
All the HODs are requested to inform and direct B. Tech. IV year students [R19-2020 Admitted] to perform selection of elective courses through EDUPRIME software as per the schedule given below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date &amp; Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of Open Elective – IV, Professional Elective – V &amp; VI courses of B.Tech. VIII semester by B.Tech. IV year students</td>
<td>19.10.2023 (16.00 p.m.) to 20.10.2023 (17.00 p.m.)</td>
</tr>
</tbody>
</table>

B. Tech. IV year students can perform this activity by logging to their respective login accounts in EDUPRIME software through the following address:

http://automation.vnrvjiet.ac.in/EduPrime3

You are also requested to inform the students to ENSURE THAT THEIR EDUPRIME ACCOUNTS ARE UNLOCKED & PASSWORD PROTECTED AND NOT TO DISCLOSE THEIR EDUPRIME ACCOUNT PASSWORDS TO ANYONE.

Detailed instruction sheet containing the guidelines for performing this activity and list of courses on offer in VIII semester is attached to this circular and shall be also available in the Institute website and student login account in EDUPRIME software.

Dr. Y. Shivraj Narayan  
Co-ordinator, Academics

Copy to:
- Principal for information
- CAMS
- All HODs – with a request to circulate among B.Tech. VII semester students and also to visit Institute Website for more information

Dr. K. Anuradha  
Dean, Academics
GUIDELINES FOR ELECTIVE COURSES

VNRVJiet B.TECH. R19 ACADEMIC REGULATIONS :: OPEN ELECTIVE COURSES

:: PLEASE READ THE INSTRUCTIONS CAREFULLY ::

1. All the students of B.Tech. programmes under B.Tech. R19 academic regulation are informed that there are a total of four Open-Elective (OE) courses to be studied by them one each in V, VI, VII and VIII semester.
2. A student needs to select and pursue one open-elective course of his/her choice in each semester.
3. These courses are designed and grouped as specialized tracks based on emerging technologies called as “Mezzanine Technologies”.
4. There are a total of 12 OE tracks based on Mezzanine Technologies in the curriculum i.e.,
   i) Smart Cities
   ii) Waste Management
   iii) Green Energy
   iv) 3D Printing & Design
   v) Internet of Things
   vi) Augmented Reality (AR) / Virtual Reality (VR)
   vii) Artificial Intelligence
   viii) Blockchain Technologies
   ix) Robotics
   x) Cyber Security
   xi) Data Sciences / Big Data & Analytics
   xii) Autonomous Vehicles
5. Each OE track based on a Mezzanine Technology shall have four courses, one placed in each semester i.e., one each in V, VI, VII and VIII semester respectively as shown below.

<table>
<thead>
<tr>
<th>Name of the OE Track</th>
<th>V semester</th>
<th>VI semester</th>
<th>VII semester</th>
<th>VIII semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 Course</td>
<td>Level 2 Course</td>
<td>Level 3 Course</td>
<td>Level 4 Course</td>
<td></td>
</tr>
</tbody>
</table>

In order to pursue a level 2 course, student is expected to complete level 1 course as the pre-requisite.

6. Apart from the above mentioned 12 OE tracks based on Mezzanine Technologies and the courses in it, there is a ‘General Pool’ of open-elective courses consisting of mixed and independent courses without any pre-requisites.
7. Courses to be offered from ‘General Pool’ in each semester shall be decided by the Institute well before the selection of elective courses by the students. Courses from the ‘General Pool’ may be offered multiple times depending upon the need.
8. A student before joining V semester may opt to study EITHER open-elective course that is based on a Mezzanine Technology track OR an open-elective course from General pool.
A student completing all the 4 open-elective courses (Level 1 to Level 4) from the chosen single Mezzanine Technology track successfully, as mentioned in the R18 Academic Regulation, shall be awarded a separate PROFICIENCY CERTIFICATE IN THAT SPECIALIZED TECHNOLOGY from the Institute.

Ex. B.Tech. (Mechanical Engineering) with Proficiency in “Internet of Things”

By default, an open-elective course from a specialized OE track selected by the student in V semester shall be his / her preferred OE track for the remaining 3 semesters. It shall be deemed that the student is willing to continue to study the remaining 3 OE courses (level 2, 3 & 4) from the same track in the subsequent semesters unless the student wishes to exit from the track and opt for another OE track or course from General pool. Those students who would like to go for change of OE track need to submit a request in writing to the Dean, Academic through HoD.

Students dropping out of the OE track may opt to choose and pursue a course either from the General pool OR from any other OE track subjected to the offering and availability of seats of that OE track/course in semester.

a) In the event of student selecting a course from other OE track for studying in VI or VII semester, it shall be the responsibility of the student to fulfill the eligibility conditions (pre-requisite courses) to pursue that course.

b) That is the student shall complete all the pre-requisite courses on his/her own through MOOC offered by SWAYAM-NPTEL (courses that are atleast 80% equivalent – as decided by the respective Chairman, BoS and Dean, Academic) prior to the start of semester in which the course is to be studied.

c) Student shall produce a documentary evidence in support of this claim to the Dean, Academic to become eligible for taking the course. In case of the pre-requisite course not on offer in the MOOC platforms, the fulfillment of pre-requisite courses shall be decided through a Diagnostic test conducted by the parent department offering the course. A student completing the diagnostic test successfully shall be deemed to have met the pre-requisite courses criteria and shall be allowed to change the OE track depending upon offering and availability of seats in that track.

Changing of an OE track by a student shall be allowed for pursuing OE courses of VI and VII semesters only i.e., a student shall be allowed to change the OE track only twice i.e., before the start of VI and VII semesters in the four semester span. However, this condition shall not be applicable to the students opting for pursuing courses from General pool.

In the event of a STUDENT COMING OUT OF THE ALREADY CHOSEN OE track in any semester, due to any reason whatsoever, shall FORFEIT THE CLAIM ON THE PROFICIENCY CERTIFICATE.

Open-elective courses offered in General pool may be appended with more number of courses as and when required at the discretion of the Institute and shall be informed well before the selection of electives by the students.

It is informed that only a limited number of elective courses shall be offered for selection at the discretion of the offering department and Institute which shall be announced well before the start of the next semester.

The list of OE courses under each of the specialized OE tracks is given in next section. For more details please refer to the Institute.
OE TRACKS BASED ON MEZZANINE TECHNOLOGIES:

<table>
<thead>
<tr>
<th>OE TRACKS (Parent Department)</th>
<th>V SEMESTER</th>
<th>VI SEMESTER</th>
<th>VII SEMESTER</th>
<th>VIII SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Cities (CE)</td>
<td>Smart Cities Planning and Development</td>
<td>Green Building Technology</td>
<td>Smart Materials and Structures</td>
<td>Intelligent Transportation System</td>
</tr>
<tr>
<td>3D Printing &amp; Design (ME)</td>
<td>Elements of CAD</td>
<td>Introduction to 3D Printing</td>
<td>3D Printing - Machines, Tooling &amp; Systems</td>
<td>Reverse Engineering</td>
</tr>
<tr>
<td>Internet of Things (ECE)</td>
<td>Sensors Transducers and Actuators</td>
<td>Introduction to Microcontrollers and Interfacing</td>
<td>Fundamentals of Internet of Things</td>
<td>Wireless Sensor Networks</td>
</tr>
<tr>
<td>Augmented Reality (AR) / Virtual Reality (VR) (ECE)</td>
<td>Introduction to C Sharp</td>
<td>Introduction to Signal Processing</td>
<td>Introduction to Image &amp; Video Processing</td>
<td>Fundamentals of Augmented Reality &amp; Virtual Reality</td>
</tr>
<tr>
<td>Robotics (EIE)</td>
<td>Fundamentals of Robotics</td>
<td>Kinematics and Dynamics of Robots</td>
<td>Drives and Control System for Robotics</td>
<td>Robot Programming and Intelligent Control Systems</td>
</tr>
<tr>
<td>Data Sciences / Big Data &amp; Analytics (IT)</td>
<td>Statistical Methods for Data Science</td>
<td>Computational Thinking using Python</td>
<td>Fundamentals of Data Mining</td>
<td>Data Analysis and Visualization</td>
</tr>
</tbody>
</table>
## GENERAL POOL OF OE COURSES:

| General-Computing (CSE / IT) | • Programming through Java  
| • Relational Data Base Management Systems  
| • Computational Thinking using Python  
| • Introduction to Data Analytics  
| • Fundamentals of Computer Algorithms |
| General (H&S) | • Professional Ethics & Human Values  
| • Entrepreneurship  
| • Personality Development & Public Speaking  
| • Foreign Language (French / German / Spanish) |
| General | • Smart Cities  
| • Trends in Energy Sources for Sustainable Development  
| • 3D Printing and Design  
| • Embedded Systems for IoT  
| • Artificial Intelligence - A Beginner's Guide  
| • Blockchain Technology Essentials  
| • Fundamentals of Robotics and Drones  
| • Fundamentals of Cyber Security  
| • Fundamentals of Data Science  
| • Introduction to Advanced Vehicle Technologies  
| • Introduction to Application Development with C#  
| • Introduction to Application Development with Java  
| • Introduction to Application Development with Python |

### NOTE:

(i) Students belonging to Parent Department shall not be able to select the OE tracks/courses offered by the Parent Department.

(ii) Students are **NOT ALLOWED TO REPEAT COURSES** to be pursued through ‘Open Elective’ and ‘Professional Elective’ tracks.

(iii) In case of a student selecting similar course in both open elective or professional elective track, selection of SUCH COURSE SHALL BE TREATED AS NULL SELECTION. Student shall then be allotted course based on the available courses. Similarity of the course shall be defined by the respective Chairman, Board of Studies.

(iv) Courses that are offered under H&S department shall be available for selection to students of all the departments subjected to their offering by the H&S department.

**DECISION OF THE INSTITUTE IN OFFERING THE OE COURSES SHALL BE FINAL AND ABIDING.**

Dean, Academic

Principal
NOTE:
STUDENTS MUST PROTECT THEIR LOGIN ACCOUNTS BY CHANGING THE ACCOUNT PASSWORDS (UNIQUE) AND NOT TO DISCLOSE IT TO ANYONE.

Students must note that the elective course selection is based on ‘FIRST-COME FIRST-SERVE’ basis.

1. Students are advised to go through the syllabus of the open elective and professional elective courses available in the Institute website before selecting the elective course.
2. Students must login to their account by entering ‘Username’ and ‘Password’ in Eduprime Software through the following link: https://automation.vnrvjiet.ac.in/EduPrime3
3. Click on ‘Student’ in the left panel followed by ‘Student Elective’. Screen titled ‘Elective Course Management’ containing Elective course groups would appear. Click on the edit button on the left of elective course group name.
4. Pop-up containing detailed instructions would appear. Read the instructions carefully and then click on ‘Proceed’.
5. A screen containing the list of either open elective courses or professional elective courses depending upon the elective group selected will be displayed. This screen consist of 6 columns.
• First column indicates the **names of courses on offer**.
• Second column indicates the **maximum number of seats in each course**.
• Third column indicates the **number of seats already allotted** to the students.
• Fourth column indicates the **number of seats now available**.
• Fifth column provides the option of **selecting your preferred course**. Students are advised that the elective course which they would like to study must be selected by selecting in this column. 
• Sixth and last column indicates the **status of course** selected.

