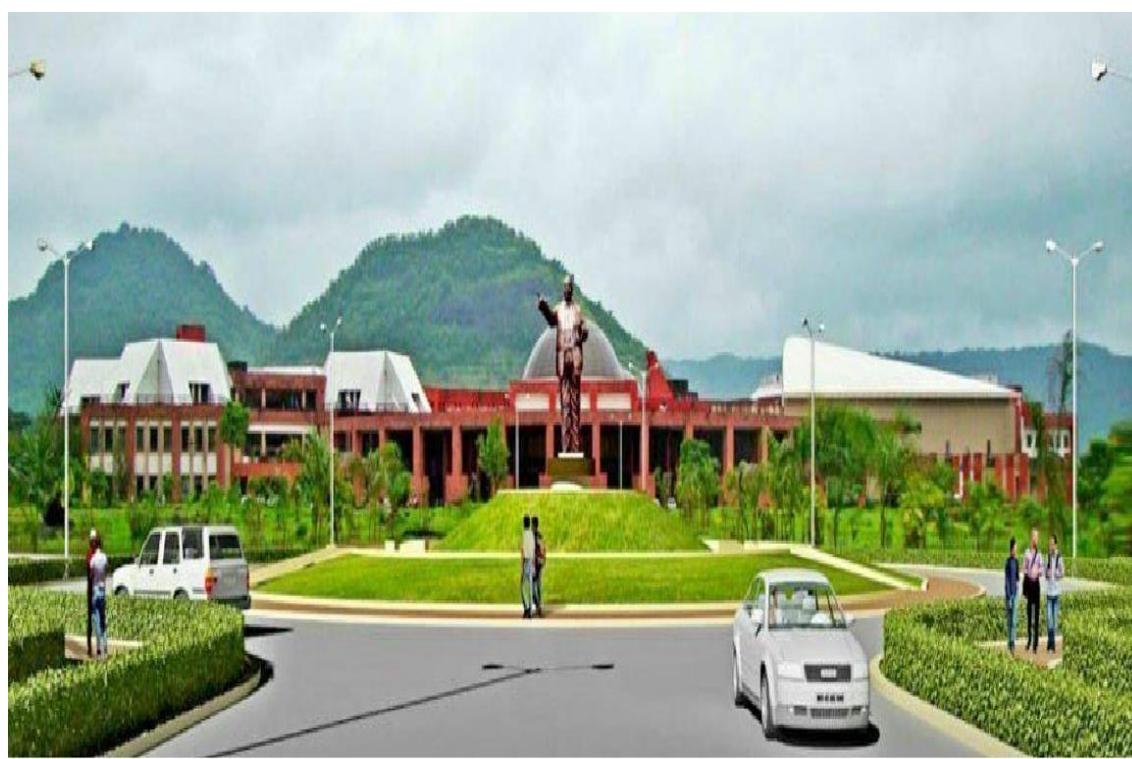
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## **CURRICULUM UNDER GRADUATE PROGRAMME FOR B. TECH**

**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**

**S.Y. B.Tech 2021-22  
T.Y. B.Tech 2022-23  
Final B.Tech 2023-24**



## **Rules and Regulations**

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

### **REGISTRATION:**

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:  
A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and 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 2019-20, starting from I year B.Tech.

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

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

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

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

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

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

<b>1</b>	Continuous Assessment Marks	60
<b>2</b>	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 2019-20.

5. *Description of Grades:*

EX Grade: An ‘EX’ grade stands for outstanding achievement.

EE Grade: The ‘EE’ grade stands for minimum passing grade.

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

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

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

6. *Evaluation of Performance:*

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

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

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

Where

‘n’ is the number of subjects for the semester,

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

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

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

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

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

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

Where

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

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

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

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

#### **AWARD OF DEGREE OF HONOURS (MAJOR) DEGREE**

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

##### **A. Eligibility Criteria for Majors**

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

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

##### **B. Eligibility Criteria for Minors**

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

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

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

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

## ATTENDANCE REQUIREMENTS

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

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

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

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

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

## TRANSFER OF CREDITS

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

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

### **Category – wise total number of credits**

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

## Programme Educational Objectives (PEO)

Name of Programme: Bachelor of Technology (Computer Engineering)

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

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

## Programme Outcomes (PO)

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

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

## **Graduate Attributes / ABET's Criteria**

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

- (a) Engineering knowledge: An ability to apply knowledge of mathematics, science and engineering.
  - (b) Problem analysis: An ability to design and conduct experiments as well as to analyze and interpret data.
  - (c) Design / development of solutions: An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
  - (d) Individual and team work: An ability to function on multidisciplinary teams.
  - (e) Problem Solving: An ability to identify, formulate and solve engineering problems.
  - (f) Ethics: An understanding of professional and ethical responsibility.
  - (g) Communication: An ability to communicate effectively.
  - (h) Environment and sustainability: The broad education necessary to understand the impact of engineering solutions in a global, economical, environmental and social context.
  - (i) Life-long learning: Recognition of the need for and an ability to engage in life-longlearning.
  - (j) A knowledge of technology: Aknowledge of contemporary issues, and state of art technology
  - (k) Modern tool usage: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
  - (l) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply in multidisciplinary environments.

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

### Semester –III (Second Year)

Course Category	Course Code	Course Title	Weekly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
	BTCOC302	Discrete Mathematics	3	1	-	20	20	60	100	4
	BTCOC303	Data Structures	3	1	-	20	20	60	100	4
	BTCOC304	Computer Architecture & Organization	3	1	-	20	20	60	100	4
	BTCOC305	Elective –I (a) Object - oriented Programming in C++ (b) Object Oriented Programming in Java	3	1	-	20	20	60	100	4
	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
	BT COS307	Seminar – I	-		4	60	-	40	100	2
	BTES211P	Field Training / Internship / Industrial Training –I (Evaluation)	-	-	-	-	-	-	-	Audit
<b>TOTAL</b>			<b>15</b>	<b>5</b>	<b>8</b>	<b>220</b>	<b>100</b>	<b>380</b>	<b>700</b>	<b>24</b>

### Semester –IV (Second Year)

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

\*Note: Lecture should be conducted only for Python Programming

**Course Structure for Third Year**  
**B. Tech in CSE (Artificial Intelligence & Machine Learning)**

<b>Semester V ( Term 5)</b>										
<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Teaching Scheme</b>			<b>Evaluation Scheme</b>				<b>Credit</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>CA</b>	<b>MSE</b>	<b>ESE</b>	<b>Total</b>	
PCC5	BTAIC501	Computer Network and Cloud Computing	3	1	-	20	20	60	100	4
PCC6	BTAIC502	Machine Learning	3	-	-	20	20	60	100	3
HSSMC4	BTAIHM503	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM503A	1. Economics and Management								
	BTAIHM503B	2. Business Communication								
	BTAIHM503C	3. Knowledge Reasoning and AI Ethics.								
PEC-2	BTAIPE504	Professional Elective Course (PEC) -II	3	1	-	20	20	60	100	4
	BTAIPE504A	1. Advanced Database System								
	BTAIPE504B	2. Soft Computing								
	BTAIPE504C	3. Sensors & Robotics Technology								
	BTAIPE504D	4. Advanced Java								
OEC-1	BTAIOE505	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE505A	1. Data Mining and Warehousing								
	BTAIOE505B	2. Digital Communication & Information Theory								
	BTAIOE505C	3. Software Engineering and Testing								
	BTAIOE505D	4. Virtual Reality								
LC3	BTAIL506	Machine Learning Lab and Competitive Programming Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM507	Mini Project I	-	-	4	60	-	40	100	2
Internship	BTCOF408	Field Training / Internship / Industrial Training II (Evaluation)	-	-	-	-	-	-	-	Audit
			<b>15</b>	<b>3</b>	<b>8</b>	<b>220</b>	<b>100</b>	<b>380</b>	<b>700</b>	<b>22</b>

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

## Course Structure for Third Year

### B. Tech in CSE ([Artificial Intelligence & Machine Learning](#))

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

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 C.S.E. (A.I. & M.L.)

### Semester VII ( Term 7)

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	
PCC9	BTAIC701	Natural Language Processing	3	1	-	20	20	60	100	4
PCC10	BTAIC702	Advanced Computer Vision	3	1	-	20	20	60	100	4
PCC11	BTAIC703	Data Engineering	3	-	-	20	20	60	100	3
PEC-4	BTAIPE704/ BTAIMPE704	Professional Elective Course (PEC) -IV	3	1	-	20	20	60	100	4
	BTAIPE704A	1. Time Series Forecasting								
	BTAIMPE704B	2. IOT & Data Analytics								
	BTAIMPE704C	3. Distributed Systems								
	BTAIPE704D	4. Full Stack Development								
OEC-3	BTAIOE705/ BTAIMOE705	Open Elective Course (OEC) – III	3	1	-	20	20	60	100	4
	BTAIMOE705A	1.Design Thinking								
	BTAIOE705B	2. Block chain Technology								
	BTAIMOE705C	3. Bioinformatics								
	BTAIOE705D	4. Mobile Application Development								
HSSMEC -6	BTAIHM706	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	-	-	2	-	-	-	-	Audit
	BTAIOE706A	1. Foreign Language Studies								
	BTAIOE706B	2. Universal Human Value & Ethics								
	BTAIOE706C	3. Intellectual Property Rights								
LC5	BTAIL707	Natural Language Processing & Data Engineering Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM708	Project Work	-	-	4	60	-	40	100	2
Internship	BTAIP608	Field Training / Internship /Industrial Training –III (Evaluation)	-	-	-	-	-	-	-	Audit
			<b>15</b>	<b>4</b>	<b>10</b>	<b>220</b>	<b>100</b>	<b>380</b>	<b>700</b>	<b>23</b>

### Semester VIII ( Term 8)

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	
Project/ Internship	BTAIF801	Project Work/ Internship	-	-	24	60	-	40	100	12
			-	-	<b>24</b>	<b>60</b>	-	<b>40</b>	<b>100</b>	<b>12</b>

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

## **BTBS 301: Engineering Mathematics-III**

### **Unit 1: Laplace Transform**

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

### **Unit 2: Inverse Laplace Transform**

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

### **Unit 3: Fourier Transform**

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

### **Unit 4: Partial Differential Equations and Their Applications**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation ( $\partial u / \partial t = c^2 \partial^2 u / \partial x^2$ ), and one dimensional wave equation (i.e.  $\partial^2 y / \partial t^2 = c^2 \partial^2 y / \partial x^2$ ).

### **Unit 5: Functions of Complex Variables**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs)

### **Text Books**

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

### **Reference Books**

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

### **General Instructions:**

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

## BTCOC302: Discrete Mathematics

### *[UNIT 1] Fundamental Structures and Basic Logic*

*[7 Hours]*

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

### *[UNIT 2] Functions and Relations*

*[7 Hours]*

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

**Combinatorics:** Counting, Recurrence relations, generating functions.

### *[UNIT 3] Graph*

*[7 Hours]*

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

### *[UNIT 4] Trees*

*[7 Hours]*

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

### *[UNIT 5] Algebraic Structures and Morphism*

*[7 Hours]*

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

#### **Text Books:**

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

#### *Reference Books:*

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

## **BTCCOC303: Data Structures**

### **[UNIT 1] Introduction**

[7 Hours]

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

### **[UNIT 2] Stacks and Queues**

[7 Hours]

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

### **[UNIT 3] Linked list**

[7 Hours]

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

### **[UNIT 4] Trees and Graphs**

[7 Hours]

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

### **[UNIT 5] Searching and Sorting**

[7 Hours]

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

#### **Text Book:**

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

#### **Reference Books:**

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

## BTCOC 304: Computer Architecture and Organization

### [UNIT 1] Introduction

[7 Hours]

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

### [Unit 2] Instruction Sets

[7 Hours]

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

### [Unit 3] Computer Arithmetic

[7 Hours]

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

### [Unit 4] Memory Organization

[7 Hours]

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

### [Unit 5] Control Unit and Input / Output Organization

[7 Hours]

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

### Text Book:

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

### Reference Books:

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

## **Elective –I**

### **(A) BTCOC 305: Object Oriented Programming in C++**

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

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

**[Unit 2] Operator Overloading, Inheritance and Polymorphism** [7 Hours]

Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

*[Unit 3] Polymorphism* [7 Hours]

