**Dr. Babasaheb Ambedkar Technological University (Established a University of Technology in the State of Maharashtra)**
**(under Maharashtra Act No. XXIX of 2014)**
**P.O. Lonere, Dist. Raigad, Pin 402 103,**
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www.dbatu.ac.in

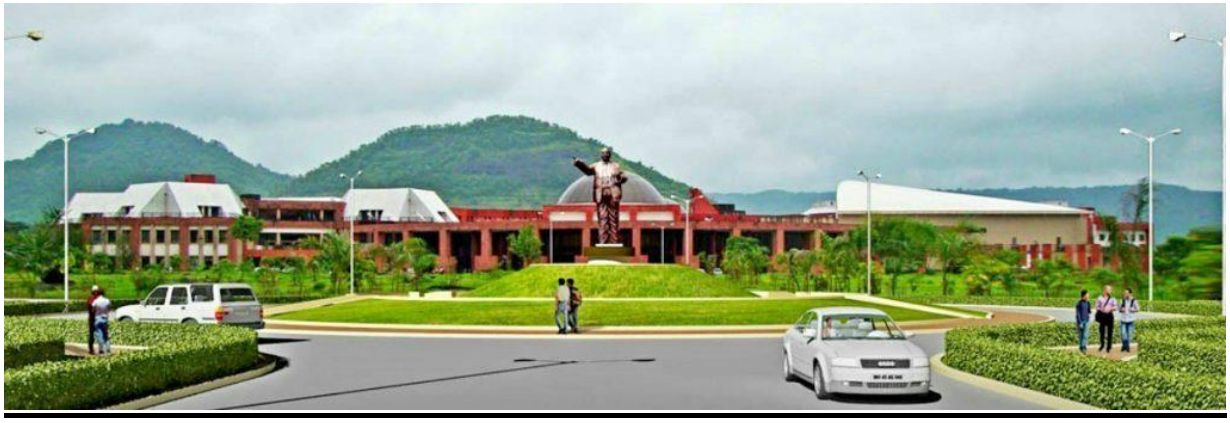
# PROPOSED CURRICULUM UNDER GRADUATE PROGRAMME

# B. TECH

## ARTIFICIAL INTELLIGENCE & DATA SCIENCE

**Second Year**

**WITH EFFECT FROM THE ACADEMIC YEAR 2021-2022**



# Rules and Regulations

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

## REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme: A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

**Course Pre-Requisites:**

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.

3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.

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

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

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

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

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

## EVALUATION SYSTEM:

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

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

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

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

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

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

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

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

**It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.**

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

5. Description of Grades:

**EX Grade:** An 'EX' grade stands for outstanding achievement.

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

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only. If any of the student remain **absent** for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

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

6. Evaluation of Performance:

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

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

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

Where

'n' is the number of subjects for the semester,

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

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

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

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he

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

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

Where
'm' is the total number of subjects from the first semester onwards up to and including the semester S,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.
#CGPA will be rounded off to the second place of decimal and recorded as such.

## Award of Degree of Honours

## Major Degree

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

**A. Eligibility Criteria for Majors**

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

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

**B. Eligibility Criteria for Minors**

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

**Student complying with these criteria will be awarded with B. Tech Degree in -------Engineering with Minor in----------Engineering.**
(For e.g.: B. Tech in Artificial Intelligence & Data Science with Minor in Computer Engineering).

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

## ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (e.g. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like Medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.
    a) If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
    b) The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
    c) In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

## TRANSFER OF CREDITS

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

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i. e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

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

# Suggested Plan of Study

| Sr. No. | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|
| 1 | Engineering Mathematics-III | Probability Theory and Random Processes | Artificial Intelligence (Knowledge Representation and Reasoning) and its tools | Deep Learning & Neural Network | Natural Language Processing | - |
| 2 | An Introduction to Artificial Intelligence | Data Analysis | Machine Learning | Data Engineering (Data Modeling & Visualization) | Web Development Framework | - |
| 3 | Programming, Data Structure and Algorithm | Database Management System | Software Engineering & Testing | Professional Ethics and Values | Universal Human Value & Ethics | - |
| 4 | Digital Logic & Signal Processing | Image Processing & Computer Vision | **Open Elective Course (OEC) - I** | **Open Elective Course (OEC) - II** | **Open Elective Course (OEC) - III** | - |
| | | | 1. Cloud Computing | 1. Pattern Recognition | 1. Modern Application Development in AI | |
| | | | 2. Human Computer Interface | 2. Information Retrieval | 2. Quantum AI | |
| | | | 3. Enterprise Architecture & Component | 3. Project Design & Management | 3. Intellectual Property Right | |
| | | | 4. Soft Computing | 4. Advance Machine Learning | 4. Recommendation System | |
| 5 | Building Essential Language and Life Skills | **Professional Elective Courses -I** | **Professional Elective Course (PEC) -II** | **Professional Elective Course (PEC) -III** | **Professional Elective Course (PEC) -IV** | - |
| | | 1. Internet of Things & Embedded System | 1. Sensors & Robotics Technology | 1. Industry 4.0 & Automation | 1. Autonomous Vehicle | |
| | | 2. Computer Architecture& Operating System | 2. Data Warehouse & Data Mining | 2. Big Data Analytics | 2. AI with Hadoop | |
| | | | | | 3. Big Data Framework (Apache Hadoop, Hive, Spark) | |
| | | 3. Cryptography and Network Security | 3. Cyber Security | 3. Blockchain Technology | | |
| | | 4. Programming in JAVA | 4. Theory of Computing | 4. Virtual and Augmented Reality | 4. GPU Programming | |