6. Status of course: There are 3 statuses for an elective course.

   i) **Course not yet confirmed**: It means the **number of students selecting an elective course is less than 20 hence the course will not be run during the semester**. Such students will have to choose another elective course.

   ii) **Course is confirmed**: It means the **number of students selecting an elective course is equal to or more than 20 hence the course will be run during the semester**.

   iii) **Seats are not available**: It means the **maximum number of seats defined for an elective course are exhausted or over**. Students will not be able to choose such courses and shall select another course of their choice.
7. Students who want to pursue an OE Course based on Open Elective Track in VII semester shall be able to see the following screen consisting of Level-3 course defined in VII semester. After selection of the displayed open elective course, press Save.

8. A message regarding confirmation of selection would appear on screen. Press OK.

9. Click on Freeze button for course confirmation.

10. A message regarding confirmation of selection would appear on screen, then press OK.
11. Upon pressing ‘Close’ button displayed on the screen, student would be taken back to the first screen wherein against the open elective group name, title of the open elective course selected by the student would be shown along with the status of course.

12. Students who want to pursue an OE Course from General Pool in VIII semester shall be able to see the screen consisting of General Pool Courses offered in VIII semester as shown below. After selection of an open elective course of your choice, press Save.

13. A message regarding confirmation of selection would appear on screen. If the student is satisfied with his / her choice, press OK, otherwise press Cancel and make selection of another open elective course.
14. If the student is satisfied with the selected open elective course then click on **Freeze** button for course confirmation.

15. A message regarding confirmation of selection would appear on screen. If the student is satisfied with his / her choice, press **OK**, otherwise press **Cancel** and make selection of another open elective course.

16. Upon pressing ‘**Close**’ button displayed on the screen, student would be taken back to the first screen wherein against the open elective group name, title of the elective course selected by the student would be shown along with the status of course.
17. In the screen titled ‘Elective Course Management’ containing Open Elective and Professional Elective course group, click on the edit button on the left of Professional Elective course group name.

18. Pop-up containing detailed instructions would appear. Read the instructions carefully and then click on ‘Proceed’.

19. A screen containing the list of Professional Elective courses will be displayed.

20. After selection of professional elective course of your choice, press Save.

21. A message regarding confirmation of selection would appear on screen. If the student is satisfied with his / her choice, press OK, otherwise press Cancel and make selection of another professional elective course.
22. If the student is satisfied with the selected professional elective course then click on **Freeze** button for course confirmation.

23. A message regarding confirmation of selection would appear on screen. If the student is satisfied with his / her choice, press **OK**, otherwise press **Cancel** and make selection of another professional elective course.

24. Upon pressing ‘**Close**’ button displayed on the screen, student would be taken back to the first screen wherein against the Professional Elective group name, title of the elective course selected by the student would be shown along with the status of course.
NOTE:
(i) FOR AN ELECTIVE COURSE TO BE ALLOTTED, IT IS COMPULSORY TO SAVE THE SELECTED COURSE BY PRESSING ‘SAVE’ AND FOLLOWED BY FREEZING THE CHOICE BY PRESSING ‘FREEZE’.
(ii) STUDENT WILL NOT BE ABLE TO CHANGE HIS / HER SELECTION OF COURSE(S) UPON PRESSING ‘FREEZE’ BUTTON.
IF THE COURSE IS NOT FREEZED, THEN THAT COURSE SHALL NOT BE ALLOTTED.

25. A student can change his/her selection of Professional Elective course / Open Elective General Pool course any number of times during the time the elective selection window is open, provided the student has not freezed his course. Note that if the preferred elective course is already FREEZED through ‘FREEZE’ button, then student will not be able to change his/her selection of course.

26. As the elective course selection is dynamic in nature, status of course may change at any point of time depending upon selection of elective courses by the students. Hence, STUDENTS ARE ADVISED TO CHECK THE STATUS OF THE ELECTIVE COURSE SELECTED BY THEM ON THE CLOSING DATE OF ELECTIVE SELECTION WINDOW.

27. If the status changes from ‘confirmed’ to ‘not confirmed’, student may opt for another elective course of his/her choice on the last date.

28. If a student does not perform this activity during the elective selection window, then the student shall be allotted an elective course by the concerned HoD. For such students, a message regarding non-selection of elective course shall be displayed in the student login dashboard.

29. A student may select / change his / her Professional Elective course / Open Elective General Pool course (only if not freezed) upto the closing date of the window.

30. ONLINE SELECTION OF PROFESSIONAL ELECTIVE COURSE IN EDUPRIME SOFTWARE BY A STUDENT WHO HAS OPTED FOR PURSUING PROFESSIONAL ELECTIVE COURSE THROUGH NPTEL-SWAYAM PLATFORM SHALL NOT BE CONSIDERED.

**DO NOT FORGET TO PRESS ‘SAVE’ & ‘FREEZE’ BUTTONS UPON FINALIZED SELECTION OF ELECTIVE COURSES**
<table>
<thead>
<tr>
<th>OE Track</th>
<th>Name of the Open Elective – IV Course &amp; Offering Department</th>
<th>Course code</th>
<th>Number of Sections to be offered in 2023-2024</th>
<th>Maximum Seats available for selection</th>
<th>Courses available to B.Tech.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Cities</td>
<td>INTELLIGENT TRANSPORTATION SYSTEM (CE)</td>
<td>19OE1CE04</td>
<td>1</td>
<td>80</td>
<td>EEE, ME, ECE, CSE, EIE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
</tr>
<tr>
<td>Waste Management</td>
<td>INTELLIGENT WASTE MANAGEMENT AND RECYCLING SYSTEM (CE)</td>
<td>19OE1CE08</td>
<td>1</td>
<td>159</td>
<td>EEE, ME, ECE, CSE, EIE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
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<tr>
<td>Green Energy</td>
<td>ENERGY MANAGEMENT AND CONSERVATION (EEE)</td>
<td>19OE1EE04</td>
<td>2</td>
<td>159</td>
<td>CE, ME, ECE, CSE, EIE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
</tr>
<tr>
<td>3D Printing &amp; Design</td>
<td>REVERSE ENGINEERING (ME)</td>
<td>19OE1ME04</td>
<td>2</td>
<td>100</td>
<td>CE, EEE, ECE, CSE, EIE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
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<tr>
<td>Internet of Things</td>
<td>WIRELESS SENSOR NETWORKS (ECE)</td>
<td>19OE1EC08</td>
<td>1</td>
<td>67</td>
<td>CE, EEE, ME, AE</td>
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<tr>
<td>Artificial Intelligence</td>
<td>DEEP LEARNING (CSE)</td>
<td>19OE1CS03</td>
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<td>CE, EEE, ME, ECE, EIE, AE</td>
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<td>Blockchain Technologies</td>
<td>Blockchain Technology (CSE)</td>
<td>19OE1CS07</td>
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<tr>
<td>Robotics</td>
<td>ROBOT PROGRAMMING AND INTELLIGENT CONTROL SYSTEMS (EIE)</td>
<td>19OE1EI04</td>
<td>1</td>
<td>73</td>
<td>CE, EEE, ME, ECE, CSE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
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<tr>
<td>Cyber Security</td>
<td>Computer Forensics (IT)</td>
<td>19OE1IT02</td>
<td>2</td>
<td>102</td>
<td>CE, EEE, ME, ECE, EIE, AE</td>
</tr>
<tr>
<td>Data Sciences/Big Data Analytics</td>
<td>DATA ANALYSIS AND VISUALIZATION (IT)</td>
<td>19OE1IT05</td>
<td>1</td>
<td>80</td>
<td>CE, EEE, ME, ECE, EIE, AE</td>
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<tr>
<td>Autonomous Vehicles</td>
<td>CONNECTED AND AUTONOMOUS VEHICLES (AE)</td>
<td>19OE1AE04</td>
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<td>46</td>
<td>CE, EEE, ME, ECE, CSE, EIE, IT, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
</tr>
<tr>
<td>OE Track</td>
<td>Name of the Open Elective – IV Course &amp; Offering Department</td>
<td>Course code</td>
<td>Number of Sections to be offered in 2023-2024</td>
<td>Maximum Seats available for selection</td>
<td>Courses available to B.Tech.</td>
</tr>
<tr>
<td>-------------------------</td>
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<tr>
<td>General-Computing</td>
<td>Introduction to Data Analytics (CSE/IT)</td>
<td>19OE1IT03</td>
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<td>FOREIGN LANGUAGE-FRENCH (H&amp;S)</td>
<td>19OE1HS04</td>
<td>1</td>
<td>80</td>
<td>CE, EEE, ME, ECE, CSE, IT, EIE, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
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<tr>
<td></td>
<td>SMART CITIES (CE)</td>
<td>19OE1CE09</td>
<td>1</td>
<td>80</td>
<td>EEE, ME, ECE, CSE, IT, EIE, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
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<td></td>
<td>TRENDS IN ENERGY SOURCES FOR SUSTAINABLE DEVELOPMENT (EEE)</td>
<td>19OE1EE05</td>
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<td>80</td>
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<tr>
<td></td>
<td>3D PRINTING AND DESIGN (ME)</td>
<td>19OE1ME05</td>
<td>2</td>
<td>160</td>
<td>CE, EEE, ECE, CSE, EIE, IT, AE, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
</tr>
<tr>
<td></td>
<td>EMBEDDED SYSTEMS FOR IOT (ECE)</td>
<td>19OE1EC09</td>
<td>1</td>
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<tr>
<td></td>
<td>ARTIFICIAL INTELLIGENCE - A BEGINNER’S GUIDE (CSE)</td>
<td>19OE1CS09</td>
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<td>CE, EEE, ME, ECE, EIE, AE</td>
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<td></td>
<td>Blockchain Essentials (CSE)</td>
<td>19OE1CS10</td>
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<td></td>
<td>FUNDAMENTALS OF ROBOTICS AND DRONES (EIE)</td>
<td>19OE1E05</td>
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<tr>
<td></td>
<td>FUNDAMENTALS OF CYBER SECURITY (IT)</td>
<td>19OE1IT08</td>
<td>1</td>
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<td>CE, EEE, ME, ECE, EIE, AE</td>
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<tr>
<td></td>
<td>FUNDAMENTALS OF DATA SCIENCE (IT)</td>
<td>19OE1IT09</td>
<td>1</td>
<td>80</td>
<td>CE, EEE, ME, ECE, EIE, AE</td>
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<tr>
<td></td>
<td>INTRODUCTION TO ADVANCED VEHICLE TECHNOLOGIES (AE)</td>
<td>19OE1AE05</td>
<td>1</td>
<td>80</td>
<td>CE, EEE, ME, ECE, CSE, IT, EIE, IT, CSE(AIML), CSE(CYS), CSE(DS), CSE(IOT)</td>
</tr>
</tbody>
</table>

Maximum strength of each section in an elective course shall be 80.