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

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

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

**[Unit 5] Templates, Exception Handling and STL** [7 Hours]

Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

#### *Text Book:*

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

#### *Reference Books:*

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

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

[Unit 1] Introduction to Java Applications

[7 Hours]

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

[Unit 2] Control Statements

[7 Hours]

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

[Unit 3] Arrays

[7 Hours]

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

**[Unit 4] Inheritance and Polymorphism in Java**

[7 Hours]

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

**[Unit 5] Exception-handling and Java script**

[7 Hours]

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

*Text Book:*

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

*Reference Books:*

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

## **BTCOL306: Data Structure Laboratory**

### **List of Experiments:**

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

**BTCOL306: Object Oriented Programming Lab**

*(a) Object Oriented Programming in C++*

List of Experiments:

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

*(b) Object Oriented Programming in JAVA*

List of Experiments:

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

# **BTCCOC401: Design and Analysis of Algorithms**

## *[Unit 1] Introduction to Algorithms*

*[7 Hours]*

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

## *[Unit 2] Divide and Conquer*

*[7 Hours]*

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

## *[Unit 3] Backtracking*

*[7 Hours]*

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

## *[Unit 4] Greedy Algorithms*

*[7 Hours]*

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

## *[Unit 5] Dynamic Programming*

*[7 Hours]*

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

### *Text Book:*

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

### *Reference Books:*

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

## **BTCOC402: Operating Systems**

**[Unit 1]**

**[7 Hours]**

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

**[Unit 2]**

**[7 Hours]**

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

**[Unit 3]**

**[7 Hours]**

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

**[Unit 4]**

**[7 Hours]**

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

**[Unit 5]**

**[7 Hours]**

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

**Text Book:**

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

**Reference Books:**

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

## **BTHM403: Basic Human Rights**

[Unit 1]

[6 Hours]

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

[Unit 2]

[6 Hours]

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

[Unit 3]

[6 Hours]

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

[Unit 4]

[6 Hours]

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

[Unit 5]

[6 Hours]

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

*Text Book:*

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

*Reference books:*

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

## **BTBSC404: Probability and Statistics**

### *[Unit 1] Probability Theory*

*[7 Hours]*

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

### *[Unit 2] Random Variable and Mathematical Expectation*

*[7 Hours]*

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

### *[Unit 3] Correlation*

*[7 Hours]*

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

### *[Unit 4] Linear Regression Analysis*

*[7 Hours]*

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

### *[Unit 5] Estimation and Hypothesis*

*[7 Hours]*

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

#### *Text Book:*

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

#### *Reference Books:*

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

Publication, 2nd Edition, 2001.

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

# **BTES405: Digital Logic Design & Microprocessor**

## **[Unit 1] Introduction**

**[7 Hours]**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, Number Systems: binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.

## **[Unit 2] Combinational Digital Circuits**

**[7 Hours]**

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions, Don't care conditions, Multiplexer, De-Multiplexer / Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, parity checker / generator.

## **[Unit 3] Sequential circuits and systems**

**[7 Hours]**

1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

## **[Unit 4] Fundamentals of Microprocessors**

**[7 Hours]**

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

## **[Unit 5] 8086 Instruction Set and Programming**

**[7 Hours]**

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

### **Text Book:**

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

### **Reference Books:**

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

## **BTCOL406: Python Programming**

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

<b>[Unit 1]</b>	<b>[2 Hours]</b>
Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.	
<b>[Unit 2]</b>	<b>[2 Hours]</b>
Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.	
<b>[Unit 3]</b>	<b>[2 Hours]</b>
Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.	
<b>[Unit 4]</b>	<b>[2 Hours]</b>
Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.	
<b>[Unit 5]</b>	<b>[4 Hours]</b>
Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.	

\*Programming assignments are mandatory.

### *Text Book:*

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

### *Reference Books:*

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

## **BTCOL406: Python Programming**

### **List of Experiments:**

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

## **BTCOL406: Operating Systems Laboratory**

### **List of Experiments:**

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

## **BT COS407: Seminar – II**

### **[Unit 1]**

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

### **[Unit 2]**

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

### **[Unit 3]**

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

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

### **[Unit 4]**

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

### **[Unit 5]**

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

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

### *Suggestive List of Experiments:*

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

6. Develop and demonstrate a HTML file that includes JavaScript for the following problems:
  - a. Input: A starting and ending number
  - b. Output: find all the prime numbers between starting and ending number.
7. Write a PHP program to display a digital clock which displays the current time of the server.
8. Write a PHP program to implement sign-In and Sign-out functionality.
9. Write a PHP program to keep track of the number of visitors visiting the Web page and to display this count of visitors, with proper headings.
10. Write a PHP code to implement AJAX functionality.
11. Write a PHP program to perform search operation on the student records using AJAX.
12. Write a PHP program to sort the student records which are stored in the database using ascending/descending order.

*Text Book:*

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

*Reference Books:*

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

*Guidelines for Seminar:*

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

**BTCOF408**  
**Field Training / Internship/ Industrial Training Evaluation**

**Guidelines for Internships**

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

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

**Semester –V**  
**Computer Network and Cloud Computing**

<b>BTAIC501</b>	<b>Computer Network and Cloud Computing</b>	<b>PCC5</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Computer Fundamentals, Fundamentals of Digital Communication

**Course Objectives:**

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

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

***Course Outcomes:***

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

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

***Course Contents:***

**Unit No 1: Introduction to Computer Networks**

**[7 Hours]**

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

**Unit No 2: The Data Link Layer and Network Layer**

**[8 Hours]**

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

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

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

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

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

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

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

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

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

**Text Books**

1. A Tanenbaum, N Feamster, D Wetherall, Computer Networks, Sixth Edition, Pearson Education Limited. ISBN 10: 1-292-37406-3, 2021
2. John W. Rittinghouse, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press , Routledge Publisher, ISBN-10 : **1818 ,1189978311879**

**Reference Books**

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

**Semester –V**  
**Machine Learning**

<b>BTAIC502</b>	<b>Machine Learning</b>	<b>PCC6</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Data Analysis, Python Programming Language

**Course Objectives:**

After completion of the course, students will learn:-

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

**Course Outcomes:**

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

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

**Course Contents:**

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

Introduction to Machine Learning: Definition of Machine Learning, Definition of learning. Classification of Machine Learning: Supervised learning, unsupervised learning, Reinforcement learning, Semi-supervised learning.

Categorizing based on required Output: Classification, Regression, and Clustering. Difference in ML and Traditional Programming, Definition of Data, Information and Knowledge.

Split data in Machine Learning: Training Data, Validation Data and Testing Data.

Machine Learning: Applications

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

Performance Metrics for Classification Problems- Confusion Matrix, Classification Accuracy, Classification Report- Precision, Recall or Sensitivity, Support, F1 Score, AUC (Area Under ROC curve).

Performance Metrics for Regression Problems- Mean Absolute Error (MAE), Mean Square Error (MSE), R Squared (R2)

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

Introduction to linear regression:

Introduction to Linear Regression, Optimal Coefficients, Cost function, Coefficient of Determination, Analysis of Linear Regression using dummy Data, Linear Regression Intuition. Multivariable regression and gradient descent:

Generic Gradient Descent, Learning Rate, Complexity Analysis of Normal Equation Linear Regression, How to find More Complex Boundaries, Variations of Gradient Descent. Logistic regression:

Handling Classification Problems, Logistic Regression, Cost Function, Finding Optimal Values, Solving Derivatives, Multiclass Logistic Regression, Finding Complex Boundaries and Regularization, Using Logistic Regression from Sklearn.

#### *Unit No 4: Decision Trees and Random Forests*

[7 Hours]

Decision trees:

Decision Trees, Decision Trees for Interview call, Building Decision Trees, Getting to Best Decision Tree, Deciding Feature to Split on, Continuous Valued Features

Code using Sklearn decision tree, information gain, Gain Ratio, Gini Index, Decision Trees & Overfitting, Pruning.

Random forests:

Introduction to Random Forests, Data Bagging and Feature Selection, Extra Trees, Regression using decision Trees and Random Forest, Random Forest in Sklearn

#### *Unit No 5: Naive Bayes, KNN and SVM*

[7 Hours]

Naive Bayes:

Bayes Theorem, Independence Assumption in Naive Bayes, Probability estimation for Discrete Values Features, How to handle zero probabilities, Implementation of Naive Bayes, Finding the probability for continuous valued features, Text Classification using Naive Bayes.

K-Nearest Neighbours:

Introduction to KNN, Feature scaling before KNN, KNN in Sklearn, Cross Validation, Finding Optimal K, Implement KNN, Curse of Dimensionality, Handling Categorical Data, Pros & Cons of KNN.

Support Vector Machine:

Intuition behind SVM, SVM Cost Function, Decision Boundary & the C parameter, using SVM from Sklearn, Finding Non Linear Decision Boundary, Choosing Landmark Points, Similarity Functions, How to move to new dimensions, Multi-class Classification, Using Sklearn SVM on Iris, Choosing Parameters using Grid Search, Using Support Vectors to Regression.

#### *Text Books*

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

#### *Reference Books*

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

**Semester –V**  
**Economics and Management**

<b>BTAIHM503A</b>	<b>Economics and Management</b>	<b>HSSMEC4</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

**Unit No 2: Relevant Information and Decision Making** [8 Hours]

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

***Unit No 3: Financial Statements*** [7 Hours]

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

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

Evolution of Management Thoughts, Functions of Management Directing.

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

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

**Text Books**

1. R. Panneerselvam, Engineering Economics, PHI publication.

**Reference Books**

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

**Semester –V**  
**Business Communication**

<b>BTAIHM503B</b>	<b>Business Communication</b>	<b>HSSMEC4</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
<b>Teaching Scheme</b>		<b>Examination Scheme</b>		
Lecture: 3 hrs./week		Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn business Communication

*Course Outcomes:*

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

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

*Course Contents:*

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

Introduction, Definitions & Concepts, Communicative Competence.

**Unit No 2: Intercultural Communication** [8 Hours]

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

*Unit No 3: Barriers to Communication* [7 Hours]

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

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

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

**Unit No 5: Negotiation and Conflict Management** [7 Hours]

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

**Text Books**

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

**Reference Books**

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

**Semester –V**  
**Knowledge reasoning and AI ethics**

<b>BTAIHM503C</b>	<b>Knowledge reasoning and AI ethics</b>	<b>HSSMC4</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
<b>Teaching Scheme</b>	<b>Examination Scheme</b>			
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)			

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Unit 1: Knowledge & Reasoning**

**[7 Hours]**

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

**Unit 2: Logical Agents**

**[7 Hours]**

Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural versus declarative knowledge, Logic programming, forward versus backward reasoning, Matching, Control knowledge.

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

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

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

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

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

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

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

**Text / Reference Book:**

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

**Semester –V**  
**Advanced Database Systems**

<b>BTAIPE504A</b>	<b>Advanced Database Systems</b>	<b>PEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Nil.

**Course Objectives:**

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

*Course Outcomes:*

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

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

*Course Contents:*

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

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

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

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

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

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

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

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

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

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

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

*Books*

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

*Reference Books*

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

**Semester –V**  
**Soft Computing**

<b>BTAIPE504B</b>	<b>Soft Computing</b>	<b>PEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

**Course Objectives:**

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

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

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

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

**Unit 3: Feedforward and Backpropagation learning [7 hours]**

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

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

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

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

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

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

*Note: Hands-on practice of Soft Computing Algorithms should cover under Tutorialsslots.*

**Text Books**

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

**Reference Books**

1. Francois Chalbot, “Deep Learning with Python”, second edition.
2. B. Satish Kumar, “Neural Networks - A Classroom Approach”, McGrawHill Publication  
S. Rajasekaran, VijaylakshmiPai, “Neural Networks, Fuzzy Logic and Genetic algorithmsSynthesis and Applications”, PHI Publications.