## Degree Requirements:

**Total Credits: 160**

| Sr. No | Category | Suggested Breakup of Credits by AICTE | Credits awarded to First year | Credits awarded to Second year to Final Year | Total |
|---|---|---|---|---|---|
| 1 | Humanities and Social Sciences including Management courses | **12*** | 3 | 9 | **12** |
| 2 | Basic Science courses | **25*** | 18 | 8 | **26** |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. | **24*** | 15 | 4 | **19** |
| 4 | Professional core courses | **48*** | 0 | 57 | **57** |
| 5 | Professional Elective courses relevant to chosen specialization/branch | **18*** | 0 | 15 | **15** |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | **18*** | 0 | 12 | **12** |
| 7 | Project work, seminar and internship in industry or elsewhere | **15*** | 1 | 18 | **19** |
| 8 | Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition] | **NC** | -- | -- | **--** |
| | **Total** | **160*** | **37** | **123** | **160** |

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

# Program Educational Objectives and Outcomes

## A. Program Educational Objectives (PEOs)

Graduates will able to–

1.To equip graduates with a strong foundation in engineering sciences and Artificial Intelligence and Data Science Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

2.Perceive the limitation and impact of engineering solutions in social, legal, environmental, economic and multidisciplinary contexts.

3.Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

## B. Program Outcomes

Engineering Graduate will be able to –

1.**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6.**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7.**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8.**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9.**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend

and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## C. Program Specific Outcomes (PSOs)

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

# Course Structure for Second Year

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

| Semester III ( Term 3) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| BSC | BTSE301 | Engineering Mathematics-III | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC1 | BTSE302 | An Introduction to Artificial Intelligence | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC2 | BTSE303 | Programming, Data Structure and Algorithm | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| ESC | BTSE304 | Digital Logic & Signal Processing | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| HSSMC | BTSE305 | Building Essential Language and Life Skills | 2 | - | - | 20 | 20 | 60 | 100 | 2 |
| LC | BTSE306 | An Introduction to Artificial Intelligence Lab | - | - | 2 | 60 | - | 40 | 100 | 1 |
| LC | BTSE307 | Programming, Data Structure and Algorithm Lab | - | - | 2 | 60 | - | 40 | 100 | 1 |
| Seminar | BTSE308 | Seminar-I | - | - | 4 | 30 | - | 20 | 50 | 2 |
| Internship | BTSE309 | Internship -I | - | - | - | - | - | - | - | Audit |
| | | | **15** | **4** | **6** | **250** | **100** | **400** | **750** | **22** |

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

# Course Structure for Second Year

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

| Semester IV ( Term 4) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| BSC | BTSE401 | Probability Theory and Random Processes | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC3 | BTSE402 | Data Analysis | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC4 | BTSE403 | Database Management System | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC5 | BTSE404 | Image Processing & Computer Vision | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| PEC-1 | BTSE405 | Professional Elective Courses –I | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| | BTSE405A | 1. Internet of Things & Embedded System | | | | | | | | |
| | BTSE405B | 2. Computer Architecture& Operating System | | | | | | | | |
| | BTSE405C | 3. Cryptography and Network Security | | | | | | | | |
| | BTSE405D | 4. Programming in JAVA | | | | | | | | |
| LC | BTSE406 | Data Analysis Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| LC | BTSE407 | Database Management System Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| LC | BTSE408 | Image Processing & Computer Vision Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| PROJ | BTSE409 | Project Based Learning (PBL) –I | - | - | 2 | 60 | - | 40 | 100 | 1 |
| Internship | BTSE410 | Internship -II | - | - | - | - | - | - | - | Audit |
| | | | **15** | **3** | **8** | **250** | **100** | **400** | **750** | **22** |

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# Course Structure for Third Year