Minimum strength required for running an elective course shall be 20.
CIVIL ENGINEERING

R19 - B.TECH. VIII SEM - PROFESSIONAL ELECTIVE – V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Elective Group</th>
<th>Name of the Professional Elective</th>
<th>Course Code</th>
<th>Number of Sections to be offered in 2023-2024</th>
<th>Maximum Seats available for selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elective – V</td>
<td>Pavement Analysis Design and Evaluation</td>
<td>19PE1CE21</td>
<td>2</td>
<td>160</td>
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<tr>
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<td>Urban Transport Planning</td>
<td>19PE1CE22</td>
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<td>Elective – VI</td>
<td>Pre-Stressed Concrete</td>
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<td>2</td>
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<td>Pre-Engineered Buildings</td>
<td>19PE1CE29</td>
<td>2</td>
<td>160</td>
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</tbody>
</table>

Maximum strength of each section in an elective course shall be 80.

Minimum strength required for running an elective course shall be 20.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Elective Group</th>
<th>Name of the Professional Elective</th>
<th>Course Code</th>
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<th>Maximum Seats available for selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elective – V</td>
<td>HVDC Transmission</td>
<td>19PE1EE13</td>
<td>2</td>
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<tr>
<td>1</td>
<td>Elective – VI</td>
<td>Energy Auditing and Conservation</td>
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Maximum strength of each section in an elective course shall be 80.

Minimum strength required for running an elective course shall be 20.
MECHANICAL ENGINEERING

R19 - B.TECH. VIII SEM - PROFESSIONAL ELECTIVE – V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)

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### COMPUTER SCIENCE AND ENGINEERING


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# ELECTRONICS & INSTRUMENTATION ENGINEERING

R19 - B.TECH. VIII SEM - **PROFESSIONAL ELECTIVE – V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)**

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### INFORMATION TECHNOLOGY


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CSE (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

R19 - IV B.TECH. II SEM - PROFESSIONAL ELECTIVE-V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)

<table>
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### CSE (CYBER SECURITY)

**R19 - IV B.TECH. II SEM - PROFESSIONAL ELECTIVE-V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)**

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Minimum strength required for running an elective course shall be 20.
### CSE (DATA SCIENCE)

**R19 - IV B.TECH. II SEM - PROFESSIONAL ELECTIVE-V & VI COURSES AVAILABLE FOR SELECTION (A.Y. 2023 – 2024)**

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Maximum strength of each section in an elective course shall be 80.

Minimum strength required for running an elective course shall be 20.
CSE (IOT)

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Maximum strength of each section in an elective course shall be 80.

Minimum strength required for running an elective course shall be 20.
VNR VIGNANA JYothi institute of Engineering & Technology
An Autonomous, ISO 9001:2015 & QS 1-Gauge Diamond Rated Institute, Accredited by NAAC with ‘A++’ Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT, AE Programmes and M.Tech. STRE, PE, AMS, SWE Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH,
NIRF 113th Rank in Engineering Category
Recognized as “College with Potential for Excellence” by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O),
Hyderabad – 500 090, Telangana, India
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❖ OPEN ELECTIVE TRACKS – MEZZANINE TECHNOLOGIES

❖ GENERAL POOL OF OPEN ELECTIVE COURSES

❖ SYLLABI OF VIII SEMESTER OPEN ELECTIVE COURSES
**Offered by:**

**CIVIL ENGINEERING**

**Courses in the OE Track:**

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<th>OE Tracks</th>
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<tbody>
<tr>
<td>Smart Cities</td>
<td>Smart Cities Planning and Development</td>
<td>Green Building Technology</td>
<td>Smart Materials and Structures</td>
<td>Intelligent Transportation System</td>
</tr>
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</table>
OE TRACK :: SMART CITIES

In the twenty-first century, engineers are being tasked with solving ever more complex and subtle societal challenges – from climate change to unprecedented urbanisation that is materially affecting the lives of many urban populations. As engineers become ever more interdisciplinary and the boundaries of disciplines soften, they need to reflect as a community as to the appropriateness of the engineering paradigm to address these needs. Currently the engineering community is pointing to the digital technologies and the ‘smart city’ as a deliverer of efficiency and resilience without fully acknowledging the intricate socio-political context in which it is situated.

The domain of EIE was developed to modernise and automate these operations using the technological advancements in the realm of electronics. Even outside the industry, common household appliances — such as washing machine, air-conditioner, geyser, and microwave oven — cannot attract customers without features such as auto cut-off after certain time or temperature, which is again an example of instrumentation. The field of Instrumentation Engineering is also core to the recent advances such as smart home appliances, smart cities and automobiles. It is thus not far from the truth to claim that the fourth industrial revolution.

The world population is continuously growing and reached a significant evolution of the society, where the number of people living in cities surpassed the number of people in rural areas. This puts national and local governments under pressure because the limited resources, such as water, electricity, and transports, must thus be optimized to cover the needs of the citizens. Therefore, different tools, from sensors to processes, service, and artificial intelligence, are used to coordinate the usage of infrastructures and assets of the cities to build the so-called smart cities.

Different definitions and theoretical models of smart cities are given in literature. However, smart city can usually be modelled by a layered architecture, where communication and networking layer plays a central role. In fact, smart city applications lay on collecting field data from different infrastructures and assets, processing these data, taking some intelligent control actions, and sharing information in a secure way. Thus, a two-way reliable communications layer is the basis of smart cities. This chapter introduces the basic concepts of this field and focuses on the role of communication technologies in smart cities. Potential technologies for smart cities are discussed, especially the recent wireless technologies adapted to smart city requirements.

What is the concept of a smart city?

There is no universally accepted definition for a smart city because people can interpret different meanings for it. Hence, it means different things to different people. Here, you will get a basic definition that captures the essence of what a smart city is and what it does. While the concept varies from area to area depending on the resources, the basic idea behind it remains the same. A smart city aims to bring various components together to live harmoniously and attempts to do with the least environmental damage or impact. In other words, a smart city is a place with high standards of living, which survives and thrives on eco-friendly means. The size and
amenities within a smart city vary according to geography, resources available, geopolitical scenario and investment received.

Growth in Global population continues to drive citizens from rural areas to cities. With rapid expansion of urban areas, cities need to become intelligent to handle this large scale urbanization. This is driving city operators to look at smarter ways to manage complexities, increase efficiencies and improve quality of life. Today we need cities that monitor& integrate infrastructure to better optimize resources while maximizing service to its citizens. So to meet all the needs we need our cities to be smarter which brings a concept "Smart cities" Smart cities optimize the use of technology in the design & operation of infrastructure and buildings in such a way which meets the current and future needs of their citizens. To be truly smart they also require consideration of governance &growth, urban development and infrastructure, the environment & natural resources, society and community.

Smart city programs provide a range of technologies that can be applied to solve infrastructure problems associated with ageing infrastructure and increasing demands. The potential for infrastructure and urban improvement remains unrealized, however, due to technical, financial, and social constraints and criticisms that limit the implementation of smart cities concepts for infrastructure management. The discussion presented here provides a review of smart technologies including sensors, crowdsourcing and citizen science, actuators, data transmission, Internet of Things, big data analytics, data visualization, and blockchain, which can be used for infrastructure management. Smart infrastructure programs are reviewed to explore how enabling technologies have been applied across civil engineering domains, including transportation systems, water systems, air quality, energy infrastructure, solid waste management, construction engineering and management, structures, and geotechnical systems.

Making cities “smarter” by efficient management of resources and infrastructure, greener environment, and smart governance resulting in a better quality of living of its citizens. This can be enabled by the effective use of information and communication technologies (ICTs) tools, which have the ability to provide eco-friendly and economically viable solutions for cities.

Setting up a smart city is more than improving the old system with technology by simply adding sensors, remote supervision, and control to essential city services. It should be a complete shift of a paradigm in daily life when using new technologies, especially new ICT leading to smart outcomes.

**Smart solutions**

Another important feature of smart cities is that they will provide smart solutions to modern problems. These include:
- Public information systems
- Redressal of grievances
- Electronic service delivery
- Maximum engagement of citizens
- Reduced energy and fuel usage
- Reduces the development of wastes
- Smart water monitoring
- Treatment of wastewater
- Sustainable monitoring water quality
- Maximum utilization of renewable energy sources
- Usage of green building techniques
- Smart parking to reduce clutter
- Intelligent traffic management system.

**Advantages of a smart cities:**

1. Promotion of mixed land usage resulting in higher efficiency and reduced wastage of land.
2. Expanded housing opportunities.
3. Reduced congestion, air pollution and resource depletion.
4. Helps to boost local economies by promoting localized trade and interactions.
5. Efficient use of public transport to reduce fuel wastage.
6. Safe and secure localities.
8. Reduction in urban heating.

Here’s a look at some projects that have taken inspiration from the concepts used for the design of smart cities. These projects will help you build energy-efficient systems that will help heal the world.

1. **Home Automation using IoT**
2. **Smart Irrigation System**
3. **Smart Building using IoT**
4. **Smart Energy Meter using GSM**
5. **Solar and Smart Energy Systems**
6. **Smart Water Monitoring**
7. **Automated Street Lighting**
8. **Automated Railway Crossing**
9. **Intelligent Transportation Systems**
10. **Smart Sewage Maintenance Systems.**

To develop new smart cities and to transform our cities into smart cities the engineers in particular are stepping up as leaders.

**Civil & Environmental Engineers** are working to harness the potential of latest technologies and data for our urban infrastructure, which is among the most complex system in the world. They provide sustainable, resilient and advanced means of
transportation system, green building, better water management system and better waste management system. This not only develop physical infrastructure but also develop institutional & social infrastructure that enable our societies to function. Modelling these systems of systems will require managing data at an unprecedented scale.

To support them Computer and Electronics & Communication Engineers help in creating future cities that are digital, build and operate cities ICT landscape across application and infrastructure like IOT (Internet of Things), e-payment, e-market, the latest communication devices etc which is leveraging next generation technologies. They create a platform for conveyance of different city services, leverage big data analytics to manage city performance and proactive crisis management.

**Electrical Engineers** developing new renewable source of energy to meet ever increasing power demands. They also develop methods of effective power transmission with minimum losses which is more economical and safer. They also work on developing microchips to micro sensors which are helping in making our households, institution efficient and safer.