**Semester –V**  
**Sensors and Robotics Technology**

<b>BTAIPE504C</b>	<b>Sensors and Robotics Technology</b>	<b>PEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

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

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

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

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

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

**Force and Pressure Sensors:** Strain Gauge, Piezoelectric

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

**Chemical and Bio Sensors:** Gas sensors, Nano Sensors

**Vision Sensing:** Digital Camera

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

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

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

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

**Unit No 3: Introduction to Robotic [7 Hours]**

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

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

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

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

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

*Note: Practical should cover under Tutorial slots. Text*

**Books**

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

**Reference Books**

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

**Semester –V**  
**Advanced JAVA**

<b>BTAIPE504D</b>	<b>Advanced JAVA</b>	<b>PEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Core Java Programming

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

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

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

**Unit No 2: Advanced GUI Programming [7 Hours]**

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

### **Unit No 3: Conventional Non-Conventional Database Programming using**

#### **JDBC**

**[7 Hours]**

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

### **Unit No 4: Remote Method Invocation (RMI)**

**[7 Hours]**

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

### **Unit No 5: Networking and Servlet**

**[7 Hours]**

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

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

#### *Books*

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

#### *Reference Books*

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

**Semester –V**  
**Data Mining and Warehousing**

BTAIOE505A	Data Mining and Warehousing	OEC1	3L- 1T - 0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Database Management Systems

**Course Objectives:**

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

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

***Course Outcomes:***

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

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

***Course Contents:***

**Unit No 1: Introduction** [8 Hours]  
Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis.

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

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

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

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

**Unit No 4: Association Rules Mining [7 Hours]**

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

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

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

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

**Books**

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

**Reference Books**

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

**Semester –V**  
**Digital Communication & Information Theory**

<b>BTAIOE505B</b>	<b>Digital Communication &amp; Information Theory</b>	<b>OEC1</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

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

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

***Unit 2: Carrier Modulation Techniques*** **[7 Hours]**

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

***Unit 3: Noise in digital communication*** **[7 Hours]**

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

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

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

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

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

*Note: Hands-on practice should cover under Tutorial slots.* [Text](#)

**Books:**

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

**Reference Books:**

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

**Semester –V**  
**Software Engineering and Testing**

<b>BTAIOE505C</b>	<b>Software Engineering and Testing</b>	<b>OEC1</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn:-

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

**Course Outcomes:**

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

CO1	To use the techniques, skills, and modern engineering tools necessary for engineering practice.
CO2	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
CO3	To apply software testing knowledge and its processes to software applications.
CO4	To identify various software testing problems and solving software testing problems by designing and selecting software test models, criteria, strategies and methods.
CO5	To apply the techniques learned to improve the quality of software development.

**Course Contents:**

**Unit No 1:**

**[7 Hours]**

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

**Unit No 2:**

**[7 Hours]**

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

### *Unit No 3:*

[8 Hours]

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

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

### *Unit No 4:*

[7 Hours]

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

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

### *Unit No 5:*

[7 Hours]

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

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

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

### *Books*

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

### *Reference Books*

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

**Semester –V**  
**Virtual Reality**

<b>BTAIOE505D</b>	<b>Virtual Reality</b>	<b>PEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

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

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

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

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

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

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

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

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

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

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

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

**Books**

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

**Reference Books**

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

**Semester –V**  
**Machine Learning Lab and Competitive Programming Lab**

<b>BTAIL506</b>	<b>Machine Learning Lab and Competitive Programming Lab</b>	<b>LC3</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

### **Machine Learning Lab**

#### **List of practicals:**

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

### **Competitive Programming Lab**

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

Note:

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

**OR**  
**Competitive Programming Lab**

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

**Semester –V**  
**Mini Project -I**

<b>BTAIM507</b>	<b>MINI PROJECT-I</b>	<b>Project</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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### **Guidelines for Mini Project**

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

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

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

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

#### *Continues Assessment:*

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

**Semester –V**  
**Internship - II**

<b>BTAIP508</b>	<b>Field Training / Internship / Industrial Training</b>	<b>Internship</b>	<b>Audit</b>
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**Guidelines for Internships**

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

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

**Semester –VI**  
**Deep Learning**

BTAIC601	Deep learning	PCC7	3L- 1T - 0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

**Course Objectives:**

In this course, attendees will:

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

***Course Outcomes:***

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

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

***Course Contents:***

**Unit 1: Introduction to Neural Network [8 Hours]**

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

**Unit 2: Convolutional Neural Network [7 Hours]**

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

**Unit 3: Transfer Learning and Effective training in Deep Net:** [7 Hours]

**Transfer Learning:** Introduction To Transfer Learning, Need For Transfer Learning, Feature Extraction Using Transfer Learning, Fine Tuning.

**Effective Training:** Bias Variance Tradeoff, Dealing With Overfitting and Underfitting, Data Augmentation, Early Stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization, Regularization, Hyperparameter Tuning.

**Unit 4: Deep learning for text and Sequences** [7 Hours]

Introduction To Sequential/Temporal Data, Sequential Models, Introduction to Recurrent Neural Network ,Working of RNN, Representing Sequential Data using RNN, Working With Text Data, Text Generation With LSTM, LSTM And GRU, Transformer Network.

**Unit 5: Generative Deep Learning** [7 Hours]

Neural Style Transfer ,Variational Autoencoder, Generative Adversarial Network , Classical Supervised Tasks With Deep Learning, Image Denoising, Semantic Segmentation, Object Detection Etc.

*Text Books*

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

*Reference Books*

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

**Semester –VI**  
**Advanced Machine Learning**

<b>BTAIC602</b>	<b>Advanced Machine Learning</b>	<b>PCC8</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

***Course Objectives:***

After completion of the course, students will learn:-

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

***Course Outcomes:***

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

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

***Course Contents:***

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

**Unsupervised Learning - 1**

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

**Unsupervised Learning - 2**

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

**Principal Component Analysis PCA**

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

**PCA - 2**

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

**Unit No 2: Association Rules Mining and Recommendation Systems [7 Hours]**  
What are Association Rules, Association Rule Parameters, Calculating Association Rule Parameters, Recommendation Engines, Recommendation Engines working, Collaborative Filtering ,Content Based Filtering.

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

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

*Unit No 4: Time Series Analysis* [7 Hours]

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

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

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

*Text Books:*

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

*Reference Books:*

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

**Semester –VI**  
**Geographic Information System**

<b>BTAIPE603A</b>	<b>Geographical Information System</b>	<b>PEC3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Nil.

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

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

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

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

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

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

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

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

Quality assessment of freely available DEMS GIS analysis-1

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

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

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

**Text Books**

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

*Reference Books*

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

**Semester –VI**  
**Recommended Systems**

<b>BTAIPE603B</b>	<b>Recommended Systems</b>	<b>PEC3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

**Course Objectives:**

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

1. Understand basics concepts of Recommended System.
2. Apply various types of recommendation system.
3. Evaluate recommendation system.

**Course Outcomes:**

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

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

**Course Contents:**

**Unit 1: Introduction to Recommended Systems [7 Hours]**

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

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

**Unit 2: Collaborative Filtering [7 Hours]**

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

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

**Case study:** Book Recommendation using Collaborative Filtering

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

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

Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity measures, Similarity based retrieval, Classification algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders

**Case Study:** 1.Content Based Recommendation System

2. Movie recommendation system (using K nearest Neighbor K-nearest neighbor method, using Pearson Correlation etc).

**Unit 4: Time- and Location-Sensitive Recommender Systems [7 Hours]**

Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, case study.

**Unit 5: Evaluating Recommender Systems [7 Hours]**

Introduction, Evaluation Paradigms, General Goals of Evaluation Design , Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures.

*Note: Hands-on practice of Recommender System should cover under Tutorial slots.* [Text](#)

*Books*

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

*Reference Books*

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

**Semester –VI**  
**Industry 4.0 and Automation**

<b>BTAIPE603C</b>	<b>Industry 4.0 and Automation</b>	<b>PEC3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:**

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

**Course Objectives:**

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

1. Globalization and emerging issues of Industry 4.0
2. Internet of Things and Robotics as Pillars of Industry 4.0
3. Process control and Automation
4. Understand architecture of PLC, SCADA and DCS and their Importance in Industrial Automation

***Course Outcomes:***

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

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

***Course Contents:***

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

Introduction, core idea of Industry 4.0, Globalization and Emerging Issues, The Fourth Revolution, Smart and Connected Business Perspective, Smart Factories, Technology Roadmap of for Industry 4.0, A brief overview of pillars of Industry 4.0: Internet of Things, Cloud Computing, Cybersecurity, Big Data and Analytics, Additive Manufacturing, Virtual/Augmented Reality, and Robotics.

**Unit No 2: Internet of Things in Industry 4.0** **[7 Hours]**

Introduction to Internet of things (IoT) and Industrial Internet of Things (IIoT), IIoT Business Model and Reference Architecture, IIOT Layers: Sensing, Processing, Communication, and Analytics. Software Defined Networks.

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

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

**Unit No 4: Introduction to Automation****[7 Hours]**

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

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

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

*Note: Consider practical approach of Robotics under Practical slots. Text*

**Books**

1. Alp Ustundag, Emre Cevikacan, Industry 4.0 : Managing the Digital Transformation, Springer
2. Curtis Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson Education.
3. Madhuchhanda Mitra, Samarjit Sen Gupta, “Programmable Logic controllers and Industrial Automation”, Penram International Publishing India Pvt. Ltd

**Reference Books**

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

**Semester –VI**  
**Web Development**

<b>BTAIPE603D</b>	<b>Web Development</b>	<b>PEC3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

1. Fundamentals of web essentials and markup languages
2. Use of the Client-side technologies in web development
3. Use of the Server-side technologies in web development
4. Understand the web services and frameworks

***Course Outcomes:***

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

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

***Course Contents:***

**Unit No 1: Introduction to Web Essentials**

**[7 Hours]**

The internet, basic internet protocols, the world wide web, HTTP Request message, HTTP response message, web clients, web servers. **HTML:** Introduction, history and versions.

**HTML Elements:** heading, paragraphs, line break, colors and fonts, links, frames, list, tables, images and forms. Difference between HTML and HTML5. **CSS:** Introduction to style sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap

**Unit No 2: Client-Side Technologies: JavaScript and DOM**

**[7 Hours]**

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. DOM: Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

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

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

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

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

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

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

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

**Text Books**

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

**Reference Books**

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

**Semester –VI**  
**Big Data Analytics**

<b>BTAIOE604A</b>	<b>Big Data Analytics</b>	<b>OEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

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

**Course Objectives:**

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

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

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

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

***Unit No 3: Map Reduce:*** **[7 Hours]**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, TaskExecution,

Map Reduce Types and Formats, Map Reduce Features, Hadoop cluster.

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

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

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

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

Big SQL : Introduction

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

Apache kafka: Feature, concept, architecture, components

Apache Spark: Feature, concept, architecture, components.

Kerberos authentication: Feature, concept, architecture, components

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

**Books**

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

**Reference Books**

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

**Semester –VI**  
**Cryptography & Network Security**

<b>BTAIOE604B</b>	<b>Cryptography &amp; Network Security</b>	<b>OEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Unit No 1: Security Concepts:**

**[7 Hours]**

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

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

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

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

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

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

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

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

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

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

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

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

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

**Text Book:**

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

**Reference Books:**

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

**Semester –VI**  
**Agile Methodology**

<b>BTAIOE604C</b>	<b>Agile Methodology</b>	<b>OEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn:-

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

## *Unit No 2: AGILE PROCESSES*

*[8 Hours]*

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

## *Unit No 3: AGILITY AND KNOWLEDGE MANAGEMENT*

*[7 Hours]*

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

## *Unit No 4: AGILITY AND REQUIREMENTS ENGINEERING*

*[7 Hours]*

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

## *Unit No 5: AGILITY AND QUALITY ASSURANCE*

*[7 Hours]*

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

### *Text Books*

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

### *Reference Books*

1. Craig Larman, —Agile and Iterative Development: A Manager\_s Guide», Addison-Wesley, 2004.
2. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management», Butterworth-Heinemann, 2007.

**Semester –VI**  
**Augmented Reality**

<b>BTAIOE604C</b>	<b>Augmented Reality</b>	<b>OEC2</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

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

***Course Outcomes:***

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

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

***Course Contents:***

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

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

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

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

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

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

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

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

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

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

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

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

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

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

AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene

AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, Video see-through systems.

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

**Text Books**

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

*Reference Books*

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

**Semester –VI**  
**Development Engineering**

<b>BTAIHM605A</b>	<b>Development Engineering</b>	<b>HSSMEC5</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
<b>Teaching Scheme</b>	<b>Examination Scheme</b>			
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)			

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn:-

*Course Outcomes:*

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

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

*Course Contents:*

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

Introduction, Various Definitions of Development Engineering.