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

| Semester V ( Term 5) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| PCC6 | BTTE501 | Artificial Intelligence (Knowledge Representation and Reasoning) and its tools | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC7 | BTTE502 | Machine Learning | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC8 | BTTE503 | Software Engineering and Testing | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| PEC-2 | BTTE504 | Professional Elective Course (PEC) -II | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTTE504A | 1. Sensors & Robotics Technology | | | | | | | | |
| | BTTE504B | 2. Data Warehouse & Data Mining | | | | | | | | |
| | BTTE504C | 3. Cyber Security | | | | | | | | |
| | BTTE504D | 4. Theory of Computation | | | | | | | | |
| OEC-1 | BTTE505 | Open Elective Course (OEC) - I | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTTE505A | 1. Cloud Computing | | | | | | | | |
| | BTTE505B | 2. Human Computer Interface | | | | | | | | |
| | BTTE505C | 3. Enterprise Architecture & Component | | | | | | | | |
| | BTTE505D | 4. Soft Computation | | | | | | | | |
| LC | BTTE506 | Machine Learning Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| LC | BTTE507 | Software Engineering and Testing Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| PROJ | BTTE508 | Project Based Learning (PBL) –II | - | - | 2 | 60 | - | 40 | 100 | 1 |
| HSSMC | BTTE509 | Corporates and Business Skill | - | 1 | - | 50 | - | - | 50 | 1 |
| Internship | BTTE510 | Industrial Internship-I | - | - | - | - | - | - | - | Audit |
| | | | **15** | **3** | **10** | **270** | **100** | **380** | **750** | **23** |

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# Course Structure for Third Year

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

| Semester VI ( Term 6) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| PCC9 | BTTE601 | Deep Learning & Neural Network | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC10 | BTTE602 | Data Engineering (Data Modeling & Visualization) | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PEC-3 | BTTE603 | Professional Elective Course (PEC) -III | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTTE603A | 1. Industry 4.0 & Automation | | | | | | | | |
| | BTTE603B | 2. Big Data Analytics | | | | | | | | |
| | BTTE603C | 3. Blockchain Technology | | | | | | | | |
| | BTTE603D | 4. Virtual and Augmented Reality | | | | | | | | |
| OEC-2 | BTTE604 | Open Elective Course (OEC) - II | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTTE604A | 1. Pattern Recognition | | | | | | | | |
| | BTTE604B | 2. Information Retrieval | | | | | | | | |
| | BTTE604C | 3. Project Design & Management | | | | | | | | |
| | BTTE604D | 4. Advance Machine Learning | | | | | | | | |
| HSSMC | BTTE605 | Professional Ethics and Values | 3 | | - | 20 | 20 | 60 | 100 | 3 |
| LC | BTTE606 | Deep Learning & Neural Network Lab | - | - | 2 | 60 | - | 40 | 100 | 1 |
| LC | BTTE607 | Data Engineering Lab | - | - | 2 | 60 | - | 40 | 100 | 1 |
| PROJ | BTTE608 | Project Based Learning (PBL) -IV | - | - | 2 | 30 | - | 20 | 50 | 1 |
| Internship | BTTE609 | Industrial Internship-II | - | - | - | - | - | - | - | Audit |
| | | | **15** | **2** | **10** | **250** | **100** | **400** | **750** | **22** |

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# Course Structure for Final Year

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

| Semester VII ( Term 7) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Category | Course Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| PCC11 | BTBE701 | Natural Language Processing | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PCC12 | BTBE702 | Web Development Framework | 3 | 1 | - | 20 | 20 | 60 | 100 | 4 |
| PEC-4 | BTBE703 | Professional Elective Course (PEC) -IV | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTBE703A | 1. Autonomous Vehicle | | | | | | | | |
| | BTBE703B | 2. AI with Hadoop | | | | | | | | |
| | BTBE703C | 3. Apache Spark & Scala | | | | | | | | |
| | BTBE703D | 4. Recommendation System | | | | | | | | |
| OEC-3 | BTBE704 | Open Elective Course (OEC) - III | 3 | - | 2 | 20 | 20 | 60 | 100 | 4 |
| | BTBE704A | 1. Modern Application Development in AI | | | | | | | | |
| | BTBE704B | 2. Quantum AI | | | | | | | | |
| | BTBE704C | 3. Intellectual Property Right | | | | | | | | |
| | BTBE704D | 4. GPU Programming | | | | | | | | |
| HSSMC | BTBE705 | Universal Human Value & Ethics | 3 | - | - | 20 | 20 | 60 | 100 | 3 |
| LC | BTBE706 | Natural Language Processing Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| LC | BTBE707 | Web Development Framework Lab | - | - | 2 | 30 | - | 20 | 50 | 1 |
| PROJ | BTBE708 | Mini Project | - | - | 2 | 50 | - | 100 | 150 | 1 |
| Internship | BTBE709 | Industrial Internship-III | - | - | - | - | - | - | - | Audit |
| | | | **15** | **2** | **10** | **210** | **100** | **440** | **750** | **22** |

| Semester VIII ( Term 8) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Category | Couse Code | Course Title | Teaching Scheme | | | Evaluation Scheme | | | | |
| | | | L | T | P | CA | MSE | ESE | Total | Credit |
| Project/ Internship | BTBE801 | Project Work/ Internship | - | - | 24 | 60 | - | 40 | 100 | 12 |
| | | | **-** | **-** | **24** | **60** | **-** | **40** | **100** | **12** |