**Conclusion:**

By going through above article, it is clear that Dreaming of a smart city without active contribution of engineers is a myth. So, there will always be demand of Engineers and because of which even after crises in the placement scenario still the maximum science students choose Engineering as their first career choice in hope of a better future.
COURSE PRE-REQUISITES: Smart Cities Planning and Development, Green Building Technology, Smart Materials and Structures

COURSE OBJECTIVES:
- To understand ITS architecture and standards
- To apply appropriate ITS technology depending upon site specific conditions
- To design and implement ITS components
- To understand concept and application of Automated Highway Systems

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Differentiate different ITS user Services
CO-2: Apply ITS for road user safety
CO-3: Interpret importance of AHS in ITS
CO-4: Extend future research and special project

UNIT – I:

UNIT – II:

UNIT – III:

UNIT – IV:

UNIT – V:
UNIT – VI:
Implementation of ITS: ITS programs globally- overview of ITS in developed countries and developing countries – ITS at Toll Plazas – Parking lots – Highways.

TEXT BOOKS:
1. Intelligent Transport Systems Handbook 2000: Recommendations for World Road Association (PIARC), Kan Paul Chen, John Miles
2. Intelligent Transport Systems – Cases and Policies, Roger R. Stough, Publisher: Edward Elgar, 2001

REFERENCES:
Offered by: CIVIL ENGINEERING

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</table>
OE TRACK :: WASTE MANAGEMENT

The courses such as solid waste management (SWM), hazardous waste management (HWM), waste to energy (WTE) and intelligent waste management and recycling system (IWM&RS) are the courses available in the waste management track stream which having a potential syllabus content to meet out the industrial and research needs. Solid waste management is an interesting track course which actual highlights the day-to-day problems where everybody is facing due to the improper management of industrial, domestic and household waste. Further, the enthusiastic aspects involved in the track courses such as: awareness on its impact over on environment, formal or scientific way of handling and management of waste and disposal scenarios.

In hazardous waste management course, handling and management of nuclear waste at national and international level have been highlighted. Further, the content enlightens about the legal process of state, central and industrial responses toward any emergency situations arise by hazardous waste. Finally, it deals about natural resource damage assessment and restoration.

Waste to energy is a pioneering course available in the track; it is one of the interesting and mindboggling course in the track which highlights the importance of converting the waste materials into wealth. It gives enough space to understand the basic process technologies in a theoretical and industrial way such as: thermal, chemical and biological conversion process. From the above, biological conversion process is in its embryonic state and having potential to expands its technological wings in the near future and having enormous scope of industrial applications where students can be benefited. Finally, conversion devices is an innovative module have been framed to explore the young minds in the line of designing and creating a demand based conversion device products which even lays an entrepreneurial pathway to them.

First of its kind, even at both international and national level a dedicated and extensive course for intelligent waste management and recycling system have been framed with conventional and advanced modules. It is really an interesting course where a student can apply his/her innovative creations to solve the existing and futuristic problems in a smart way with the help of smart tools. Optimistic modules such as: life cycle assessment and carbon- footprint-based IWMS, principles of systems engineering and regulatory frameworks have been incorporated to meet out the international requirements.

In the pathway of exploring the fundamentals and basic knowledges about the course, the six units of all the courses have been formulated keeping in the mind that the students can be able to competitive among the international community at the end of semester. In this context, comprehensive theoretical and industrial processes have been incorporated in each and every module of courses. Further, it is highly believed that the framed syllabus modules having 100% industrial applications which can make the students to feel motivated, satisfied and confidence to compete with the international community.
COURSE PRE-REQUISITES: Solid Waste Management, Hazardous Waste Management, Waste to Energy

COURSE OBJECTIVES:
- Understand the concepts of Solid waste
- Understand the principle and process of IWMS Tools
- Understand the applications of IoT, ML, DL, BC and LCA & Carbon Foot Print (CFP) based SWM
- Understand the principles of Process Systems Engineering (PSE) and various laws and regulation of SWM

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply the fundamental concepts of Solid waste
CO-2: Apply the knowledge to resolve the practical problems with the help of IWMS Tools
CO-3: Apply the knowledge of IoT, ML, DL, BC and LCA & CFP to resolve the practical problems in SWM
CO-4: Impart the PSE knowledge and various laws and regulation to resolve the practical problems in SWM

UNIT – I:

UNIT – II:

UNIT – III:
UNIT – IV:

UNIT – V:

UNIT – VI:
**Regulatory Frameworks:** Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics waste, bio-medical waste, construction and demolition waste and fly ash waste.

**TEXT BOOKS:**

**REFERENCES:**
2. Smart Waste Management- Nutshell, Vishal Gupta, Amazon.com Services LLC, September 11, 2017
3. Recyclable Household Waste Management System for Smart Home in IOT, Manpreet Kaur & Dr. Kamaljit Singh Saini, Independently Published, June 12, 2018
Offered by: ELECTRICAL AND ELECTRONICS ENGINEERING

Courses in the OE Track:

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</table>
OE TRACK :: GREEN ENERGY

RENEWABLE ENERGY SOURCES:

What we are studying?
The climate landscape is changing rapidly, and new technologies and solutions keep arising to respond to global and local challenges.
Renewable energy sources course makes you discover how Solar Thermal Energy conversion system works. It makes you understand how a Solar Photo voltaic generation system generates electricity. Scope of the course also includes wind energy generation. It also navigates you through Biomass and geo thermal energy generation systems.

Job opportunities:
When it comes to the hottest and most buzzing careers in the 21st century, the majority of people think of hardcore technical domains such as data science, machine learning & artificial intelligence. Few people might also come up with biotechnology (or biosciences). But, quite often people forget about one of the dark horses – the Renewable Energy sector. Even Bill Gates lobbied for the Energy sector as one of the top three career choices for making an impactful career.

RENEWABLE ENERGY TECHNOLOGIES:
Within crisis there are seeds of opportunity..! We are at the wedge of fossil fuel end. After few years you can witness fuel crisis all over the world, as an engineer one must aware of the solution. To design sustainable systems those last for decades, one must use renewable energy as main or auxiliary source of energy. The application may be electrical or mechanical or chemical, one must convert energy from renewable source into electricity for ease of use.
Renewable Energy Technologies course will introduce you to Different types of Solar PV systems and their characteristics. Students will know the functionality of Power Converters such as Inverters etc., through block diagram approach. Fuel cell technology, which is one of the solutions for energy crisis will be discussed in detail. Course will conclude by discussing impact of PV panel production on environment and disposal of it.

Job Opportunities:
Green jobs in the renewable energy sector are expected to touch new figures with 6 digit monthly income. Following link may describe the interesting interdisciplinary careers for budding engineers.

ENERGY STORAGE TECHNOLOGIES
Battery technology is an essential skill for every engineer in present scenario. Course on energy storage technologies will enable student to, Design storage system Residential loads integrated to Renewable and storage systems for Electric Vehicles. It will make student to understand various electrochemical storages such as Lead
acid, Li ion cell etc. and their characteristics. The course enables student to compare non electric, electric storage systems and analyze application of them to various domains.

**Job opportunities:**
Upon successful completion of course student will enhance the chances of getting into EV industry, which almost open fact. Job Profiles include

i. Battery algorithms engineer
ii. Battery management engineer
iii. Battery modeling expert
iv. Design engineer – EV

**ENERGY MANAGEMENT AND CONSERVATION**

Energy Management And Conservation course is mainly intended to monitor Energy consumption of industries and to manage energy systems. This course also deals with methods of improving efficiency of electric machinery and to design a good illumination system. It also teaches student calculate pay back periods for energy saving equipment.
(Open Elective - IV)


COURSE OBJECTIVES:
- To understand the necessity of conservation of Energy
- To Know the methods of Energy management
- To identify the factors to increase the efficiency of electrical equipment
- To know the benefits of carrying out energy Audits

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: To conduct Energy Audit of industries
CO-2: To manage energy Systems
CO-3: To specify the methods of improving efficiency of electric motor
CO-4: To improve power factor and to design a good illumination system
CO-5: To calculate pay back periods for energy saving equipment

UNIT – I:
Basic Principles of Energy Audit: Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit

UNIT – II:
Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manager, Qualities and functions, language, Questionnaire - check list for top management

UNIT – III:
Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

UNIT – IV:

UNIT – V:
Lighting Energy Audit and Energy Instruments: Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, flux meters, tongue testers, application of PLC’s
UNIT – IV:
Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis.

UNIT – VI:

TEXT BOOKS:

REFERENCES:
3D PRINTING AND DESIGN

Offered by: MECHANICAL ENGINEERING

Courses in the OE Track:

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<tr>
<td>3D Printing and Design</td>
<td>Elements of CAD</td>
<td>Introduction to 3D Printing</td>
<td>3D Printing - Machines, Tooling &amp; Systems</td>
<td>Reverse Engineering</td>
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</table>
OE TRACK :: 3D PRINTING AND DESIGN

3D Printing is a process for making a physical object from a three-dimensional digital model by laying down many successive thin layers of a material. It brings a digital CAD model into its physical form by adding layer by layer of materials. Thus called ‘Additive Manufacturing’. It is the opposite of subtractive manufacturing i.e., removing material from an object using a mechanical machine. It enables to produce complex shapes using less material than traditional manufacturing methods. There are several different techniques to 3D print an object. It saves time through prototyping and is also responsible for manufacturing impossible shapes. Due to these, it has many applications in different fields like consumer products (eyewear, footwear, design, furniture, industrial products (manufacturing tools, prototypes, functional end-use parts, dental products, prosthetics, architectural scale models, reconstructing fossils, replicating ancient artefacts, reconstructing evidence in forensic pathology etc.

3D printing has good prospects from career perspective. Various positions that could be available are CAD designers, engineers, technical developers, software developers, electronics engineers, etc.

This OE track consists of 04 courses and is designed with an objective to provide an overview of all the constituents of 3D Printing starting from elements of CAD that are needed to create CAD models, followed by basics of 3D Printing required for setting the parameters, then the machines and tools used in 3D Printing for thorough understanding of systems and processes and finally the reverse engineering of 3D printing models from actual objects.
COURSE PRE-REQUISITES: Elements of CAD, Introduction to 3D Printing, 3D Printing Machines, Tooling & Systems

COURSE OBJECTIVES:
• To understand the Reverse Engineering (RE) methodology
• To disassemble products and specify the interactions between its subsystems and their functionality
• To understand Computer-Aided RE and Rapid Prototyping technology

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Basic understanding of engineering systems
CO-2: Understanding the terminologies related to re-engineering, forward engineering, and reverse engineering
CO-3: Understanding of reverse engineering methodologies
CO-4: Understanding of reverse engineering of systems

UNIT-I:
Introduction to Reverse Engineering: Need, Definition, The Generic Process, History of Reverse Engineering, Scope and tasks of RE, Domain analysis, Overview of Applications

UNIT-II:

UNIT-III:
Data Acquisition Techniques: Contact Methods - Coordinate Measurement Machine and Robotic Arms; Noncontact Methods - Triangulation, and Structured Light, Destructive Method; Issues involved in data acquisition techniques

UNIT-IV:
Pre-processing Techniques: Need of pre-processing, Data formats, Import of point cloud data, Reduction and filtering of data
Triangular Mesh Modeling: Need, Filtering of triangular mesh model and its definition, Topological characteristics, Euler formula for triangular mesh model, Various methods of construction of triangular mesh model.