**Unit No 2: World Poverty and Development** [8 Hours]

World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer’s Role.

**Unit No 3: Social Justice** [7 Hours]

Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

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

Development Strategies: Society, Technological Change, and Development, Development Economists ‘Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

**Unit No 5: Engineering for Sustainable Community Development** [7 Hours]

The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education. ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

*Text Books*

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

**Semester –VI**  
**Employability and Skill Development**

<b>BTAIHM605B</b>	<b>Employability and Skill Development</b>	<b>HSSMEC5</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn:-

***Course Outcomes:***

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

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

***Course Contents:***

**Unit No 1: Soft Skills & Communication basics:** [7 Hours]

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

**Unit No 2: Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability** [8 Hours]

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, remainder theorem).

Matching, Selection, Arrangement, Verifications (Exercises on each of these types).  
Verbal aptitude (Synonym, Antonym, Analogy).

**Unit No 3: Grammar and Comprehension** [7 Hours]

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

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

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

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

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

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

*Text Books*

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

*Reference Books*

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

**Semester –VI**  
**Consumer Behavior**

<b>BTAIHM605C</b>	<b>Consumer Behavior</b>	<b>HSSMEC5</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** None

**Course Objectives:**

After completion of the course, students will learn:-

***Course Outcomes:***

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

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

***Course Contents:***

**Unit No 1: Introduction to the Study of Consumer Behavior:** [7 Hours]

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

**Unit No 2: Market Segmentation and Positioning** [8 Hours]

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

**Unit No 3: Models of Consumer Behavior** [7 Hours]

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

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

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

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

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

*Text Books*

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

*Reference Books*

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

**Semester –VI**  
**Deep Learning and Advanced Machine Learning Lab**

<b>BTAIL606</b>	<b>Deep Learning and Advanced Machine Learning Lab</b>	<b>LC4</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

**Deep Learning Lab**

**Practical List**

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

**Advanced Machine Learning Lab**

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

**Semester –VI**  
**Mini Project -II**

<b>BTAIM607</b>	<b>MINI PROJECT-II</b>	<b>Project</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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### **Guidelines for Mini Project**

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

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

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

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

#### *Continues Assessment:*

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

**Semester –VI**  
**Internship - III**

<b>BTAIP608</b>	<b>Field Training / Internship / Industrial Training</b>	<b>Internship</b>	<b>Audit</b>
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**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 departmentor 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 ofthe 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 –VII**  
**Natural Language Processing**

<b>BTAIC701</b>	<b>Natural Language Processing</b>	<b>PCC9</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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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:**

To explore Natural Language Processing (NLP) methods and applications, gaining insights into language understanding, sentiment analysis, and text generation for innovative advancements.

**Course Outcomes:**

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

CO1	Understand the basics of Natural language processing.
CO2	Analyze the different language models and vector semantics.
CO3	Understand the sequence labelling for text analysis.
CO4	Implement text classification and sentiment analysis systems.
CO5	Implement recurrent network for language models and illustrate the NLP applications.

**Course Contents:****Unit No 1: Introduction to NLP [7 Hours]**

Definition and scope of NLP, Applications and real-world examples of NLP, Linguistic Fundamentals, Regular Expressions, Words, Corpora, Text Normalization: Tokenization and segmentation, Stop word removal, Stemming and lemmatization, Handling capitalization and punctuation, Minimum Edit distance.

**Unit No 2: Language Models and Vector Semantics [8 Hours]**

N-gram models, Language model evaluation, Smoothing techniques, Information Retrieval, Vector space models, Term frequency-inverse document frequency (TF-IDF), Pointwise Mutual Information, Applications of the TF-IDF or PPMI vector models, Word2vec, Relevance ranking algorithms.

**Unit No 3: Sequence Labeling [7 Hours]**

Text Preprocessing, Context-Free Grammars, Part-of-speech tagging, HMM Tagging, CRF, Named entity recognition, Evaluation of Named Entity Recognition. Syntax and Parsing, Parsing techniques: dependency parsing, constituency parsing, Maximum Entropy Markov Models.

**Unit No 4: Text Classification and Sentiment Analysis [7 Hours]**

Classifiers for text classification and sentiment analysis, Optimizing Sentiment Analyzer, Other text classification tasks and the Language Model, Text Classification with Logistic Regression Model, Multinomial logistic regression, Cross-entropy loss function, Gradient Descent, Regularization, Interpreting model.

**Unit No 5: Deep Learning for NLP Applications [7 Hours]**

Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, The Encoder-Decoder Model with RNNs, Words, Characters and Byte-Pairs, Transformers and Pretrained Language Models, Fine-Tuning and Masked Language Models

CASE STUDY: ChatGPT, GPT, AI Powered Tools, Sentiment Classification, Dialog Systems, Chatbots, Movie review system, Text Summarization, Language Translation, Question Answering and Information Retrieval, Automatic Speech Recognition, Text-to-Speech Conversion, Speech to Text Conversion.

**Text Books**

1. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin.
2. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schutze.

**Reference Books**

1. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper.
2. "Natural Language Processing: Python and NLTK" by Jacob Perkins.
3. "Sentiment Analysis and Opinion Mining" by Bing Liu.

**Semester –VII**  
**Advanced Computer Vision**

<b>BTAIC702</b>	<b>Advanced Computer Vision</b>	<b>PCC10</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Basic knowledge of linear algebra and calculus, Image processing fundamentals,

Programming skills in Python.

### **Course Objectives:**

To acquire a comprehensive understanding of Computer Vision principles and techniques, enabling the development of advanced image processing, recognition systems, and visual perception applications

### **Course Outcomes:**

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

CO1	Demonstrate a solid understanding of fundamental computer vision & image processing concepts.
CO2	Apply various computer vision algorithms and techniques in image processing.
CO3	Apply various computer vision algorithms and techniques to solve real-world engineering problems, such as object recognition, motion analysis, and texture.
CO4	Analyze and interpret results obtained from computer vision algorithms, and critically evaluate their performance and limitations
CO5	Implement and evaluate computer vision algorithms using programming languages and libraries commonly used in the field, such as Python and OpenCV

### **Course Contents:**

#### **Unit No 1: Introduction to Computer Vision & Image Processing [7 Hours]**

Introduction to computer vision and its applications, Image representation, image processing operations, Image filtering & convolution.

Image enhancement: Contrast stretching, Histogram specification, Adaptive Histogram Equalization (AHE), Wavelet-based enhancement.

Image Filtering: Smoothing: Linear Filter (Box filter, Gaussian Filter) & Non-linear Filter: Median, Mini. & Max.), Sharpening: Laplacian Filter.

#### **Unit No 2: Image Transformation & Restoration: [7 Hours]**

**Image Transformation:** Definition & its properties (scaling, rotation), DFT, DCT, DST, Walsh-Hadamard Transform, Slant Transform, Haar Transform.

**Image Restoration:** Noise model, Types of Noise: Gaussian, Rayleigh, Erlang, Exponential, Uniform, salt & Pepper noise. Restoration Filtering: Mean Filter (Arithmetic, Geometric, Hormonic, Contrahamonic), Median Filter, Midpoint Filter.

#### **Unit No 3: Segmentation, Texture & Motion Analysis [8 Hours]**

**Segmentation:** Edge Detection (Prewitt, Sobel, Canny), Optimum Edge Detection, Thresholding techniques, Region-based segmentation.

**Texture Analysis:** Introduction to texture in images, Statistical texture analysis methods: Gray Level Co-occurrence Matrix (GLCM), Local Binary Patterns (LBP); Filter-based texture analysis methods: Gabor filters, Laws' texture energy measures; Texture-based segmentation.

**Motion Analysis:** Optical flow estimation, Lucas-Kanade method, Horn-Schunck method, Background subtraction, Dense optical flow using Deep Learning (FlowNet), Motion-based segmentation.

**Unit No 4: Feature Matching Algorithms [7 Hours]**

**Feature Extraction:** SIFT (Scale-Invariant Feature Transform), SURF (Speeded-Up Robust Features), BRISK (Binary Robust Invariant Scalable Keypoints).

**Feature Representation:** Building a dataset with extracted features, feature vector representation by Bag-of-words, vector quantization.

**Feature Classification:** SVM, KNN, Random forest.

**Unit No 5: Computer Vision with Deep Learning [7 Hours]**

Image classification: CNN, Attention models, Vision transformation.

Generative Models: GAN.

Object detection: Regions with CNN, Fast R-CNN, Faster R-CNN & Mask R-CNN, SSD, YOLO.

Semantic Segmentation using U-Net, Centroid based object tracking

**Text Books / Reference Books**

1. Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press.
2. Computer Vision: Algorithms & Applications, R. Szeliski, Springer. Computer vision: A modern approach: Forsyth and Ponce, Pearson.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
4. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
5. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
6. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
7. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
8. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
9. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
10. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004.

<b>BTAIC703</b>	<b>Data Engineering</b>	<b>PCC11</b>	<b>3L- 0T - 0P</b>	<b>3 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Basic knowledge of Excel and familiarity with data concepts will be beneficial but not mandatory.

**Course Objectives:**

To learn data engineering concepts, Advanced Excel, Power BI, Tableau, and basic data analysis for effective data manipulation and visualization.

**Course Outcomes:**

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

CO1	Understand the importance of data engineering and its workflow in managing and integrating data from various sources.
CO2	Apply advanced data manipulation techniques using Excel functions and tools for efficient data processing.
CO3	Utilize Power BI to connect, transform, and model data from diverse sources into meaningful relationships
CO4	Employ Tableau to prepare and transform data through connections, blending, and calculated fields.
CO5	Integrate and automate data pipelines across tools to streamline data workflows and promote collaboration.

**Course Contents:**

**Unit No 1: Introduction to Data Engineering and Data Analysis Fundamental [7 Hours]**

Understanding Data Engineering concepts and importance, Workflow and pipeline, Data sources and data integration.

Basic Concepts of Data Analysis: Data types: Categorical, numerical, ordinal, and time-series data, Data distribution: Measures of central tendency and dispersion, Data visualization: Histograms, box plots, scatter plots, etc., Data preprocessing and cleaning, Exploratory Data Analysis (EDA).

**Unit No 2: Advanced Excel for Data Manipulation and Analysis [7 Hours]**

Excel Data Manipulation Techniques: Sorting and filtering data, Basic Functions (SUMIF and SUMIFS, COUNTIF and COUNTIFS, AVERAGEIF and AVERAGEIFS, IFERROR, CHOOSE, TEXTJOIN, TRANSPOSE, CONCATENATE, SUBTOTAL, INDIRECT, OFFSET, etc.) Advanced functions (VLOOKUP, INDEX, MATCH, etc.), Text-to-columns and data cleansing, Data validation and conditional formatting.

Excel Data Analysis Tools: PivotTables and PivotCharts, What-If analysis and Scenario Manager, Data tables and Goal Seek, Solver add-in for optimization.

**Unit No 3: Power BI for Data Transformation and Visualization [7 Hours]**

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Introduction to Power BI: Power BI components, Power BI Desktop and Power BI Service, Connecting to data sources.

Data Transformation and Modeling in Power BI: Data loading and shaping using Power Query Editor, Data modeling and relationships, Calculated columns and measures, DAX (Data Analysis Expressions) language fundamentals.

Creating Interactive Reports and Dashboards in Power BI: Visualizations and chart types, formatting and customization options, Drill-through and drill-down capabilities, Filters, slicers, and hierarchies.

### **Unit No 4: Tableau for Data Preparation and Advanced Visualization [7 Hours]**

Introduction to Tableau: Tableau Desktop and Tableau Server, Connecting to various data sources, Understanding Tableau workspace and terminology.

Data Preparation and Transformation in Tableau: Data connections and joins, Data blending and data reshaping. Working with metadata and calculations, Tableau data extracts.

Creating Visualizations and Dashboards in Tableau: Building basic charts and graphs, Interactive filters and parameters, advanced visualization techniques, Dashboard design best practices.

### **Unit No 5: Data sharing and collaboration and Integration [8 Hours]**

Explore more complex data engineering challenges and solutions.

Data Integration: Integrating data from different sources, Automating data pipelines.

Excel Automation and Visual Basic for Applications (VBA): Macro recording and editing, User-defined functions (UDFs), Error handling and debugging.

Power BI Sharing and Collaboration: Publishing and sharing reports, Collaboration features and workspaces, Power BI gateways for on-premises data access.