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

# Second Year (Semester –III)

## Engineering Mathematics-III

| | | | | |
|---|---|---|---|---|
| **BTSE301** | **Engineering Mathematics-III** | **BSC** | **3L- 1T -0P** | **4 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week<br>Tutorial : 1 hr./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam:20 Marks<br>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. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits. |
| CO2 | Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing. |
| CO3 | Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative |
| CO4 | Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields. |
| CO5 | Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing. |
| CO6 | Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing. |

**Course Contents:**

**Unit 1: Laplace Transform** **[08 Hours]**

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 tn, 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 [ [07 Hours]**

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

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

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 [07 Hours]**

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 , and one dimensional wave equation (i.e. )

**Unit 5: Functions of Complex Variables [07 Hours]**

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.

## Second Year (Semester –III)

## An Introduction to Artificial Intelligence

| | | | | |
|---|---|---|---|---|
| **BTSE302** | **An Introduction to Artificial Intelligence** | **PCC1** | **3L- 1T - 0P** | **4 Credits** |

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

**Pre-Requisites:** None

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

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

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

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

**Course Contents:**

**Unit No 1: Introduction:** **[6 Hours]**

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

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

**Unit No 2: State Space Search** **[6 Hours]**

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

**Unit No 3: Heuristic Search & Randomized Search** **[6 Hours]**

**Heuristic Search:**

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

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

**Unit No 4: Optimal Path Finding** **[6 Hours]**

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

**Unit No 5: Game Playing & Automated Planning:** **[6 Hours]**
**Game Playing:** Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and Algorithm SSS*, B* search.
**Automated Planning**: Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning

**Unit No 6: Constraint Satisfaction** **[6 Hours]**
N Queens, Constraint Propagation, Scene labelling, Higher order consistency, Algorithm backtracking, Look-head strategies, Strategic retreat.

**Text Books**

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

**Reference Books**

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

**Semester –III**

# Programming, Data Structure and Algorithm

| BTSE303 | Programming Data Structure and Algorithm | PCC2 | 3L-1T-0P | 4 Credits |
|---|---|---|---|---|

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

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

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

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

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

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

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

**Unit 2: Functions & Object Oriented Programming using Python [06 Hours]**

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

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

**Unit 3: Data Structures in Python [06 Hours]**

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

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

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

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

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

**Unit 4: Non-Linear Data Structures in Python [08 Hours]**

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

Binary Search Trees- Operations and Algorithms (searching, insertion, deletion, min, max),

AVL Tree-Insertions, deletions, implementation

Hash Tables- Hashing techniques, Hash functions, Applications

**Unit 5: Searching & Sorting Algorithms [06 Hours]**

Search Algorithms- Linear Search Algorithm, Binary Search Algorithm,

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

**Unit 6: Algorithmic Techniques and Analysis [04 Hours]**

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

**Text Books / Reference Books**

1. Data Structures and Algorithms Using Python, Rance D. Necaise
2. Python for Everybody, Exploring Data Using Python 3, Dr. Charles R. Severance
3. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.

## Semester –III

# Digital Logic & Signal Processing

| BTSE304 | Digital Logic & Signal Processing | ESC | 3L-1T-0P | 4 Credits |
|---|---|---|---|---|

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

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

**Unit 1: Number System and Boolean Algebra [06 Hours]**

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

Boolean algebra and theorems.

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

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

**Unit 2: Introduction to Signals [06 Hours]**

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing:

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

**Unit 3: Systems** **[06 Hours]**

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

System modeling: Input-output relation, definition of impulse response, LTI systems, convolution integral, computation of convolution integral using graphical method, Properties of convolution.

**Unit 4: Discrete Fourier Transform** **[06 Hours]**

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

**Unit 5: Z transform** **[06 Hours]**

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

**Unit 6: Correlation and Spectral Density** **[06 Hours]**

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

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

**Text Books**

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

**Reference Books**

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

**Semester –III**

# Building Essential Language and Life Skills

| | | | | |
|---|---|---|---|---|
| **BTSE 305** | **Building Essential Language and Life Skills** | **HSSMC** | **2L-0T-0P** | **2 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 02 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Examination : 20 Marks<br>End Semester Examination: 60 Marks (Duration 3 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. Language skills, grammar, phonology, and strong vocabulary for effective use of language.
2. Comprehensive reading of different technical and non-technical material, business writing, listening skills, and speaking skills required for professional career development.
3. Self-management, self-awareness, self-analysis, positive attitude, emotional intelligence, decision making, problem solving attitude, time management and goal setting.
4. Interpersonal communication, relationship building, conflict resolution, being empathetic, ability to negotiate well, assertiveness and handling peer pressure.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Use language correctly and confidently without committing grammatical mistakes. |
| CO2 | Read different technical material with comprehension and write business letters and applications. |
| CO3 | Utilize the listening skills for getting engaged in situational speaking in a productive way. |
| CO4 | Manage ‘self’ for grooming the professional career by being ready to take the responsibilities and career challenges. |
| CO5 | Develop strong interpersonal relations at the professional and social spheres by being a good team player. |