UNIT-V:
Segmentation: Definition and need, Methods for segmentation - Edge based and face based.
Integration Between Reverse Engineering and Additive manufacturing: Modeling Cloud Data, Integration of RE and AM for Layer-based Model Generation, Adaptive
Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness

UNIT-VI:
Applications: Automotive, Aerospace, Medical sectors
Legal Aspects: Copyright Law, Reverse Engineering, Recent Case Law Barriers in adopting RE

TEXT BOOKS:
1. Reverse Engineering: An Industrial Perspective, V. Raja and K. Fernandes, Springer-Verlag

REFERENCES
1. Smart Product Engineering, Michael Abramovici, Rainer stark, Springer Berlin Heidelberg
INTERNET OF THINGS

Offered by: ELECTRONICS AND COMMUNICATION ENGINEERING

Courses in the OE Track:

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<tr>
<td>Internet of Things</td>
<td>Sensors Transducers and Actuators</td>
<td>Introduction to Microcontrollers and Interfacing</td>
<td>IoT Protocols and its applications</td>
<td>Wireless Sensor Networks</td>
</tr>
</tbody>
</table>
OE TRACK :: INTERNET OF THINGS

The IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions. IoT is changing how we live, work, travel, and do business. It is even the basis of a new industrial transformation, known as Industry 4.0, and key in the digital transformation of organizations, cities, and society overall. The IoT track helps students to learn about how to

- Learn different protocols and connectivity technologies used in IOT.
- Expose the various sensors and transducers for measuring mechanical quantities.
- Develop simple applications using 8051 microcontrollers.
- Understand the key routing protocols for sensor networks and their design issues.

Some of the more common career paths in the Internet of Things path are

- IoT Developer... 
- IoT Architect...
- IoT Embedded Systems Designer...
- IoT Solutions Engineer...
- Professional in Sensors and Actuators...
- Embedded Programs Engineer...
- Safety Engineer...
COURSE PRE-REQUISITES: Sensors Transducers and Actuators, Introduction to Microcontrollers and Interfacing, IoT Protocols and its applications

COURSE OBJECTIVES:
- To expose basic concepts of wireless sensor network technology
- To study medium access control protocols and various issues in a physical layer
- To understand the key routing protocols for sensor networks and their design issues
- To understand sensor management in networks and design requirements

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Appreciate various design issues of wireless sensor networks
CO-2: Understand the hardware details of different types of sensors and select the application specific sensor
CO-3: Understand radio standards and communication protocols to be used for wireless sensor networks

UNIT – I:
Introduction: Overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

UNIT – II:
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): TinyOS, MANTIS, Contiki, and RetOS.

UNIT – III:
Programming Tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet, NetSim)

UNIT – IV:
Overview of Sensor Network Protocols (Details of at least 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster-based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

UNIT – V:
Data Dissemination and Processing: Differences compared with other database management systems, Query models, In-network data aggregation, data storage; query processing.

UNIT – VI:
Specialized Features: Energy preservation and efficiency; security challenges; Fault tolerance, Issues related to Localization, connectivity and topology, Sensor
deployment mechanisms; coverage issues; sensor Web; sensor Grid. Open issues for future research, and Enabling technologies in wireless sensor network.

**TEXT BOOKS:**

**REFERENCES:**
Offered by: ELECTRONICS AND COMMUNICATION ENGINEERING

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<tbody>
<tr>
<td>Augmented Reality (AR)/Virtual Reality (VR)</td>
<td>Introduction to C Sharp</td>
<td>Introduction to Signal Processing</td>
<td>Introduction to Image &amp; Video Processing</td>
<td>Applications of AR &amp; VR</td>
</tr>
</tbody>
</table>
Augmented reality (AR) and Virtual Reality (VR) bridge the digital and physical worlds. They allow you to take in information and content visually, in the same way you take in the world. AR dramatically expands the ways our devices can help with everyday activities like searching for information, shopping, and expressing yourself. VR lets you experience what it's like to go anywhere from the front row of a concert to distant planets in outer space.

Job Roles in Augmented reality and virtual reality (AR & VR) Track
- Design Architect...
- Software Designer...
- System Validation Engineers...
- Software Developer...
- 3D Artist...
COURSE PRE-REQUISITES: Introduction to C Sharp, Introduction to Signal Processing, Introduction to Image & Video Processing

COURSE OBJECTIVES: Throughout the course, Students will be expected to develop AR VR applications by being able to do each of the following:

- A review of current Virtual Reality (VR) and Augmented Reality (AR) technologies
- The fundamentals of VR/AR modeling and programming
- Provides a detailed analysis of engineering scientific and functional aspects of VR/AR

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Acquire knowledge in main applications VR / AR technologies
CO-2: Analyze different tools for VR/AR applications
CO-3: Developing VR/AR applications

UNIT – I:
Augmented Reality and Virtual Reality:
Augmented Reality: Introduction to Augmented Reality (AR), Fundamentals, Chronicle order of AR, features
Virtual Reality: Introduction to Virtual Reality (VR), Features of VR and Chronicle order of VR; Difference between AR and VR.

UNIT – II:
Types of Augmented Reality: Marker based AR, Marker less AR, Projection based AR, Super Imposition based AR, Applications of AR.

UNIT – III:
Types of Virtual Reality: Non-immersive simulation, Semi-immersive simulations, Fully immersive simulations; Applications VR.

UNIT – IV:
Making an AR App with Simple CUBE: Introduction to Unity, Installation steps, Fundamentals while implementing Project, importing a cube, Create an account in Vuforia, license manager, target manager, downloading database and uploading target database in Unity.

UNIT – V:
AR App with Interaction: Introduction to C#, Scripting interactive objects, implementation C# Script using unity, uploading target object, deploying application into ANDROID Device.

UNIT – VI:
Creating an Virtual Reality: Creating an Virtual Reality Scene in unity, adding colliders, Settings of Unity to make the application compatible with Google cardboard.
TEXT BOOKS:

REFERENCES:

ADDITIONAL RESOURCES:
Offered by: **COMPUTER SCIENCE AND ENGINEERING**

Courses in the OE Track:

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</table>
OETRACK :: ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is a cognitive science with highly research activities in the major areas like Machine Learning, Robotics, Natural Language Processing and image processing. This track will cover basic foundations of artificial intelligence it will make the students industry-ready for artificial intelligence and data science job roles. Artificial intelligence is used in wide range of industrial applications such as healthcare, transportation, entertainment, insurance, transport and logistics, and customer service. Future applications of AI would be utilized in automated transportation, cyborg technology, solving problems associated with climate change, deep-sea and space exploration.
COURSE PRE-REQUISITES: Mathematics for Artificial Intelligence, Fundamentals of Artificial Intelligence, Machine Learning Techniques

COURSE OBJECTIVES:
• To introduce the foundations of deep learning
• To acquire the knowledge on Deep Learning Concepts

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify and select appropriate learning network models required for real world problems
CO-2: Design an efficient model with various deep learning techniques
CO-3: Implement deep learning algorithms and solve real-world problems
CO-4: Apply optimization strategies necessary for problem solving required for large scale applications

UNIT – I:

UNIT – II:

UNIT – III:

UNIT – IV:

UNIT – V:
Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Markov Networks, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO
UNIT – VI:

TEXT BOOKS:

REFERENCES:
1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
### BLOCKCHAIN TECHNOLOGIES

Offered by: **COMPUTER SCIENCE AND ENGINEERING**

Courses in the OE Track:

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<tr>
<td>Blockchain Technologies</td>
<td>Fundamentals of Computer Networks / Relational Database Management Systems</td>
<td>Distributed Data Bases</td>
<td>Cryptography and Network Security</td>
<td>Blockchain Technology</td>
</tr>
</tbody>
</table>
The blockchain is one of the fastest growing skills in the IT sector today. This track will help the students to gain knowledge in blockchain technology, it has taken quite a turn in the industry given its popularity in providing safe and secured online transactions. Most individuals and organizations have started adopting blockchain because of the many benefits it offers to the industry today. It is used in many industry applications such as banking sector, voting, health care, real estate, the legal industry and government.
VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. VIII Semester

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(19OE1CS07) BLOCKCHAIN TECHNOLOGY
(Open Elective - IV)

COURSE PRE-REQUISITES: Fundamentals of Computer Networks, Distributed Data Bases, Cryptography and Network Security

COURSE OBJECTIVES:
• Get the terminologies and overview of blockchain technologies
• Study the concepts and foundation of blockchain technology
• Understand security mechanism and consensus in blockchain
• Design use cases and architecture blockchain technology

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Gain a clear understanding of the concepts that underlie digital distributed ledger
CO-2: Understand key mechanisms like Decentralization, Transparency and trust, Immutability, High availability, Highly secure and different types of Blockchain
CO-3: Apply the concept of Hash Function and Related Hash Algorithm
CO-4: Design and implement applications using Blockchain Technology

UNIT – I:
Introduction to Blockchain Part I: Introduction to Centralized, Decentralized and Distributed system, History of Blockchain, Various technical definitions of Blockchain.
Introduction to Blockchain Technology Part II: Generic elements of a blockchain: Block, Transaction, Peer-to-peer network, Node, Smart contract, Why It’s Called “Blockchain”, Characteristics of Blockchain Technology, Advantages of blockchain technology.

UNIT – II:
Concept of Blockchain Technology Part I: Cryptography, Hashing, Nonce, Distributed database, Consensus, Smart Contract, Component of block, Structure of Block chain, Technical Characteristics of the Blockchain.
Concept of Blockchain Technology Part II: Applications of blockchain technology, Tiers of blockchain technology Blockchain 0, Blockchain 1, Blockchain 2, Blockchain 3, Generation of Blockchain X.