Sharing and Collaboration in Tableau: Publishing and sharing dashboards, User roles and permissions.

### **Text Books / Reference Books**

1. "Excel Bible" by John Walkenbach (For comprehensive Excel reference)
2. "Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot" by Rob Collie and Avichal Singh (For Power BI and DAX)
3. "Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software" by Daniel G. Murray (For Tableau)

## **Semester –VII** **Time Series Analysis & Forecasting**

<b>BTAIPE704A</b>	<b>Time Series Analysis &amp; Forecasting</b>	<b>PEC-4</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks
Tutorial: 1 hr./week	Mid Semester Exam: 20 Marks
	End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Basic knowledge of statistics and data analysis concepts. Familiarity with data manipulation and visualization using tools like Python or R.

### **Course Objectives:**

To Gain proficiency in analyzing time-dependent data patterns and using statistical methods to make accurate predictions and forecasts for future trends and events.

### **Course Outcomes:**

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

CO1	Knowledge of basic concepts in time series analysis and forecasting
CO2	Understanding the use of time series models for forecasting and the limitations of the methods.
CO3	Ability to criticize and judge time series regression models.
CO4	Distinguish the ARIMA modelling of stationary and nonstationary time series
CO5	Compare with multivariate times series and other methods of applications

### **Course Contents:**

**Unit No 1: Introduction of Time Series Analysis [7 Hours]**  
 Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series- Models for time series analysis-Autocorrelation and Partial autocorrelation.  
 Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting.

**Unit No 2: Statistics Background For Forecasting [8 Hours]**  
 Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

**Unit No 3: Time Series Regression Model [7 Hours]**  
 Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.

**Unit No 4: Autoregressive Integrated Moving Average (ARIMA) Models [7 Hours]**  
 Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the “BEST” Model - Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models

- Comparing Impulse Response Functions for Competing Models.

**Unit No 5: Multivariate Time Series Models and Forecasting**

**[7 Hours]**

Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting.

**Text Books**

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015). <https://b-ok.cc/book/2542456/2fa941>
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017) <https://b-ok.cc/book/3413340/2eb247>
3. Time Series Analysis And Forecasting By Example Søren Bisgaard Murat Kulahci Technical University Of Denmark Copyright © 2011 By John Wiley & Sons, Inc. All Rights Reserved. <https://b-ok.cc/book/1183901/9be7ed>

**Reference Books**

4. Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016). <https://b-ok.cc/book/2802612/149485>
5. Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd. <https://b-ok.cc/book/3704316/872fbf>
6. Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press. <https://b-ok.cc/book/3685042/275c71>

**Semester –VII**  
**IOT & Data Analytics**

<b>BTAIMPE704B</b>	<b>IOT &amp; Data Analytics</b>	<b>PEC-4</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks

Tutorial: 1 hr./week	Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)
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**Pre-Requisites:** Basic knowledge of Programming concepts. Familiarity with Microprocessors and visualization using tools like Python.

**Course Objectives:** To Gain proficiency in architecture, operation, and business benefits of an IoT solution and using statistical methods to make accurate predictions.

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

CO1	Demonstrate the working of IoT
CO2	Identify the need of cloud computing for IoT
CO3	Apply Machine Learning Algorithms for IoT data
CO4	Predict and visualize output using Data Analytic tools
CO5	Identify the Vulnerability in connected networks

### Course Contents:

#### Unit No 1: introduction to IOT

[7 Hours]

Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT data vs big data- IoT Analytics lifecycle and Techniques-IoT complete Technology chain- Applications of IoT Opportunities and challenges in IoT.

#### Unit No 2: IoT and CLOUD

[8 Hours]

Cloud computing – Cloud service models – Cloud Deployment models – Need of cloud computing for IoT-Fog computing Vs Cloud Computing for IoT-IoT Cloud Platforms –Microsoft Azure IoT-Amazon Web Services IoT-IBM WATSON IoT-Google's cloud IoT.

#### Unit No 3: : IOT & Machine Learning

[7 Hours]

Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT – Supervised learning for IoT-Linear regression-Logistic regression-SVM – Decision Tree -Naïve's bayesDeep Learning for IoT-Neural Network.

#### Unit No 4: Data Analytics for IOT

[7 Hours]

Defining IoT Analytics - IoT Analytics challenges – IoT analytics for the cloud-Microsoft Azure overview– Designing data processing for analytics – Designing visual analysis for IoT data-Data science for IoT-Feature engineering with IoT data.

#### Unit No 5: IoT Security

[7 Hours]

Overview of IoT Security- security Threats in IoT- APIs in IoT-Authentication in IoT-Strategies for securing IoT-Public Key Cryptography.

### Text Books / Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi," Internet of Things: Principles and Paradigms", Elsevier,2016. "AIOps:

2. R. Chandrasekaran," Essentials of Cloud computing", 2nd Edition, Chapman and Hall/CRC, 2015.
3. Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publishing, 2019.
4. David Etter," IoT Security: Practical Guide Book", CreateSpace Independent Publishing Platform, 2016

**Reference Books**

1. John Soldatos, "Building Blocks for IoT Analytics", River Publishers,2016.
2. John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016.

**Semester –VII**  
**Distributed Systems**

<b>BTAIMPE704C</b>	<b>Distributed Systems</b>	<b>PEC-4</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:**

1. Data Structure
2. Operating System

**Course Objectives:**

Understand the basic concepts and challenges of distributed systems.

Familiarize students with the architecture and design principles of distributed systems.

**Course Outcomes:**

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

CO1	Gain a comprehensive understanding of distributed computing concepts, models, and communication mechanisms.
CO2	Understand remote procedure calls and handling exceptions and security concerns in distributed systems.
CO3	Comment on Distributed Shared Memory systems and various consistency models
CO4	Identify resource management strategies in distributed environment
CO5	Evaluate the features of good Distributed File System

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

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

**Unit 2: Remote Procedure Calls****[7 Hours]**

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

**Unit 3: Distributed Shared Memory****[6 Hours]**

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

**Unit 4: Resource Management****[6 Hrs]**

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

**Unit 5: Distributed File System****[6 Hrs]**

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

**Text Books**

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

**NPTEL Course:**

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

**Semester –VII**  
**Full Stack Development**

<b>BTAIPE704D</b>	<b>Full Stack Development</b>	<b>PEC-4</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Basic Knowledge of HTML and CSS

**Course Objectives:**

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

1. Fundamentals of web essentials and markup languages
2. Use of the Client-side technologies in web development
3. Use of the Server-side technologies in web development
4. Understand the web services and frameworks

**Course Outcomes:**

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

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

**Course Contents:****Unit No 1: Full Stack Fundamentals****[7 Hours]**

HTML, Basic, HTML5 Doctype, Some New HTML5 Elements, HTML5 advance feature Canvas Elements, Geolocation API, Responsive Images, Audio and Video Support, Header And Footer, Allow spell check and editable areas, Adding audio, Drag & drop.

CSS Advanced: Advanced Colors: Alpha transparency, At-Rules: Importing style sheets, styles for different media types, specifying the character set of a stylesheet and embedded fonts, CSS3: also known as Cascading Style Sheets Level 3.

**Unit No 2: jQuery****[8 Hours]**

jQuery Introduction, - Overview, Syntax, Selectors, Events, Attributes, jQuery DOM manipulation: - Add Elements, Remove Elements, Replace Elements. jQuery CSS manipulations: CSS Classes, Dimensions, CSS Properties.

Jquery Traversing, Traversing Ancestors, Traversing Descenants.

**Unit No 3: Angular JS****[7 Hours]**

Overview, Environment Setup, AngularJS – MVC Architecture, directives, Expressions, controllers, Angular Lifecycle, HTML DOM, Angular Modules, Angular Components, Angular Data Binding, Angular services, Dependency Injection.

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

Arrow Functions, Template Strings, Rest Operator, Spread Operator, Object Literals, Destructuring objects in javascript, inheritance, Getting parts of a value: split & substr, Programming fundamentals: Try...Catch And Throw, Getting the users date and time, Some more complex math, Regular Expressions, Get the users browser (navigator), Add timing: setInterval & setTimeout, Javascript Classes, Async in JavaScript, Error Handling in JavaScript.

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

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Introduction to Node JS, What is Node JS, Node.js Process Model, Node JS Modules: Functions, Buffer, Module, Core Modules, Local Modules, Built-in Modules.

File System, Fs.readFile, Writing a File, Opening a file, deleting a file, Other IO Operations  
Database operations: Database Connectivity, Connecting String, Configuring, Working with Select Command, Updating Records, Deleting Records, MERN: Overview of MERN, Introduction of MERN.

### **Text Books / Reference Books**

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035
2. Robert W Sebesta, "Programming the World Wide Web , 4th Edition, Pearson education, 2008 3.  
Marty Hall, Larry, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
4. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
5. Chris Bates, "Web Programming Building Internet Applications , 3rd Edition, Wiley India, 2006.
6. Xue Bai et al, "The web Warrior Guide to Web Programming , Thomson, 2003

### **Semester –VII** **Design Thinking**

<b>BTAIMOE705A</b>	<b>Design Thinking</b>	<b>OEC-3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Basic Algorithm concepts

#### **Course Objectives:**

1. To recognize the latest and future issues and challenges in design thinking
2. To expose the student with state-of-the-art perspectives, ideas, concepts, and solutions related to the design and execution of innovation driven projects using design thinking principles.
3. To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, and insight generation

**Course Outcomes:**

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

CO1	Understand the concepts of design thinking approaches
CO2	Illustrate and use phases of design thinking
CO3	To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions.
CO4	Understand prototyping and validation for design thinking
CO5	To propose a concrete, feasible, viable and relevant innovation project/challenge

**Course Contents:****Unit 1: Overview of Design Thinking Process**

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

**Unit 2: Empathize**

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

**Unit 3: Analyse or Define**

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

**Unit 4: Prototyping and Validation**

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

**Unit 5: Design Innovation**

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

**Text Books / Reference Books**

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

**Reference Books:**

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

2. Human-Centered Design Toolkit: An Open-Source Toolkit To Inspire New Solutions in the Developing World by IDEO.
3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

**Semester -VII**

**Blockchain Technology**

<b>BTAIOE705B</b>	<b>Blockchain Technology</b>	<b>OEC-3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Digital Communication.

**Course Objectives:**

1. To understand the cryptographic techniques used in blockchain systems and to introduce the fundamental concepts and principles of blockchain technology.
2. Understand the fundamentals of Ethereum and DApps and implementation Smart contract.

**Course Outcomes:**

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

<b>CO1</b>	Explain the fundamental characteristics of blockchain using bitcoin.
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CO2	Demonstrate the application of hashing and public key cryptography in protecting the blockchain.
CO3	Explain the elements of trust in a Blockchain: validation, verification, and consensus.
CO4	Develop smart contracts in Ethereum framework.
CO5	Blockchain Usecases

### **Course Contents:**

#### **Unit No 1: Introduction to blockchain**

**[7 Hours]**

History of blockchain, peer to peer (P2P) network, public ledger, double spend problem, features of blockchain, types of blockchain: public, private and consortium based blockchain and applications of blockchain.

#### **Unit No 2: Cryptographic primitives**

**[7 Hours]**

Public key cryptography, hash functions, message digest, secure hash algorithms (SHAS-256), digital signature, elliptic curve digital signature algorithms (ECDSA), merkle tree.

#### **Unit No 3: Bitcoin definition, transactions**

**[8 Hours]**

The transaction life cycle, the structure of a block, genesis block, wallet, bitcoin mining, forking: hard and soft fork. Consensus algorithms: proof of work, proof of stake, practical byzantine fault tolerance, proof of burn and prof of elapsed time.

#### **Unit No 4: Smart contracts, Ethereum basics**

**[7 Hours]**

Introduction to Ethereum & Ether, Gas, the world state, transactions, Ethereum virtual machine (EVM), types of accounts, block structure, ether, DApps. Ethereum vs bitcoin.

#### **Unit No 5: Blockchain Use Cases**

**[7 Hours]**

Land Registry Records, Cross-border payments over blockchain, Project Ubin, Food Security, Supply chain financing, Voting system and Identity on Blockchain, Supply chain management, Healthcare and electronic medical records, Blockchain and Metaverse.