**Course Contents:**

**Unit 1: Language Efficiency** **[04 Hours]**

Language – Concept of language, Roles of language, Functions of language, use of language effectively; Grammar – Sentence Formation, Tenses, adverbial forms, articles, prepositions, subject verb agreement, Common Errors, Vocabulary Building (exercises by using dictionary and library books); Change the voice.

**Unit 2: Reading and Writing Skills** **[04 Hours]**

Reading skills – SQW3R Method and Note-taking, different types of reading, reading different technical and non-technical material (exercises reading – comprehension passages), ways to improve reading skills,
Writing skills – writing emails, notices, office orders, agenda of the meeting, minutes of the meetings, Business letters, job application and resume writing.

**Unit 3: Listening and Speaking Skills** **[04 Hours]**

Listening skills, types of listening, techniques improve listening skills, Exercises of comprehension through listening, Verbal and non-verbal communication, Pronunciation – Representative Pronunciation, Articulation of Sounds in English with transcriptions, Effective ways to develop speaking skills, Speaking at the situations (Communicative skill – style of communication, engage in communication in an analytical and creative manner).

**Unit 4: Self-Management Skills** **[04 Hours]**

Self-Awareness and Self-analysis, Emotional intelligence (EQ), Attitude building, Thinking Skills (inference, prediction, analysis and critical thinking), Problem solving skill, Decision Making, Time Management, Goal Setting.

**Unit 5: Interpersonal Skills** **[04 Hours]**

Interpersonal Communication, Humour in communication (definition, humor at workplace), Interpersonal Relations, Conflict Resolution, Relationship building, understanding multiculturalism, Questioning Techniques, Leadership Skills.

**Unit 6: Developing People Skills** **[04 Hours]**

Definition of People skills, Types of People, How to say 'No', What makes other dislike you? What makes other like you? Empathy, Assertiveness, Negotiation Skills, Team working skills, Handling Peer Pressure

**Text Books / Reference Books**

1. Effective Technical Communication. Ashraf Rizvi. Mac Grall Hill Edu.Chennai, 2018.
2. English for Engineers and Technologists: A Skill Approach, Pub. Orient BlackSwan
3. Communicative English, E. Suresh Kumar & P. Sreehari, Orient BlackSwan
4. Interpersonal Skills at Work, John Hayes
5. Martin Hewings. Advanced Grammar in Use. Cambridge University Press, 2013.
6. Michael Swan. Practical English Usage. 3rd ed. OUP, 2005.
7. John Seely. The Oxford Guide to Effective Writing and Speaking. OUP, 2005

**Semester –III**

# An Introduction to Artificial Intelligence Lab

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|---|---|---|---|---|
| **BTSE 306** | **An Introduction to Artificial Intelligence Lab** | **LC** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

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

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

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

**Note:**

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

**Semester –III**

## Programming, Data Structure and Algorithm Lab

| | | | | |
|---|---|---|---|---|
| **BTSE 307** | **Programming, Data Structure and Algorithm Lab** | **LC** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

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

**List of Practical**

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

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

**Note:**

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

**Semester –III**

## Seminar

| | | | | |
|---|---|---|---|---|
| **BTSE 308** | **SEMINAR** | **Seminar** | **0L-0T-4P** | **2 Credits** |

## Guidelines for Seminar

The students shall study in group of two or three members on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

**Continues Assessment**:

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

**Semester –III**

## Internship - I

| | | | |
|---|---|---|---|
| **BTSE 309** | **Field Training / Internship / Industrial Training** | **Internship** | **Audit** |

## Guidelines for Internships

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

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

## Semester –IV

# Probability Theory and Random Processes

| | | | | |
|---|---|---|---|---|
| **BTSE401** | **Probability Theory and Random Processes** | **BSC** | **3L- 1T -0P** | **4 Credits** |

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

**Pre-Requisites:** None

**Course Objectives:**

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

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

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

**Course Contents:**

**UNIT 1: Introduction to Probability**: **[07 Hours]**

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes‟ rule and applications, Examples.

**UNIT 2: Random variables:** **[07 Hours]**

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation.

**UNIT 3: Random vector and distributions:** **[07 Hours]**

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound.