UNIT – III:
Technical Foundations Part II: Consensus algorithm: Proof of work (PoW), Proof-of-Stake (PoS), Byzantine Fault Tolerance (BFT)

UNIT – IV:
Types of Blockchain: Public blockchains, Private blockchains, Semi-private blockchains, Side chains, Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, CAP theorem and blockchain

UNIT – V:
Financial markets and trading, Trading, Exchanges, Trade life cycle, Order anticipators, Market manipulation.
Crypto Currency: Bitcoin, Bitcoin definition, Keys and addresses, Public keys in Bitcoin, Private keys in Bitcoin, Bitcoin currency units

UNIT – VI:
Implementation Platforms: Hyperledger as a protocol, Reference architecture, Hyperledger Fabric, Transaction Flow, Hyperledger Fabric Details, Fabric Membership, Fabric Membership

TEXT BOOKS:
2. Blockchain Basic, Daniel Drescher, A Press

REFERENCES:
# ROBOTICS

**Offered by:**

**ELECTRONICS AND INSTRUMENTATION ENGINEERING**

**Courses in the OE Track:**

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<tr>
<td>Robotics</td>
<td>Fundamentals of Robotics</td>
<td>Kinematics and Dynamics of Robot</td>
<td>Drives and Control System for Robotics</td>
<td>Robot Programming and Intelligent Control Systems</td>
</tr>
</tbody>
</table>
OE TRACK :: ROBOTICS

Robotics is a field of study that involves the design, construction and operation of robots. This field overlaps with electronics, computer science, mechatronics and artificial intelligence. Robotic companies are booming all over the world and are seeking engineers with skills for implementing Next -Level Automation. This Open Elective Track for Robotics consists of four courses and is intended for making students industry ready in the field of robotics.

The First course in this track "Fundamentals of Robotics" introduces various physical aspects of building a robot, exploring topics like how a robot perceives its environment using Sensors and how it interacts with its environment through various Actuators & Grippers. This course also inspects a variety of robot applications in different domains. Second Course in this track "Kinematics & Dynamics of robots" delves a level deeper discussing analysis and control of robots. It establishes strong mathematical foundation for describing and controlling robot movement. In this course students will learn in detail about Forward Kinematics, Inverse Kinematics, Workspace Analysis and Trajectory planning for robots.

Third Course in the Robotics track “Drives and Control System for Robots” explores in detail various Drive Mechanisms used in robotics such as Hydraulic, Pneumatic & Electric drives. After completing this course students will be able to analyze operational aspects of a drive system for a given robotic application. Fourth Course in the track “Robot Programming and Intelligent Control System” expands on Robot Programming, discussing various aspects of Robot Programming Languages and their functions. This course also dives deep into advanced topics like Artificial Intelligence, Neural Networks and Fuzzy control for robots.
COURSE PRE-REQUISITES: Fundamentals of Robotics, Kinematics and Dynamics of Robotics, Drives and Control Systems for Robotics

COURSE OBJECTIVES:
- Understand the fundamentals of robot programming
- Learn robot textual languages that are in common use
- Expose to artificial intelligence in robotics
- Acquire basic Knowledge on neural networks in robotics
- Acquire basic Knowledge on fuzzy logic in robotics

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Gain knowledge about different methods of robot programming
CO-2: Examine various robot language elements and their functions
CO-3: Analyze different AI techniques employed in robotics
CO-4: Design basic neuro-controller for robot motion control
CO-5: Apply fuzzy logic to robot control systems

UNIT – I:
Robot Programming: Methods of robot programming, leadthrough programming methods, robot program as a path in space - defining position in space, speed control, motion interpolation, WAIT, SIGNAL, DELAY commands, Branching.

UNIT – II:
Robot Languages: Textual robot language, generations of robot languages, robot language structure, operating systems, Robot language Elements and functions, constraints and variables, aggregates and location variables.

UNIT – III:
Basic Commands and Operations: Motion commands- move and related statements, speed control, points in workspace, paths and frames. End effector and sensor commands- end effector operation, sensor operation, REACT statement. Computations and operation. Program control and subroutines. Communications and data processing. Monitor mode commands.

UNIT – IV:
AI for Robotics: Introduction to Artificial Intelligence, goals of AI research, AI techniques- knowledge representation, problem representation, search techniques. LISP programming, AI and Robotics. LISP in the factory. Robotic Paradigms.
UNIT – V:


UNIT – VI:

**Fuzzy Logic Approach in Robotics:** Introduction, Fuzzy sets, Operation of Fuzzy sets, Fuzzy relations, Fuzzy rule formation, Control rules, Fuzzy algorithm in robotics, Robot obstacle avoidance using fuzzy logic, Fuzzy logic for robot path tracking and behavior coordination, fuzzy control system in mobile robots, fuzzy controller design for robot systems, Case study of fuzzy logic in robotics.

**TEXT BOOKS:**

**REFERENCES:**
1. Design and Control of Intelligent Robotic Systems, (Studies in Computational Intelligence 177) M. Begum, F. Karray (auth.), Dikai Liu, Lingfeng Wang, Kay Chen Tan (eds.), Springer
4. Introduction to Neural Networks using MATLAB 6.0, S.N. Sivanandam, S. Sumathi, S.N. Deepa, TMH, 2006
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Cybersecurity is important because it incorporates everything that relates to protecting our sensitive data, personally identifiable information (PII), protected health information (PHI), personal information, intellectual property, data, and governmental and industry information systems from stealing and destruction endeavoured. The cyber security track helps students to learn about how to defend networks and data from unapproved access. Enhanced information security and business endurance supervision. Upgraded stakeholder confidence in your information security preparations. Developed company authorizations with the correct security controls in place.

Some of the more common career paths in the cyber security path are:
- Chief Information Security Officer.
- Forensic Computer Analyst.
- Information Security Analyst.
- Penetration Tester.
- Security Architect.
- IT Security Engineer.
- Security Systems Administrator.
- IT Security Consultant.

COURSE OBJECTIVES:
- To provide an understanding of computer forensics fundamentals
- To analyze various computer forensics technologies and to provide computer forensics systems
- To identify methods for data recovery
- To apply the methods for preservation of digital evidence

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Define and discuss the concepts of computer forensics
CO-2: Explain and apply the concepts of computer investigations
CO-3: Select and apply current computer forensics tools
CO-4: Identify and apply current practices for processing crime and incident scenes

UNIT – I:

UNIT – II:

UNIT – III:
UNIT – IV:
**Computer Forensics Analysis and Validation:** Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions. **Network Forensics:** Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. **Processing Crime and Incident Scenes:** Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.

UNIT – V:
**Current Computer Forensic Tools:** Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software. **E-Mail Investigations:** Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools. **Cell Phone and Mobile Device Forensics:** Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices.

UNIT – VI:
**Working with Windows and DOS Systems:** understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, virtual machines.

TEXT BOOKS:
3. Real Digital Forensics, Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Addison Wesley, Pearson Education

REFERENCES:
2. Computer Evidence Collection & Presentation, Christopher L.T. Brown, Firewall Media
3. Homeland Security, Techniques & Technologies, Jesus Mena, Firewall Media
5. Windows Forensics, Chad Steel, Wiley India Edition
Courses in the OE Track:

<table>
<thead>
<tr>
<th>OE Tracks</th>
<th>V Sem (OE-I)</th>
<th>VI Sem (OE-II)</th>
<th>VII Sem (OE-III)</th>
<th>VIII Sem (OE-IV)</th>
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<tbody>
<tr>
<td>Data Sciences / Big Data &amp; Analytics</td>
<td>Statistical Methods for Data Science</td>
<td>Computational Thinking using Python</td>
<td>Fundamentals of Data Mining</td>
<td>Data Analysis and Visualization</td>
</tr>
</tbody>
</table>
Data science helps in risk evaluation and observing, possible deceitful comportment, payments, customer analysis, and experience, among much other exploitation. The capability to make data-driven choices generates a steadier financial situation and data scientists make the strength of the industry.

As such, data science track helps students to apply business concepts in banking, finance, manufacturing, transport, e-commerce, education, etc. that use data science. As a consequence, there are numerous Data Science applications associated to it.

Job Roles in Data Science Track
- Data Analyst
- Data Engineers
- Database Administrator
- Machine Learning Engineer
- Data Scientist
- Data Architect
- Statistician
- Business Analyst
- Data and Analytics Manager

Big Data analytics track helps the students to learn the process of gathering, establishing and examining large sets of data (called Big Data) to determine patterns and other beneficial information. Analysts occupied with Big Data characteristically want the acquaintance that comes from investigating the data.

Big data analytics is the practice of mining useful information by examining different types of big data sets. Big data analytics is utilized to determine concealed patterns, market developments and consumer favorites, for the advantage of organizational decision making.

Job responsibilities in a Big Data Analytics Track are
- To gather and accumulate data from disparate sources, clean it, organize it, process it, and analyse it to extract valuable insights and information.
- To identify new sources of data and develop methods to improve data mining, analysis, and reporting.
- To create data definitions for new database files or alterations made to the already existing ones for analysis purposes.
- To present the findings in reports (in table, chart, or graph format) to help the management team in the decision-making process.
- To apply statistical analysis methods for consumer data research and analysis purposes.
• To keep track of the trends and correlational patterns among complex data sets.
• To perform routine analysis tasks to support day-to-day business functioning and decision making.
• To collaborate with Data Scientists to develop innovative analytical tools.
• To work in close collaboration with both the IT team and the business management team to accomplish company goals.
VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. VIII Semester

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(19OE1IT05) DATA ANALYSIS AND VISUALIZATION
(Open Elective -IV)

COURSE PRE-REQUISITES: Statistical Methods for Data Science, Computational Thinking using Python, Fundamentals of Data Mining

COURSE OBJECTIVES:
• To introduce concept and characteristics of probability distribution
• To introduce underlying design principles, properties and assumptions of linear and non-linear regression modelling
• To introduce design principles involved in identifying interesting classification and prediction of data patterns
• To introduce properties of time series data and perform time series analysis

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply probability distribution concepts to identify univariate data patterns
CO-2: Apply regression modelling to build efficient mathematical models for prediction and classification
CO-3: Apply decision and regression trees for supervised learning
CO-4: Visualize time series data by applying time series techniques

UNIT – I:
Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization, Introduction to statistical learning, Descriptive Statistics: Measures of central tendency, Measures of location of dispersions.

UNIT – II:
Basic Analysis Techniques: Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test Analysis of variance, Correlation analysis, Maximum likelihood test.

UNIT – III:
Data Analysis Techniques: Regression analysis and visualization, Classification techniques and visualization, Clustering and visualization, Association rules analysis and visualization

UNIT – IV:
Time-series Analysis and Forecasting – Time-series components, Variation in Time Series, Cyclic Variation, Seasonal Variation, Irregular Variation.
UNIT – V:
Smoothing Techniques: A problem involving all four components of time series, Introduction to forecasting, forecasting models, Trend and Seasonal effects, Trend Analysis

UNIT – VI:
Case-studies and Projects: Understanding business scenarios, Feature engineering and visualization, Sensitivity Analysis.