### **Text Books / Reference Books**

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, A Beginner's Guide to Building Blockchain Solutions, Apress, 2018.
2. Ritesh Modi, Solidity Programming Essentials-A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd.
3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly, 2015
4. William Stallings, Cryptography and Network Security, eighth edition, Pearson, 2020.
5. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O Dowd, Venkatraman Ramakrishna, Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer , Import, 2018.
6. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing, 2020, ISBN: 9781839213199, book website: <https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199>

**Semester –VII**  
**Bioinformatics**

<b>BTAIMOE705C</b>	<b>Bioinformatics</b>	<b>OEC-3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks
Tutorial: 1 hr./week	Mid Semester Exam: 20 Marks
	End Semester Exam: 60 Marks (Duration 03 hrs.)

**Pre-Requisites:** Some familiarity with molecular biology along with probability and statistics

**Course Objectives:**

1. To introduce students to the rapidly evolving field of bioinformatics
2. To cover the most fundamental topics, such as sequence alignment and pattern finding
3. To gain an understanding of the computational challenges (and their solutions) in the analysis of large biological data sets

**Course Outcomes:**

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

CO1	Illustrate the basic concepts of bioinformatics, biological databases and their growth.
CO2	Understand genomics and proteomics
CO3	Identifying interactions and applications of microarrays
CO4	Understand the use of bioinformatics in drug discovery
CO5	Pattern finding in protein and DNA sequencing

**Course Contents:****Unit 1: Introduction to Bioinformatics**

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

**Unit 2: Genomics & Proteomics**

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

**Unit 3: Phylogenetic Analysis**

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

**Unit 4: Bioinformatics in Drug Discovery**

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

**Unit 5: Human Genome Project**

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

**Text Books / Reference Books**

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.
2. "Introduction to Bioinformatics Algorithms" by Neil Jones and Pavel Pevzner.

3. "Bioinformatics" by David Mount (2nd edition).

**NPTEL Course:**

1. Prof. M. Michael Gromiha, BioInformatics: Algorithms and Applications, <https://nptel.ac.in/courses/102/106/102106065/>

**Semester –VII**  
**Mobile Application Development**

<b>BTAIOE705D</b>	<b>Mobile Application Development</b>	<b>OEC-3</b>	<b>3L- 1T - 0P</b>	<b>4 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
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:** Data Structures, Object Oriented, Java Programming.

**Course Objectives:**

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

1. Overall life cycle of Android programming
2. Essential Components of an Android Application

**Course Outcomes:**

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

CO1	Understand Android architecture, activities and their life cycle
CO2	Apply the knowledge to design user interface using Android UI and Component
CO3	Describe Memory and File operations in Android
CO4	Manage system database, remote database operations using web services and Firebase

CO5	Apply knowledge of map, location services, Graphics, android system and background services
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**Course Contents:****Unit No 1: Introduction to Android [7 Hours]**

Background about mobile technologies, Android – An Open Platform for Mobile development, Native Android Application, Android SDK Features, Android Architecture, Application Frameworks, Android Libraries, Android Runtime, Dalvik Virtual Machine. Creating First Android Application. Creating Configurations. Android Project Structure. Testing the application (AVD, Active device), Android Manifest file. Running and Debugging.

**Unit No 2: User Interface, Activities [7 Hours]**

Introduction, Android Application Life Cycle, Activity, Layouts, Application Priority and process states, Fundamental Android UI Design, Study of different layouts, Introducing Views, Creating new Views, Draw able Resources. Designing fragments: Fragments lifecycle, Fragment management and integration. Advanced UI: Adapters, Complex UI components, Menus and Dialogs, Tabbed Activities, Navigation Drawer, Animations, Create activity layouts programmatically. Android Material Design: introduction, properties, Material Styling / Animations, Material Patterns.

**Unit No 3: Intents, Broadcast Receivers and Files [8 Hours]**

Introducing Intents, Intents and Intent filters, What are Pending Intents, Adapters, Internet Resources, Notifications, Introducing Dialogs, Saving Application Data in external and internal memory, Creating and saving preferences, Retrieving shared preferences, Creating a standard preference activity, Saving Activity State, Saving and Loading Files, Including static files as Resources, File management tools.

**Unit No 4: Database and Content Providers [7 Hours]**

Introducing Android Databases, Introducing SQLite, Cursors and content values, working with SQLite Database, Creating new content Provider. SQLite Open Helper and creating a database. Opening and closing a database, working with cursors, Inserts, updates, and deletes. Native Content Providers: Content provider types, searching for content, Adding, changing, and removing content, Native Android Content Providers, Accessing Contact Book, Calendar. Custom Content Providers: Custom Content Provider classes, Publishing content providers. Introduction to Firebase, Real time/Cloud, Authentication in firebase.

Connecting to MySQL using JSON (Web services).

**Unit No 5: Telephony, Hardware and Network Services [7 Hours]**

Telephony, Reading Phone device details, Reading Sims Details, Incoming and outgoing call monitoring, Tracking Service Change, Introducing SMS and MMS, Sending SMS and MMS, Sending SMS messages manually, Use of Bluetooth, Managing Network Connectivity, Managing Wi-Fi. Google Map - Layout file, Google Map – Android Manifest file, Customizing Google Map, Adding Marker, Changing Map Type.

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

**Text Books / Reference Books**

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1. John Horton, "Android Programming for Beginners", 2nd Edition Packt Publishing
2. Pradeep Kothari "Android Application Development Black Book" , DreamTech
3. Dawn Griffiths, "Headfirst Android Development", 1st Edition, O'Reilly
4. Lauren Darcey, "Android Wireless Application Development", Shane Conder, Pearson
5. Wei Meng Lee "Beginning Android 4 Application Development", Wrox

**Semester –VII**

**Natural language Processing Lab and Data Engineering Lab**

<b>BTAIL707</b>	<b>Natural language Processing Lab and Data Engineering Lab</b>	<b>LC5</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

**Natural language Processing Lab**

**List of Practical/Tutorial**

<b>Experiment No.</b>	<b>Title of the Experiment</b>
1	Convert the text into tokens. Find the word frequency.
2	Find the synonym /antonym of a word using WordNet.
3	Demonstrate a bigram / trigram language model. Generate regular expression for a given text
4	Perform Lemmatization and Stemming. Identify parts-of Speech using Penn Treebank tag set.
5	Implement HMM for POS tagging. Build a Chunker
6	Implement Named Entity Recognizer.

- 7      Implement semantic role labelling to identify named entities.
- 8      Implement text classifier using logistic regression model.
- 9      Implement a movie reviews sentiment classifier.
- 10     Implement RNN for sequence labelling.
- 11     Implement POS tagging using LSTM.
- 12     Word sense disambiguation by LSTM/GRU.

**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.
- 4. Conduct any 10 practical.

**Data Engineering Lab**

**List of Practical**

**Excel -**

- 1. To study and demonstrate fundamentals in Microsoft excel.
- 2. To study and demonstrate Entering and editing text and formulas.

**Advanced Excel –**

- 3. To study and demonstrate working with basic excel functions, modifying an excel worksheet.
- 4. To study and demonstrate data formatting in an excel worksheet.

**Power BI –**

- 5. To study and demonstrate introduction to Power BI, basic charts in Power BI, working with maps, Tables and Matrix in Power BI.
- 6. To study and demonstrate other charts in Power BI, cards and filters, slicers in Power BI, Advanced charts in Power BI.
- 7. To study and demonstrate objects in Power BI, Power BI service introduction, power query [text, Date functions].
- 8. To study and demonstrate Number functions, append files, merge files, conditional columns, power query [imp topics, M language introduction].

**Tableau –**

- 9. To study and demonstrate Introduction to Tableau, Data in Tableau, Sets, sorting and filtering in Tableau, parameters.

10. To study and demonstrate Groups, folders and hierarchies, marks card, views and highlighting, formatting in Tableau.
11. To study and demonstrate Lines and bands, Tableau worksheets, charts in Tableau part -1, calculated fields.
12. To study and demonstrate charts in Tableau part -2, aggregation and granularity, database functions, box and whisker plot, time series and forecasting.

**Note:**

1. Open-Source tools and technology use for programs (Advanced Excel, Power BI & Tableau).
2. Lab should be in the scope of hands of experience and practice related programs.
3. Add case study and Live project experience if any related content.
4. Conduct any 10 practical.

**Semester –VII  
Project**

<b>BTAIM708</b>	<b>PROJECT</b>	<b>PROJ</b>	<b>0L-0T-4P</b>	<b>2 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Practical: 024hrs./week	Continuous Assessment : 60 Marks End Semester Examination: 40 Marks

**Guidelines for Project**

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

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

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions

4. Implement solution using latest technology
5. Write 35-40 pages report and submit with hard binding (use of latex is more suitable).
6. Present / demonstrate the solution in front of faculty member

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

### **Continues Assessment:**

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

### **Semester –VIII**

### **Project Work / Internship**

<b>BTAIF801</b>	<b>Project Work/ Internship</b>	<b>Project/ Internship</b>	<b>0L-0T-24P</b>	<b>12 Credits</b>
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<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Practical: 24 hrs./week	Continuous Assessment : 60 Marks End Semester Exam: 40 Marks Total : 100 Marks

### **Guidelines for Project**

It is recommended to complete industry or industry sponsored project. The students shall study in group of max. three members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Machine learning or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

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

1. Identify problem statement / idea which is solving one problem preferably local problem may being their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions,
4. Implement solution using latest technology,
5. Write 60-70 pages report and submit with hard binding (use of latex is more suitable),

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

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

**Continues Assessment:**

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

**DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE**  
**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL**

Sr . N o	Name of Subject as per Curriculum	Course Code	Semeste r	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relev ance %	Duratio n of Course
1	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing <a href="https://onlinecourses.nptel.ac.in/noc22_cs87/previev">https://onlinecourses.nptel.ac.in/noc22_cs87/previev</a> Computer Networks and Internet Protocol <a href="https://onlinecourses.nptel.ac.in/noc22_cs19/previev">https://onlinecourses.nptel.ac.in/noc22_cs19/previev</a>	IIT Kharagpur	60 %	12 weeks
2	Machine Learning	BTAIC502	V	Introduction to machine learning <a href="https://onlinecourses.nptel.ac.in/noc22_cs97/previev">https://onlinecourses.nptel.ac.in/noc22_cs97/previev</a>	IIT Kharagpur	80 %	8 weeks
3	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning <a href="https://nptel.ac.in/courses/106106140">https://nptel.ac.in/courses/106106140</a>	IIT Madras	60 %	12 weeks
4	Virtual Reality	BTAIPE504A	V	Virtual reality engineering <a href="https://nptel.ac.in/courses/121106013">https://nptel.ac.in/courses/121106013</a>	IIT Madras	70 %	12Week s
5	Soft computing	BTAIPE504B	V	Introduction to soft computing <a href="https://onlinecourses.nptel.ac.in/noc22_cs54/previev">https://onlinecourses.nptel.ac.in/noc22_cs54/previev</a>	IIT Kharagpur	40 %	8 Weeks
6				Neural networks and applications <a href="https://archive.nptel.ac.in/courses/117/105/117105084/">https://archive.nptel.ac.in/courses/117/105/117105084/</a>	IIT Kharagpur	40 %	37 lectures
7	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics <a href="https://onlinecourses.nptel.ac.in/noc22_de11/previev">https://onlinecourses.nptel.ac.in/noc22_de11/previev</a> Introduction to robotics <a href="https://archive.nptel.ac.in/courses/107/106/10710690/">https://archive.nptel.ac.in/courses/107/106/10710690/</a>	IIT Madras	70 %	12 weeks
8	Advanced Java	BTAIPE504D	V	Programming in Java <a href="https://onlinecourses.nptel.ac.in/noc22_cs47/previev">https://onlinecourses.nptel.ac.in/noc22_cs47/previev</a>	IIT Kharagpur	50 %	12 weeks
9	Data mining and warehousing	BTAIOE505A	V	Data mining <a href="https://onlinecourses.swayam2.ac.in/cec19_cs01/previev">https://onlinecourses.swayam2.ac.in/cec19_cs01/previev</a>		60 %	12 weeks
10				Data mining <a href="https://onlinecourses.nptel.ac.in/noc21_cs06/previev">https://onlinecourses.nptel.ac.in/noc21_cs06/previev</a>	IIT Kharagpur	40 %	8 weeks
11	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory <a href="https://onlinecourses.nptel.ac.in/noc22_ee108/previev">https://onlinecourses.nptel.ac.in/noc22_ee108/previev</a>	IIT Kanpur	80 %	12 weeks
12				Principles of Digital communication <a href="https://nptel.ac.in/courses/10810113">https://nptel.ac.in/courses/10810113</a>	IIT Bombay	90 %	12 weeks
13	Software engineering and testing	BTAIOE505C	V	Software engineering <a href="https://onlinecourses.nptel.ac.in/noc22_cs106/previev">https://onlinecourses.nptel.ac.in/noc22_cs106/previev</a>	IIT Kharagpur	60 %	12 weeks
14				Software testing <a href="https://onlinecourses.nptel.ac.in/noc19_cs71/previev">https://onlinecourses.nptel.ac.in/noc19_cs71/previev</a>	IIT Bangalore	60 %	12 weeks
15				Software testing <a href="https://onlinecourses.nptel.ac.in/noc20_cs19/previev">https://onlinecourses.nptel.ac.in/noc20_cs19/previev</a>	IIT Kharagpur	40 %	4 weeks
16	Deep learning	BTAIC601	VI	Deep learning <a href="https://onlinecourses.nptel.ac.in/noc20_cs62/previev">https://onlinecourses.nptel.ac.in/noc20_cs62/previev</a>	IIT Kharagpur	80 %	12 week
17				Deep learning <a href="https://onlinecourses.nptel.ac.in/noc22_cs124/previev">https://onlinecourses.nptel.ac.in/noc22_cs124/previev</a>	IIT Ropar	70 %	12 weeks
18	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application <a href="https://onlinecourses.nptel.ac.in/noc19_cs82/previev">https://onlinecourses.nptel.ac.in/noc19_cs82/previev</a>	IIT Madras	50 %	12 Weeks
19	Augmented reality	BTAIPE603A	VI	-			
20	Recommender system	BTAIPE603B	VI	-			
21	Industry 4.0 & automation	BTAIPE603 C	VI	Introduction to industry 4.0 and industrial internet of things <a href="https://onlinecourses.nptel.ac.in/noc22_cs95/previev">https://onlinecourses.nptel.ac.in/noc22_cs95/previev</a>	IIT Kharagpur	50 %	12 weeks
22	Web Development	BTAIPE603 D	VI	Modern application development <a href="https://nptel.ac.in/courses/106106156">https://nptel.ac.in/courses/106106156</a>	IIT Madras	40 %	8 weeks