**UNIT 4: Sequence of random variables** **[07 Hours]**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

**UNIT 5: Random process:** **[07 Hours]**

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross-correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

**Text Books**

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, DavidStirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John WilliamWoods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, PearsonEducation
5. A. Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill.

**Reference Books**

1. Cooper. G.R., McGillem. C.D., “Probabilistic Methods of Signal and System Analysis”, Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, “Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes “, Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., —Probability and Random Processes with Applications to Signal Processing and Communications “, Academic Press, 2004.
4. Stark. H. and Woods. J.W., —Probability and Random Processes with Applications to Signal Processing “, Pearson Education, Asia, 3rd Edition, 2002.

# Semester –IV

## Data Analysis

| BTSE402 | Data Analysis | PCC3 | 3L - 1T - 0P | 4 Credits |
|---|---|---|---|---|

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

**Pre-Requisites:** Basics of *Linear Algebra*, Introduction, Probability and Statistics.

**Course Objectives:**

After completion of the course, students will learn:-

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

**Course Outcomes:**

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

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

**Course Contents:**

**Unit 1: Statistical data and Concepts [06 Hours]**

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

**Unit 2: Descriptive Statistics [06 Hours]**

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

**Unit 3: Data transformation and standardization** **[06 Hours]**

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

**Unit 4: Classical Tests** **[06 Hours]**

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

**Unit 5: Contingency Tables** **[06 Hours]**

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

**Unit 6: Analysis of Variance and Covariance** **[06 Hours]**

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

**Text Books**

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

**Reference Books**

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

**Semester –IV**

# Database Management System

| BTSE403 | Database Management System | PCC4 | 3L-1T-0P | 4 Credits |
|---|---|---|---|---|

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

**Pre-Requisites:** None

**Course Objectives:**

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

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

**Course Outcomes:**

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

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

**Course Contents:**

**Unit 1: Introduction to Databases** **[08 Hours]**

Introduction to Data and Database, Significance of Database Management System, Various Types of DBMS- relational & non-relational, Data Independence - The Three Levels Of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema

**Unit 2: Relational Database Management System** **[08 Hours]**

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

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

**Unit 3: Non-Relational Database Management System** **[08 Hours]**

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

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

**Unit 4: Columnar & Document Databases** **[10 Hours]**

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

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

**Unit 5: Graph Databases** **[08 Hours]**

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

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

**Unit 6: Future databases** **[06 Hours]**

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

**Text Books**

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

**Reference Books**

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

**Semester –IV**

# Image Processing and Computer Vision

| BTSE404 | Image Processing and Computer Vision | PCC5 | 3L-0T-0P | 4 Credits |
|---|---|---|---|---|

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

**Prerequisites:** Nil

**Course Objectives:**

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

**Course Outcomes:**

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

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

**Course Contents:**

**Unit 1: Introduction to Digital Image Processing [06 Hours]**

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

**Unit 2: Image Enhancement [06 Hours]**

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

**Unit 3: Image Transformation** **[06 Hours]**

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

**Unit 4: Morphological operations and segmentation** **[06 Hours]**

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

**Unit 5: Local Image Features** **[06 Hours]**

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

**Unit 6: Object Recognition** **[06 Hours]**

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

**Text Books:**

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

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

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

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

**Reference Books:**

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

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

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

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

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

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

**Semester –IV**

# Internet of Things & Embedded System

| BTSE405A | Internet of Things & Embedded System | PEC1 | 3L-0T-0P | 3 Credits |
|---|---|---|---|---|

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

**Prerequisites:** Basics if microprocessor, microcontroller, C language

**Course Objectives:**

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

**Course Outcomes:**

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

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

**Course Contents:**

**Unit-I: Introduction to IoT** **[06 Hours]**

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

**Unit-II: Introduction to C and Node Mcu** **[06 Hours]**

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

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

**Unit-III: Introduction to Python and Raspberry Pi** **[06 Hours]**

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

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

**Unit-IV** : **Interacting with Web Services** **[06 Hours]**

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

**Unit-V: IoT Protocols**

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

**Unit-VI: Case study and Applications of IOT**

Smart cities, Home automation, Weather Monitoring, smart Grids, Inventory Management, Smart irrigation, Industrial internet, smart Wearables.