TEXT BOOKS:
1. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012

REFERENCES:
SELF-DRIVING CAR

AUTONOMOUS VEHICLES

Offered by: AUTOMOBILE ENGINEERING

Courses in the OE Track:

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</table>
The invention of the wheel marked a large step in the evolution of mankind. With mobility, man experienced a new found freedom that opened the doors for several other inventions. Automobile engineering or automotive engineering is one of the most challenging careers in the field of engineering with a wide scope. This branch deals with the designing, developing, manufacturing, testing and servicing automobiles such as cars, trucks, motorcycles, scooters, etc. and the related engineering sub systems. For the perfect blend of designing and manufacturing automobiles, automobile engineering uses the features of different elements of engineering such as mechanical, electrical, electronic, instrumentation, civil, software and safety engineering. Exploring the topic from an interdisciplinary perspective is indispensable. Globalization and incredible growth of automobile industry have resulted in numerous opportunities for engineers both in India and abroad.

The 17th and 18th centuries were mostly about steam-powered vehicles transporting people and goods. While electric cars enjoyed popularity in the 19th and early 20th centuries, the later period saw the accelerated adoption of the petrol car, due to its advantages of power, mass production, cost and advances in the internal combustion engine. It is only in the 21st century that interest in electric cars has come back, given the need for cleaner, greener modes of transport. The modern period is associated with several path breaking technologies. Over the last couple of decades, there has been an explosion of electronics in vehicles. Connected cars that include technology features are ever more popular. These smart cars come with internet access, GPS, wi-fi, superior infotainment, advanced telematics and navigation capabilities. More innovations in in-vehicle infotainment and electronics promise to give car users even more enhanced capabilities in the near future.

Today, safety has become a larger concern than ever before. While entertainment and infotainment have made car driving a pleasure, this has also given rise to a growing tribe of distracted drivers. Add to this, underdeveloped roads, which take a toll on drivers today. Increased distractions and fatigue can also contribute to human fatalities. The future certainly points in the direction of driverless cars, which promise to alleviate concerns of traffic congestion and road safety. Driverless cars, also known as autonomous cars, will usher in a paradigm shift in the evolution of the modern automobile. Self-driving cars can sense the environment and traffic with the help of RADAR, LIDAR, GPS and computer vision and navigate without human intervention. Autonomous cars are claimed to have greater accuracy, reliability and faster reaction time compared to human drivers. This would lead to fewer traffic collisions and less road congestion.

Autonomous driving is a popular subject of today’s discussion and automakers are developing complex systems that allow cars to drive themselves. If technology continues on its current course, car will do the concentrating for you. Self-parking, automatic emergency braking, adaptive cruise control and lane keeping are just some of the technologies that have leapt into the market in the past few years. Put them all together, get a picture of driving to assisted driving to fully autonomous cars. The open elective track “Autonomous Vehicles” offered by the department of automobile engineering trains the students to meet the technological challenges and diverse needs of the industry and society in various areas of automobile engineering and equips them to excel in a truly competitive industry. With through knowledge in this filed, engineering graduates get opportunity to serve many top-notch automobile companies and IT companies as well.
CONNECTED AND AUTONOMOUS VEHICLES
(Open Elective - IV)


COURSE OBJECTIVES:
• To understand the fundamentals of vehicle communication and networking
• To provide state-of-the-art in wireless communication technology within and between vehicles
• To know various levels of vehicle autonomy and intelligent automotive systems
• To provide an overview on driver-assist and self-driving processes

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Present the fundamentals of vehicle communication and networking
CO-2: Appreciate intra-vehicle and inter-vehicle communication technologies
CO-3: Describe various levels of vehicle autonomy
CO-4: Discuss the driver-assist and self-driving processes

UNIT – I:
Introduction to Vehicle Communications: Intra-vehicle communications - communications protocols, systems and sensors (Braking, steering, power train, chassis systems, body electronics, instrument clusters, infotainment systems), inter-vehicle communications - cooperative driving (accident warning, frontal/rear collision prevention, lane change, assistance). Consumer assistance – traffic information, multimedia support and smart parking

UNIT – II:
Communication Fundamentals and Controller Area Network: Communication fundamentals – Frequency, bandwidth, power measurement, signal to noise ratio, transmission rate constraints, radio frequency spectrum allocation, RADAR operation and types of RADAR. CAN evolution, versions, types of controllers, layered architecture. CAN bus, message frames and error handling.

UNIT – III:
Intra-Vehicle Communications: Wired communication – Network comparison, two tier approach, LIN applications - Localized vehicle area support, general support areas, CAN applications - In vehicle operation, infotainment, wireless communication – Bluetooth vehicle applications, satellite services – satellite radio, vehicle care and traffic status.

UNIT – IV:
Inter-Vehicle Communication: Adhoc Communications –Applications in Vehicle traffic Monitoring, Collision and congestion avoidance, Highway lane reservation, Emission Control, Vehicle Frequency Utilization – AM Radio, Bluetooth, FM Radio, GPS, Short range RADAR, Wireless LAN, Intelligent Roadway-Infrastructure to vehicle and
vehicle to vehicle communications. Evolving smart vehicle – ECU, wireless networking, forward RADAR, side RADAR, GPS, cellular transmission and event Recorder.

UNIT – V:
**Autonomous Vehicles:** Importance, levels of automation, policy making, social costs, safety and crashes, congestion, land use, energy and emissions, costs and disadvantages

UNIT – VI:
**Current State of Autonomous Vehicles:** Research, challenges, commercial development, sensor systems, sensor suits, environmental challenges, graceful degradation, V2V and V2I communication, sharing the drive, integrity, security, verification and policy implications.

**TEXT BOOKS:**
1. Inter and Intra Vehicle Communications, Gilbert Held Auerbach Publications, 2008

**REFERENCES:**
4. In-Vehicle Network Architecture for the Next-Generation Vehicles, Syed Masud Mahmud, IGI
GENERAL-COMPUTING

Offered by: COMPUTER SCIENCE AND ENGINEERING / INFORMATION TECHNOLOGY

Courses in the Pool:

➢ Programming through Java
➢ Relational Data Base Management Systems
➢ Computational Thinking using Python
➢ Introduction to Data Analytics
➢ Fundamentals of Computer Algorithms
1. Programming through Java

Java is an extensively used programming language specifically intended for use in the distributed environment of the internet. Java help students to create wide-ranging applications that possibly will run on a single workstation or be distributed among servers and clients in a network.

Java is an extremely fruitful language and an upper option for many developers for many years. The motive that it has remained so prevalent is since it still happens the needs of functioning across networks.

Students will have different roles and responsibilities by learning Java Programming

- Designing, implementing, and maintaining Java applications that are often high-volume and low-latency, required for mission-critical systems.
- Delivering high availability and performance.
- Contributing in all phases of the development lifecycle.
- Writing well-designed, efficient, and testable code.

2. Relational Database Management Systems

A relational database permits you to effortlessly find precise information. It also consents you to sort based on any field and produce reports that comprise only definite fields from each record. With features like, Data Accuracy, Easy Access to Data, Data Integrity, Flexibility, Normalization, High Security, Feasible for Future Modifications

By learning RDBMS Students will have different roles in Database environment

- Data Administrator,
- Database Administrator
- Database Designer
- Application Programmer

3. Computational Thinking using Python

The python language is one of the utmost accessible programming languages available because it has streamlined syntax and not complex, which gives more importance on natural language. Due to its comfort of learning and practice, python codes can be readily written and executed much quicker than former programming languages.

Data Science: The libraries and frameworks Python offers, e.g. PyBrain, PyMySQL, and NumPy are one of the big reasons. Another reason is diversity. Python experience
allows you to do a lot more than any other language, e.g. you can create scripts to automate stuff, go into web development, and so much more.

**Students will have various Job Profiles by learning Python**

- Software Engineer.
- Python Developer.
- Research Analyst.
- Data Analyst.
- Data Scientist.
- Software Developer.

4. Introduction to Data Analytics

Data Scientists and Analysts use data analytics techniques in their research, and businesses also use it to inform their conclusions. Data analysis can assistance corporations healthier comprehend their customers, assess their ad-campaigns, personalize gratified, create content approaches and progress products.

**By learning Data Analytics students will get Jobs with different designations**

- IT Systems Analyst. Systems analysts use and design systems to solve problems in information technology. ...
- Healthcare Data Analyst. ...
- Operations Analyst. ...
- Data Scientist. ...
- Data Engineer. ...
- Quantitative Analyst. ...
- Data Analytics Consultant. ...
- Digital Marketing Manager.
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
• To introduce object-oriented programming concepts using the Java language
• To introduce the principles of inheritance and polymorphism; and demonstrates how they relate to the design of abstract classes
• To introduce the implementation of packages and interfaces
• To introduce exception handling, event handling and multithreading

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Develop applications for range of problems using object-oriented programming techniques
CO-2: Design simple graphical user interface applications
CO-3: Explore the design of graphical user interface using applets and swings

UNIT – I:
Object Oriented Thinking and Java Basics: Need for OOP Paradigm, Summary of OOP Concepts, Coping with Complexity, Abstraction Mechanisms, A Way of Viewing World – Agents, Responsibility, Messages, Methods, History of Java, Java Buzzwords, Data Types, Variables, Scope and Life Time of Variables, Arrays, Operators, Expressions, Control Statements, Type Conversion and Casting, Simple Java Program, Concepts of Classes, Objects, Constructors, Methods, Access Control, This Keyword, Garbage Collection, Overloading Methods and Constructors, Method Binding, Inheritance, Overriding and Exceptions, Parameter Passing, Recursion, Nested and Inner Classes, Exploring String Class.

UNIT – II:

UNIT – III:
Exception Handling and Multi-threading: Concepts of Exception Handling, Benefits of Exception Handling, Termination or Resumptive Models, Exception Hierarchy, Usage of Try, Catch, Throw, Throws and Finally, Built in Exceptions, Creating Own Exception Sub Classes.

UNIT – IV:
**Event Handling:** Events, Event Sources, Event Classes, Event Listeners, Delegation Event Model, Handling Mouse and Keyboard Events, Adapter Classes. The AWT Class Hierarchy, User Interface Components – Labels, Button, Canvas, Scrollbars, Text Components, Check Box, Check Box Groups, Choices, Lists Panels – Scrollpane, Dialogs, Menubar, Graphics, Layout Manager – Layout Manager Types – Border, Grid, Flow, Card and Grid Bag.

UNIT – V:
**Applets:** Concepts of Applets, Differences between Applets and Applications, Life Cycle of an Applet, Types of Applets, Creating Applets, Passing Parameters to Applets.

UNIT – VI:

**TEXT BOOKS:**
2. Understanding OOP with Java Updated Edition, T. Budd, Pearson Education

**REFERENCES:**
1. Introduction to Java Programming, Y. Daniel Liang, Pearson Education
2. An Introduction to Java Programming and Object-Oriented Application Development, R.A. Johnson, Thomson
COURSE OBJECTIVES:
- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Demonstrate the basic elements of a relational database management system.
CO-2: Ability to identify the data models for relevant problems.
CO-3: Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.
CO-4: Apply normalization for the development of application software.

UNIT-I:
Introduction to Database design: Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.
Relational Model: Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

UNIT-II:
SQL: Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Databases, Designing Active Databases.