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

**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA**

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Computer Network and Cloud Computing	BTAIC5 01	V	The Bits and Bytes of Computer Networking <a href="https://www.coursera.org/learn/computer-networking">https://www.coursera.org/learn/computer-networking</a>	Google Career Certificate	80%	6 Weeks
2				Introduction to Cloud Computing <a href="https://www.coursera.org/learn/introduction-to-cloud">https://www.coursera.org/learn/introduction-to-cloud</a>	IBM Cloud	75%	5 Weeks
3	Machine Learning	BTAIC5 02	V	Machine Learning for All <a href="https://www.coursera.org/learn/uol-machine-learning-for-all">https://www.coursera.org/learn/uol-machine-learning-for-all</a>	University of London	90%	4 Weeks
4	Knowledge reasoning and AI ethics	BTAIH M503	V	Artificial Intelligence Ethics in Action <a href="https://www.coursera.org/learn/ai-ethics-analysis">https://www.coursera.org/learn/ai-ethics-analysis</a>	LearnQuest	75%	3 Weeks
5	Virtual Reality	BTAIPE 504A	V	Intro to AR/VR/MR/XR: Technologies, Applications & Issues <a href="https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues">https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues</a>	University of Michigan	78%	4 Weeks
6	Soft computing	BTAIPE 504B	V	Neural Networks and Deep Learning <a href="https://www.coursera.org/learn/neural-networks-deep-learning">https://www.coursera.org/learn/neural-networks-deep-learning</a>	DeepLearning.AI	65%	4 Weeks
7	Sensors and Robotics Technology	BTAIPE 504C	V	AI For Everyone <a href="https://www.coursera.org/learn/ai-for-everyone">https://www.coursera.org/learn/ai-for-everyone</a>	DeepLearning.AI	65%	4 Weeks
8	Advanced Java	BTAIPE 504D	V	Object Oriented Programming in Java <a href="https://www.coursera.org/learn/object-oriented-java">https://www.coursera.org/learn/object-oriented-java</a>	UC San Diego	75%	6 Weeks

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9	Data mining and warehousing	BTAIOE 505A	V	Data Mining Pipeline <a href="https://www.coursera.org/learn/data-mining-pipeline">https://www.coursera.org/learn/data-mining-pipeline</a>	University of Colorado Boulder	85%	4 Weeks
10				Fundamentals of Data Warehousing <a href="https://www.coursera.org/learn/fundamentals-of-data-warehousing">https://www.coursera.org/learn/fundamentals-of-data-warehousing</a>	LearnQuest	80%	3 Weeks
11	Digital communication and information theory	BTAIOE 505B	V	Fundamentals of Network Communication <a href="https://www.coursera.org/learn/fundamentals-network-communications">https://www.coursera.org/learn/fundamentals-network-communications</a>	University of Colorado	76%	5 Weeks
12				Cryptography and Information Theory <a href="https://www.coursera.org/learn/crypto-info-theory">https://www.coursera.org/learn/crypto-info-theory</a>	University of Colorado	80%	4 Weeks
13	Software engineering and testing	BTAIOE 505C	V	Software Engineering: Implementation and Testing <a href="https://www.coursera.org/learn/software-engineering-implementation-and-testing">https://www.coursera.org/learn/software-engineering-implementation-and-testing</a>	The Hong Kong University of Science and Technology	90%	7 Weeks
14	Deep learning	BTAIC6 01	VI	Neural Networks and Deep Learning <a href="https://www.coursera.org/learn/neural-networks-deep-learning">https://www.coursera.org/learn/neural-networks-deep-learning</a>	DeepLearning.AI	80%	4 Weeks
15	Advanced Machine Learning	BTAIC6 02	VI	Advanced Machine Learning and Signal Processing <a href="https://www.coursera.org/learn/advanced-machine-learning-signal-processing">https://www.coursera.org/learn/advanced-machine-learning-signal-processing</a>	IBM Skills Network	80%	4 Weeks
16	Augmented reality	BTAIPE 603A	VI	Introduction to Augmented Reality and ARCore <a href="https://www.coursera.org/learn/ar">https://www.coursera.org/learn/ar</a>	Daydream	85%	4 Weeks
17	Recommender system	BTAIPE603 B	VI	Basic Recommender Systems <a href="https://www.coursera.org/learn/basic-recommender-systems">https://www.coursera.org/learn/basic-recommender-systems</a>	EIT Digital	70%	4 Weeks
18	Industry 4.0 & automation	BTAIPE 603C	VI	Industrial Internet of Things (IIoT) <a href="https://www.coursera.org/learn/industrial-internet-of-things">https://www.coursera.org/learn/industrial-internet-of-things</a>	University of Michigan	80%	4 Weeks
19	Web Development	BTAIPE 603D	VI	Web Application Development: Basic Concepts <a href="https://www.coursera.org/learn/web-app">https://www.coursera.org/learn/web-app</a>	University of New Mexico	80%	5 Weeks
20	Big Data Analytics	BTAIOE 604A	VI	Fundamentals of Software Architecture for Big Data <a href="https://www.coursera.org/learn/software-architecture-for-big-data-fundamentals">https://www.coursera.org/learn/software-architecture-for-big-data-fundamentals</a>	University of Colorado Boulder	75%	4 Weeks
21	Cryptography and network security	BTAIOE 604B	VI	Cryptography and Hashing Overview <a href="https://www.coursera.org/learn/crypto-hashing">https://www.coursera.org/learn/crypto-hashing</a>	University of California, Irvine	75%	4 Weeks
22	Agile Methodology	BTAIOE 604C	VI	Combining Scrum with Other Agile Methodologies <a href="https://www.coursera.org/learn/combining-scrum-with-other-methodologies">https://www.coursera.org/learn/combining-scrum-with-other-methodologies</a>	LearnQuest	85%	2 Weeks
23	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIH M605	VI	People and Soft Skills Assessment <a href="https://www.coursera.org/learn/people-soft-skills-assessment">https://www.coursera.org/learn/people-soft-skills-assessment</a>	IBM	65%	1 Week

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

**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx**

Sr. No	Name of Subject as per Curriculum	Course Code	Se me ster	Edx Course And Web Link	Name of Institute offering course	Relev ance %	Durati on of Cours e
1	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing <a href="https://onlinecourses.nptel.ac.in/noc22_cs87/preview">https://onlinecourses.nptel.ac.in/noc22_cs87/preview</a> 11Computer Networks and Internet Protocol <a href="https://onlinecourses.nptel.ac.in/noc22_cs19/preview">https://onlinecourses.nptel.ac.in/noc22_cs19/preview</a>	IIT Kharagpur	40%	12 weeks
2	Machine Learning	BTAIC502	V	Introduction to machine learning <a href="https://onlinecourses.nptel.ac.in/noc22_cs97/preview">https://onlinecourses.nptel.ac.in/noc22_cs97/preview</a>	IIT Kharagpur	80%	8 weeks
3	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning <a href="https://nptel.ac.in/courses/106106140">https://nptel.ac.in/courses/106106140</a>	IIT Madras	60%	12 weeks
4	Virtual Reality	BTAIPE504A	V	Virtual reality engineering <a href="https://nptel.ac.in/courses/121106013">https://nptel.ac.in/courses/121106013</a>	IIT Madras	70%	12Weeks
5	Soft computing	BTAIPE504B	V	Introduction to soft computing <a href="https://onlinecourses.nptel.ac.in/noc22_cs54/preview">https://onlinecourses.nptel.ac.in/noc22_cs54/preview</a>	IIT Kharagpur	40%	8 Weeks
				Neural networks and applications <a href="https://archive.nptel.ac.in/courses/117_105/117105084/">https://archive.nptel.ac.in/courses/117_105/117105084/</a>	IIT Kharagpur	40%	37 lectures
6	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics <a href="https://onlinecourses.nptel.ac.in/noc22_de11/preview">https://onlinecourses.nptel.ac.in/noc22_de11/preview</a> Introduction to robotics <a href="https://archive.nptel.ac.in/courses/107_106/107106090/">https://archive.nptel.ac.in/courses/107_106/107106090/</a>	IIT Madras	70%	12 weeks
7	Advanced Java	BTAIPE504D	V	Programming in Java <a href="https://onlinecourses.nptel.ac.in/noc22_cs47/preview">https://onlinecourses.nptel.ac.in/noc22_cs47/preview</a>	IIT Kharagpur	50%	12 weeks
8	Data mining and warehousing	BTAIOE505A	V	Data mining <a href="https://onlinecourses.swayam2.ac.in/cec19_cs01/preview">https://onlinecourses.swayam2.ac.in/cec19_cs01/preview</a>		60%	12 weeks
				Data mining <a href="https://onlinecourses.nptel.ac.in/noc21_cs06/preview">https://onlinecourses.nptel.ac.in/noc21_cs06/preview</a>	IIT Kharagpur	40%	8 weeks
9	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory <a href="https://onlinecourses.nptel.ac.in/noc22_ce108/preview">https://onlinecourses.nptel.ac.in/noc22_ce108/preview</a>	IIT Kanpur	80%	12 weeks
				Principles of Digital communication <a href="https://nptel.ac.in/courses/108101113">https://nptel.ac.in/courses/108101113</a>	IIT Bombay	90%	12 weeks
10	Software engineering and testing	BTAIOE505C	V	Software engineering <a href="https://onlinecourses.nptel.ac.in/noc22_cs106/preview">https://onlinecourses.nptel.ac.in/noc22_cs106/preview</a>	IIT Kharagpur	60%	12 weeks

**DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE**

				Software testing <a href="https://onlinecourses.nptel.ac.in/noc19_cs71/preview">https://onlinecourses.nptel.ac.in/noc19_cs71/preview</a>	IIT Bangalore	60%	12 weeks
				Software testing <a href="https://onlinecourses.nptel.ac.in/noc20_cs19/preview">https://onlinecourses.nptel.ac.in/noc20_cs19/preview</a>	IIT Kharagpur	40%	4 weeks
11	Deep learning	BTAIC601	VI	Deep learning <a href="https://onlinecourses.nptel.ac.in/noc20_cs62/preview">https://onlinecourses.nptel.ac.in/noc20_cs62/preview</a>	IIT Kharagpur	80%	12 week
				Deep learning <a href="https://onlinecourses.nptel.ac.in/noc22_cs124/preview">https://onlinecourses.nptel.ac.in/noc22_cs124/preview</a>	IIT Ropar	70%	12 weeks
12	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application <a href="https://onlinecourses.nptel.ac.in/noc19_cs82/preview">https://onlinecourses.nptel.ac.in/noc19_cs82/preview</a>	IIT Madras	50%	12 Weeks
13	Augmented reality	BTAIPE603A	VI	-			
14	Recommender system	BTAIPE603B	VI	-			
15	Industry 4.0 & automation	BTAIPE603C	VI	Introduction to industry 4.0 and industrial internet of things <a href="https://onlinecourses.nptel.ac.in/noc22_cs95/preview">https://onlinecourses.nptel.ac.in/noc22_cs95/preview</a>	IIT Kharagpur	50%	12 weeks
16	Web Development	BTAIPE603D	VI	Modern application development <a href="https://nptel.ac.in/courses/106106156">https://nptel.ac.in/courses/106106156</a>	IIT Madras	40%	8 weeks
17	Big Data Analytics	BTAIOE604A	VI	-			
18	Cryptography and network security	BTAIOE604B	VI	Cryptography and network security <a href="https://onlinecourses.nptel.ac.in/noc22_cs90/preview">https://onlinecourses.nptel.ac.in/noc22_cs90/preview</a>	IIT Kharagpur	60%	12 weeks
19	Agile Methodology	BTAIOE604C	VI	-			
20	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIH M605	VI	Developing soft skill and personality <a href="https://archive.nptel.ac.in/courses/109_104/109104107/">https://archive.nptel.ac.in/courses/109_104/109104107/</a> Educational leadership <a href="https://archive.nptel.ac.in/courses/109_105/109105122/">https://archive.nptel.ac.in/courses/109_105/109105122/</a>	IIT Kharagpur & Kanpur	40%	8 weeks
21	Development Engineering	BTAIH M605A	VI	-			
22	Employability and Skills Development	BTAIH M605B	VI	Soft skills <a href="https://onlinecourses.nptel.ac.in/noc21_hs76/preview">https://onlinecourses.nptel.ac.in/noc21_hs76/preview</a>	IIT Roorkee	70%	12 weeks
23	Consumer Behavior	BTAIH M605C	VI	Introduction to consumer behavior <a href="https://nptel.ac.in/courses/110105029">https://nptel.ac.in/courses/110105029</a>	IIT Kharagpur	50%	8 weeks
24	Economics and management	BTAIH M605D	VI	Economics / Management / Entrepreneurship <a href="https://nptel.ac.in/courses/110105067">https://nptel.ac.in/courses/110105067</a>	IIT Kharagpur	60%	12 weeks

**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL**

<b>Sr. No</b>	<b>Course Title</b>	<b>Course Code</b>	<b>Semester</b>	<b>SWAYAM/ NPTEL Course And Web Link</b>	<b>Name of Institute offering</b>	<b>Relevance</b>	<b>Duration</b>
1	Natural Language Processing	BTAIC701	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc23_cs45/">https://onlinecourses.nptel.ac.in/noc23_cs45/preview</a>	IIT Kharagpur	85%	12 Week
2	Advanced Computer Vision	BTAIC702	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc19_cs58/">https://onlinecourses.nptel.ac.in/noc19_cs58/preview</a>	IIT Kharagpur	75%	12 Week
3	Data Engineering	BTAIC703	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc21_cs69/">https://onlinecourses.nptel.ac.in/noc21_cs69/preview</a>	IIT Madras	85%	8 Week
<b>Professional Elective Course (PEC)-BTAIPE704</b>							
4	1. Time Series Forecasting	BTAIPE704A	VII	<b>NPTEL</b> <a href="https://onlinecourses.nptel.ac.in/noc21_ch28/">https://onlinecourses.nptel.ac.in/noc21_ch28/preview</a>	IIT Madras	65%	12 Week
	2. IOT & DA	BTAIMPE704B	VII	<b>NPTEL:</b> <a href="https://archive.nptel.ac.in/courses/106/105/10_6105166/">https://archive.nptel.ac.in/courses/106/105/10_6105166/</a>	IIT Delhi	75%	12 Week
	3. Distributed Systems	BTAIMPE704C	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc22_cs66/">https://onlinecourses.nptel.ac.in/noc22_cs66/preview</a>	IIT Madras	65%	8 Week
	4. Full Stack Development	BTAIPE704D	VII	-	-	-	-
<b>Open Elective Course (OEC) – BTAIOE705</b>							
5	1. Design Thinking	BTAIMOE705A	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc22_mg32/">https://onlinecourses.nptel.ac.in/noc22_mg32/preview</a>	IIT Madras	85%	8 Week
	2. Block chain Technology	BTAIOE705B	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc20_cs01/">https://onlinecourses.nptel.ac.in/noc20_cs01/preview</a>  <b>Coursera:</b> <a href="https://www.coursera.org/specializations/blockchain">https://www.coursera.org/specializations/blockchain</a>	IIT Kanpur	85%	8 Week
	3. Bio Informatics	BTAIMOE705C	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc21_bt06/">https://onlinecourses.nptel.ac.in/noc21_bt06/preview</a> <b>Coursera:</b> <a href="https://www.coursera.org/specializations/bioinformatics">https://www.coursera.org/specializations/bioinformatics</a>	IIT Kanpur	80%	12 Week
	4. Mobile Application Development	BTAIOE705D	VII	<b>NPTEL:</b> <a href="https://archive.nptel.ac.in/courses/106/106/10_6106156/">https://archive.nptel.ac.in/courses/106/106/10_6106156/</a>	IIT Madras	75%	8 Week
<b>Humanities and Social Sciences including Management Elective Course (HSSMEC) :BTAIHM706</b>							
6	1. Foreign Language Studies	BTAIOE706A	VII	<b>NPTEL (German):</b> <a href="https://nptel.ac.in/courses/109106166">https://nptel.ac.in/courses/109106166</a>	IIT Madras	45%	12 Week
				<b>NPTEL (Japanese)</b> <a href="https://nptel.ac.in/courses/121104005">https://nptel.ac.in/courses/121104005</a>	IIT Kanpur	45%	12 Week
	2. Universal Human Value & Ethics	BTAIOE706B	VII	<b>NPTEL:</b> <a href="https://nptel.ac.in/courses/109104068">https://nptel.ac.in/courses/109104068</a>	IIT Kanpur	65%	12 Week
	3. Intellectual Property Rights	BTAIOE706C	VII	<b>NPTEL:</b> <a href="https://onlinecourses.nptel.ac.in/noc22_hs59/">https://onlinecourses.nptel.ac.in/noc22_hs59/preview</a>	IIT Madras	75%	12 Week

**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA**

<b>Sr. No</b>	<b>Course Title</b>	<b>Course Code</b>	<b>Semester</b>	<b>SWAYAM/ NPTEL Course And Web Link</b>	<b>Name of Institute offering</b>	<b>Relevance</b>	<b>Duration</b>
1	Natural Language Processing	BTAIC701	VII	<a href="https://shorturl.at/hmIWZ">https://shorturl.at/hmIWZ</a>	DeepLearning.AI	50%	3 Month
2	Advanced Computer Vision	BTAIC702	VII	<a href="https://shorturl.at/biBJ6">https://shorturl.at/biBJ6</a>	DeepLearning.AI	60%	19 week
3	Data Engineering	BTAIC703	VII	<a href="https://www.coursera.org/learn/introduction-to-data-engineering">https://www.coursera.org/learn/introduction-to-data-engineering</a>	IBM		4 Week
<b>Professional Elective Course (PEC)-BTAIPE704</b>							
4	1. Time Series Forecasting	BTAIPE704A	VII		DeepLearning.AI	50%	4 week
	2. IOT&DA	BTAIMPE 704B	VII	<a href="https://www.coursera.org/specializations/iot">https://www.coursera.org/specializations/iot</a>	IBM	60%	4 week
	3. Distributed Systems	BTAIMPE 704C	VII	-	-	-	-
	4. Full Stack Development	BTAIPE704D	VII	<a href="https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer">https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer</a>	IBM	85%	3-6 Month
<b>Open Elective Course (OEC) – BTAIOE705</b>							
5	1.Design Thinking	BTAIMOE 705A	VII	-	-	-	-
	2. Block chain Technology	BTAIOE705B	VII	<b>Coursera:</b> <a href="https://www.coursera.org/specializations/blockchain">https://www.coursera.org/specializations/blockchain</a>	University of Buffalo	65%	2 Months
	3.Bio informatics	BTAIMOE 705C	VII	<b>Coursera:</b> <a href="https://www.coursera.org/specializations/bioinformatics">https://www.coursera.org/specializations/bioinformatics</a>	KAIST	60%	10 Hrs
	4. Mobile Application Development	BTAIOE705D	VII	<a href="https://www.coursera.org/learn/introduction-to-android-mobile-application-development">https://www.coursera.org/learn/introduction-to-android-mobile-application-development</a>	Meta	75%	4 Week
<b>Humanities and Social Sciences including Management Elective Course (HSSMEC) :BTAIHM706</b>							
6	1. Foreign Language Studies	BTAIOE706A	VII	-	-	-	-
				-	-	-	-
	2. Universal Human Value & Ethics	BTAIOE706B	VII	<a href="https://www.coursera.org/learn/ethical-use-of-technology">https://www.coursera.org/learn/ethical-use-of-technology</a>	The University of NOTRE DAME		4 week
	3. Intellectual Property Rights	BTAIOE706C	VII	<a href="https://www.coursera.org/specializations/introduction-intellectual-property">https://www.coursera.org/specializations/introduction-intellectual-property</a>	Penn University	80%	1 month 10 hrs

**COURSE CURRICULUM MAPPING WITH MOOC PLATFORM EDX**

<b>Sr. No</b>	<b>Course Title</b>	<b>Course Code</b>	<b>Semester</b>	<b>SWAYAM/ NPTEL Course And Web Link</b>	<b>Name of Institute offering</b>	<b>Relevance</b>	<b>Duration</b>
1	Natural Language Processing	BTAIC701	VII	<a href="https://shorturl.at/ekxDP">https://shorturl.at/ekxDP</a>	University of Canterbury	60%	6 Week
2	Advanced Computer Vision	BTAIC702	VII	<a href="https://shorturl.at/jkMZ1">https://shorturl.at/jkMZ1</a>	IBM	50%	3 week
3	Data Engineering	BTAIC703	VII	<a href="https://www.edx.org/professional-certificate/ibm-data-engineering">https://www.edx.org/professional-certificate/ibm-data-engineering</a>	IBM	50%	2 Month
<b>Professional Elective Course (PEC)-BTAIPE704</b>							
4	1. Time Series Forecasting	BTAIPE704A	VII	-	-	-	-
	2. IOT&DA	BTAIMPE 704B	VII	-	-	-	-

**DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE**

	3. Distributed Systems	BTAIMPE 704C	VII	-	-	-	-
	4. Full Stack Development	BTAIPE704D	VII	-	-	-	-
<b>Open Elective Course (OEC) – BTAIOE705</b>							
5	1.Design Thinking	BTAIMOE 705A	VII	-	-	-	-
	2. Block chain Technology	BTAIOE705B	VII	-	-	-	-
	3.Bioinformatics	BTAIMOE 705C	VII	-	-	-	-
	4. Mobile Application Development	BTAIOE705D	VII	-	-	-	-
<b>Humanities and Social Sciences including Management Elective Course (HSSMEC) :BTAIHM706</b>							
6	1. Foreign Language Studies	BTAIOE706A	VII	-	-	-	-
				-	-	-	-
	2. Universal Human Value & Ethics	BTAIOE706B	VII	-	-	-	-
	3. Intellectual Property Rights	BTAIOE706C	VII	<a href="https://www.edx.org/course/intellectual-property-rights-a-management-perspect">https://www.edx.org/course/intellectual-property-rights-a-management-perspect</a>	IIM Bangalore	80%	6 week