**Text Books:**

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

**Reference Books:**

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

**Semester –IV**

# Computer Architecture and Operation Systems

| BTSE405B | Computer Architecture and Operation Systems | PEC1 | 3L-0T-0P | 3 Credits |
|---|---|---|---|---|

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

**Pre-Requisites:** None

## Course Objectives:

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

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

## Course Outcomes:

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

| | |
|---|---|
| CO1 | Understand the theory and architecture of central processing unit & Analyze some of the design issues in terms of speed, technology, cost, performance |
| CO2 | Use appropriate tools to design verify and test the CPU architecture & Learn the concepts of parallel processing, pipelining and inter processor communication. |
| CO3 | Understand the architecture and functionality of central processing unit & Exemplify in a better way the I/O and memory organization. |
| CO4 | Describe and explain the fundamental components of a computer operating system |
| CO5 | Define, restate, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems. |
| CO6 | Describe and extrapolate the interactions among the various components of computing systems and construct OS components: System calls, Schedulers, Memory management systems, Virtual Memory |

## Course Contents:

### Unit 1: Introduction and Instruction Sets [06 Hours]

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

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

### Unit 2: Computer Arithmetic & Memory Organization [06 Hours]

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

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

**Unit 3: Control Unit & Input/ Output Organization: [06 Hours]**

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

**Unit 4: Introduction OS & Processes and CPU Scheduling: [06 Hours]**

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

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

**Unit 5: Process Synchronization & Deadlocks [06 Hours]**

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

**Unit 6: Memory Management & Virtual Memory: [06 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.
**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).

## Text Books

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

## Reference Books

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

**Semester –IV**

# Cryptography and Network Security

| BTSE405C | Cryptography and Network Security | PEC1 | 3L-0T-0P | 3 Credits |
|---|---|---|---|---|

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

**Prerequisites:** Concepts of Basics of Computer Networking

**Course Objectives:**

1. Describe how computer networks are organized with the concept of layered approach.
2. Describe how packets in the Internet are delivered.
3. Describe how routing protocols work.
4. Implement a simple LAN with hubs, bridges and switches.
5. Understand Cryptography & network security issues.

**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 | Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure. |
| CO3 | Analyze, specify and design Congestion control strategies for an IP based networking infrastructure. |
| CO4 | Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols. |
| CO5 | Have a basic knowledge of the use of cryptography and network security. |

**Course Contents:**

**Unit-I: Introduction** **[06 Hours]**

Computer Networking: Components of communication system, Date representation, Networking Hardware, Network topologies, Network software, LAN, MAN, WAN. Overview of network model: ISO-OSI and TCP/IP. Network design issues, layered architecture. Communication Networks: Switching Techniques, circuit switching, Routing for circuit switching network, Packet switching, comparison of Circuit and Packet switching.

**Unit II: Data Link Layer and Network Layer** **[06 Hours]**

Error detection and correction, Elementary data link protocols: A simplex stop and wait protocol, sliding window protocols. Network layer design issues, IPV4, IPV6, Routing algorithm, Congestion control algorithm, Quality of service.

**Unit III: Transport Layer and Application Layer** **[06 Hours]**

Connectionless verses connection oriented services, UDP, TCP, SCTP, congestion control, DNS, Electronic mail-Architecture, user Agent, SMTP, POP and IMAP, File Transfer Protocol, WWW, HTTP.

**Unit IV: Cryptography** **[06 Hours]**

Introduction, Cryptography components, Ancient Cryptography, Symmetric Key cryptography, Asymmetric Key cryptography: RSA and Diffie-Hellman, Applications

**Unit V: Network Security** **[06 Hours]**

Message confidentiality, message integrity, message Authentication, Digital signature-comparison, Need for keys, Key management, IPSecurity, SSL/TSL, PGP, firewalls.

**Unit VI: ISDN** **[06 Hours]**

ISDN overview, ISDN Interfaces and Functions, ISDN physical layer, ISDN Data Link Layer, ISDN Network Layer, ISDN services, Broadband ISDN

**Text Books :**

1. Andrew Tenenbaum, “Computer Networks”, 3rd and 4th Edition, Prentice Hall
2. Behrouz A. Forouzan, “Data Communication and Networking”, 4th Edition, McGraw Hill
3. Willam Stallings, “ISDN, Frame Relay, ATM”, Prentice Hall
4. Bansod, “Computer Networks”, Wiley Publication

**Reference Books :**

1. D.Comer, “ Computer Networks and Internet TCP/IP”
2. Willam Stallings, “Computer Networks”, Prentice Hall
3. Willam Stallings, “Data and Computer Communications”, 7th Edition Prentice Hall
4. Tularam M. Bansod, “Computer Networks”,Dreamtech

**Semester –IV**

# Programming in JAVA

| | | | | |
|---|---|---|---|---|
| **BTSE405D** | **Programming in JAVA** | **PEC1** | **3L-0T-0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam:20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

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

**Course Objectives:**

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

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

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | To understand basics of JAVA |
| CO2 | To use Packages & interfaces |
| CO3 | To apply Exception Handling & Multithreaded Programming |
| CO4 | To acquire Java Database Connectivity |
| CO5 | To recognize Applet, Event Handling and AWT |
| CO6 | To apply it for networking |

**Course Contents:**

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

Features of Java, Java Virtual Machine, Byte Code, JIT Compiler, Class fundamentals, Declaring objects, Nested and Inner Classes, Introducing Methods, Constructors, Garbage Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Access Control, Understanding static & final keyword, Inheritance Basics, Using Super, Method Overriding, Abstract Classes, Using final keyword with inheritance, Arrays, Vectors, Strings, Wrapper classes, Using Command-Line Arguments.

**Unit 2: Packages & interfaces** **[06 Hours]**

Packages: Defining a Package, Finding Packages and CLASSPATH, A Short Package Example, Access Protection, Importing Packages, Study of java.lang & java.util packages, Interfaces: Defining an Interface, Implementing Interfaces, Variables in Interfaces, Extending Interfaces, Multiple Inheritance.

**Unit 3: Exception Handling & Multithreaded Programming** **[06 Hours]**

Exception handling fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, creating your own exception subclasses, The Java Thread Model, The Main Thread, Creating a Thread , Creating Multiple Threads, Using isAlive( ) and join( ), Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads

**Unit 4: Java Database Connectivity** **[06 Hours]**

Introduction, Types of JDBC Drivers, Driver interface & DriverManager class, Connection Interface, Statement Interface, PreparedStatement , ResultSet, JDBC Program for executing Statements & processing ResultSet, Using PreparedStatement.

**Unit 5: Applet, Event Handling and AWT** **[06 Hours]**

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

**Unit 6: Input /Output & Networking** **[06 Hours]**

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

**Text / Reference Books:**

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

**Semester –IV**

# Data Analysis Lab

| | | | | |
|---|---|---|---|---|
| **BTSE 406** | **Data Analysis Lab** | **LC** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

## List of practicals:

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

**Semester –IV**

## Database Management System Lab

| | | | | |
|---|---|---|---|---|
| **BTSE 407** | **Database Management System Lab** | **LC** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

## List of practical:

1. Draw E-R diagram and convert entities and relationships to relation table for a college database.

2. Perform the following:

   a) Viewing all databases,
   b) Creating a Database,
   c) Viewing all Tables in a Database,
   d) Creating Tables (With and Without Constraints),
   e) Inserting/Updating/Deleting Records in a Table,

3. Perform the following:

   a) Altering a Table,
   b) Dropping/Truncating/Renaming Tables,
   c) Backing up / restoring a Database.

4. For a given set of relation schemes, create tables and perform the following-

   a) Simple Queries,
   b) Simple Queries with Aggregate functions,
   c) Queries with Aggregate functions (group by and having clause),

5. Perform queries with Date functions and String Functions

6. Perform queries with Math Functions, Join Queries- Inner Join, Outer Join and Subqueries- With IN clause, With EXISTS clause

7. Implement a columnar database using Apache Cassandra

8. Implement a document database with MongoDB

9. Design and Implement any 5 query using MongoDB

10. Write a case study for various types of NoSQL databases.

**Note:**

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

**Semester –IV**

# Image Processing & Computer Vision Lab

| | | | | |
|---|---|---|---|---|
| **BTSE 408** | **Image Processing & Computer Vision Lab** | **LC** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment 1: 30 Marks<br>Continuous Assessment 2: 30 Marks<br>End Semester Examination: 40 Marks |

**List of practical:**

1. Attributes of an Image
2. Import, Export and Conversion
3. Arithmetic, logical and statistical operations on image
4. Geometric Transformation (crop, resize, rotate, translate, etc.) on the image
5. Gray level transform (Intensity Transformation)
6. Histogram mapping & equalization, stretching
7. Image smoothing and sharpening.
8. Image Transformation (Frequency domain analysis)
9. Morphological operations
10. Image Segmentation.
11. Edge detection
12. Object Recognition

**Note:**

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

**Semester –IV**

## Project Based Learning (PBL) –I

| | | | | |
|---|---|---|---|---|
| **BTSE 409** | **Project Based Learning (PBL) –I** | **PROJ** | **0L-0T-2P** | **1 Credits** |

## Guidelines for Project Based Learning – I:

The project should enable the students to combine the theoretical and practical concepts studied in his / her academics. The project work should enable the students to exhibit their ability to work in a team, develop planning and execute skills and perform analyzing and trouble shooting of their respective problem chosen for the project. The students should be able to write technical Report, understand the importance of teamwork and group task.

The students will get knowledge about literature survey, problem definition, its solution, and method of calculation, trouble shooting, costing, application and scope for future development.

**Project work:**

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

**Project Activity:**

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

**Steps for Projects:**

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

**Note:** Project step may change depending on domain and project related to Artificial Intelligence and Data Science important, Understand Problem, Read the data and Preprocess and Implementation and Visualization and Results Includes and Important

**Semester –IV**

## Internship - II

| | | | |
|---|---|---|---|
| **BTSE 410** | **Field Training / Internship / Industrial Training** | **Internship** | **Audit** |

## Guidelines for Internships

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

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