UNIT- III:
UNIT-IV:

UNIT-V:
**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes. Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

UNIT-VI:
**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

TEXT BOOKS:

REFERENCES:
1. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning
2. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition
3. Database Development and Management, Lee Chao, Auerbach publications, Taylor  & Francis Group
4. Introduction to Database Systems, C. J. Date, Pearson Education
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:

- To understand why Python is a useful scripting language for developers
- To create and execute Python programs and to learn how to use lists, tuples, and dictionaries in Python programs
- To learn how to build and package Python modules for reusability
- To learn how to design object oriented programs with Python classes
- To learn how to use exception handling in Python applications for error handling

COURSE OUTCOMES: After completion of the course, the student should be able to

**CO-1:** Adapt and combine standard algorithms to solve a given problem (includes numerical as well as non-numerical algorithms)

**CO-2:** Adequately use standard programming constructs: repetition, selection, functions, composition, modules, aggregated data (arrays, lists, etc.)

**CO-3:** Explain what a given program (in Python) does identify and repair coding errors in a program

**CO-4:** Understand and use object based software concepts (constructing OO software will be dealt with in the course Software Engineering)

**CO-5:** Use library software for (e.g.) building a graphical user interface, web application, or mathematical software

UNIT-I:

UNIT- II:

UNIT- III:
Functions - Defining a function Calling a function Types of functions Function Arguments Anonymous functions Global and local variables. Modules- Creation, Importing module, Math module Random module Packages.

UNIT-IV:
Composition -Input-Output-Printing on screen, Reading data from keyboard, Opening and closing file Reading and writing files, Functions. Exception Handling -Exception, Exception Handling, Except clause, Try ? Finally clause, User Defined Exceptions
UNIT-V:
OOPs concept - Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Regular expressions- Match function, Search function, Matching VS Searching, Modifiers, Patterns. Multithreading-Thread, Starting a thread, Threading module, Synchronizing threads.

CGI - Introduction, Architecture, CGI environment variable, GET and POST methods, Cookies, File upload.

UNIT-VI:
Database- Introduction, Connections, Executing queries, Transactions Handling error, Networking - Socket, Socket Module, Methods, Client and server, Internet modules, Sending email.

TEXT BOOKS:
1. Learning Python, By David Ascher and Mark Lutz, O’Reilly

REFERENCES:
COURSE OBJECTIVES:
- To be exposed to conceptual framework of big data
- To understand different techniques of data analysis
- To be familiar with concepts of data streams
- To be exposed to item sets, clustering, frame works and Visualization

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand big data fundamentals
CO-2: Learn various data analysis techniques
CO-3: Implement various data streams
CO-4: Understand item sets, clustering, frame works & Visualizations

UNIT – I:

UNIT – II:
Data Analysis: Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and Kernel methods
Analysis of Time Series: Linear systems analysis, nonlinear dynamics – Rule induction – Neural Networks: Learning and and Generalisation, competitive learning, Principal component analysis and neural networks
Fuzzy Logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT – III:

UNIT – IV:
UNIT – V:
Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern-based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism.

UNIT – VI:
Frameworks and Visualization: MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques,
Interaction Techniques: Systems and Applications

TEXT BOOKS:
1. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007

REFERENCES:
1. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley & Sons, 2012
3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, 2nd Edition, Elsevier, 2008
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To reinforce algorithms analysis methods
- To analyse running time of an algorithm
- To understand different algorithm design strategies
- To familiarize with an assortment of important algorithms

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply algorithm design techniques and concepts to solve given engineering problem
CO-2: Analyze running times of algorithms using asymptotic analysis
CO-3: Develop efficient algorithms for computational tasks
CO-4: Computing complexity measures of algorithms

UNIT – I:

UNIT – II:
Divide and Conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen’s matrix multiplication. Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters’ theorem.

UNIT – III:
Greedy Method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem, Huffman Codes.

UNIT – IV:

UNIT – V:
Dynamic Programming-II: 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.

UNIT – VI:
Backtracking: General method, applications- N-Queen problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles.
TEXT BOOKS:

REFERENCES:
GENERAL POOL

Offered by: HUMANITIES AND SCIENCES

Courses in the OE Pool:

➢ Professional Ethics & Human Values
➢ Entrepreneurship
➢ Personality Development and Public Speaking
➢ **Foreign Language – French**
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
• To communicate verbally in a simple way by asking and responding to simple questions related to everyday language needs
• To read and comprehend different kinds of texts (notices, informal letters, catalogues, menus etc.)
• To write clear, concise, and correct sentences and paragraphs on familiar topics.
• To recognize and use basic syntax and structures in French including articles, prepositions and connecting words as well as master basic vocabulary

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Use vocabulary contextually and effectively
CO-2: Use reading skills to comprehend different kinds of texts
CO-3: Understand everyday expressions dealing with simple and concrete everyday needs, in clear, slow and well-articulated speech and manage very short mini dialogues /conversations
CO-4: Demonstrate basic competence in Written French including grammar, sentence and paragraph structure, coherence

UNIT – I: Introduce oneself and introduce someone:
Reading: Read and understand an introduction about someone
Grammar: Question words, Subject verb agreement, Mas/fem and prepositions with cities and countries
Vocabulary: professions, nationalities, countries numbers, days of the week and verbs
Writing: Build basic sentences and Write about oneself
Life Skills: Greetings, Formal and Informal way of asking questions

UNIT – II: Express likes and dislikes and Talk about your locality:
Reading: Read and understand description of a place
Grammar: Articles, prepositions, possessive adjectives, basic connecting words such as “like, and, but”, and Negation
Vocabulary: Adjectives, verbs of preference, different places, and basic vocabulary on leisure and sports activities.
Writing: Write about hobbies and pastimes
Life Skills: Conversation fillers

UNIT – III: Take / Fix an appointment with someone:
Reading: Understand propositions and counters
Grammar: How to say time, Interrogative adjectives
**Vocabulary:** Irregular verbs, days of the week, Fixed expressions with Etre and Avoir and expressions to ask for appointment or refuse/accept a proposed time  
**Life Skills:** Telephone etiquette and colloquial expressions in French

**UNIT – IV: Talk about your routine / Invite someone and Accept or refuse an invitation**  
**Reading:** Read and understand an invitation on basic info: date and time, venue, occasion, type of invitation etc.  
**Grammar:** Question word Why, Connecting word “because”, partitive and contracted articles, reflexive verbs  
**Vocabulary:** Expressions to propose, thank / apologize and accept or refuse an invitation,  
**Writing:** Respond to an invitation (Accept or refuse)  
**Life Skills:** At the table

**UNIT – V: Ask for information (timings, price, etc) and Ask for/ Give Directions**  
**Reading:** Understand signboards and instructions  
**Grammar:** Imperative mode and prepositions.  
**Vocabulary:** Directions, Expressions to ask information or seek precision  
**Writing:** Give instructions and fill a form

**UNIT – VI: Vacation (plan vacation, choose destination, visit, and appreciate)**  
**Reading:** Read and understand travel brochures for basic info on offers, locations, touristic attractions hotels and so on  
**Grammar:** demonstrative adjectives and near future tense  
**Vocabulary:** Weather forecast, modes of transport, and vacation activities  
**Writing:** Write a post card  
**Life Skills:** Types of vacation in France

**TEXT BOOKS:**  

**REFERENCES:**  
GENERAL POOL

Offered by: DEPARTMENTS

Courses in the OE Pool:

➢ Smart Cities
➢ Trends in Energy Sources for Sustainable Development
➢ 3D Printing and Design
➢ Embedded Systems for IoT
➢ Artificial Intelligence - A Beginner’s Guide
➢ Blockchain Essentials
➢ Fundamentals of Robotics and Drones
➢ Fundamentals of Cyber Security
➢ Fundamentals of Data Science
➢ Introduction to Advanced Vehicle Technologies
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
• To understand smart city basic concepts, global standards, and Indian context of smart cities
• To explain smart community, smart transportation and smart buildings
• To understand Energy demand, Green approach to meet Energy demand and their capacities
• To identify Smart Transportation Technologies in cities and concepts towards smart city

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Explain and elaborate smart city concepts and their international and national standards
CO-2: Conceptualize smart community, transportation and building concepts
CO-3: Develop and calibrate energy demand and their capacity limits
CO-4: Predict the various smart urban transportation systems and the transition from existing city towards a smart city

UNIT – I:
Introduction to Smart Cities: Introduction to Smart Cities - Understanding Smart Cities - Dimensions of Smart Cities – World urbanization, Global Experience of Smart Cities, Smart City case studies-Indian scenario - India “100 Smart Cities” Policy and Mission.

UNIT – II:

UNIT – III
Smart Cities Planning and Development: Introduction to Smart Community; Smart community concepts: Concept of Smart Community - Smart Transportation - Smart Building and Home Device - Smart Health - Smart Government - Smart Energy and Water - Cybersecurity, Safety, and Privacy; Internet of Things, Blockchain, Artificial Intelligence, Alternate Reality, Virtual Reality.

UNIT – IV:
Smart Urban Energy Systems: Conventional vs. Smart, City components, Energy demand, Green approach to meet Energy demand, Index of Indian cities towards smartness – a statistical analysis -Meeting energy demand through direct and indirect solar resources- Efficiency of indirect solar resources and its utility, Capacity limit for
the indirect solar resources- Effectiveness in responsive environment in smart city;
Smart communication using green resources- Relevant case studies

UNIT – V:
Smart Transportation Systems: Smart Transportation Technologies - Driverless and connected vehicles - ride sharing solutions - The "improve" pathway - The "shift" pathway – Smart Roads and Pavement systems – Relevant case studies

UNIT – VI:
Future of Smart Cities: The transition of legacy cities to Smart - Right transition process - the benefit of citizens, cities have to adopt effective management and governance approaches-factors in the transition phase of legacy cities to Smart cities and their managerial implications.

TEXT BOOKS:
2. Society 5.0: A People-Centric Super-Smart Society, Hitachi-UTokyo Laboratory (H-UTokyo Lab), Springer, 2020
3. The Routledge Companion to Smart Cities, Katharine S. Willis, Alessandro Aurigi, Routledge International Handbooks, 2020

REFERENCES:
2. Urban Systems Design: Creating Sustainable Smart Cities in the Internet of Things Era, Yoshiki Yamagata, Perry P. J. Yang, Elsevier, 2020
3. Smart Cities and Artificial Intelligence: Convergent Systems for Planning, Design, and Operations, Christopher Grant Kirwan, Zhiyong Fu, Elsevier, 2020
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To understand the role of sustainable energy
- To know components of solar PV and wind energy conversion systems
- To understand the principles of Biomass, geo-thermal and wave energy systems
- To learn various energy storage methods

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand various sources for sustainable energy
CO-2: Understand Solar Photo voltaic and wind energy systems
CO-3: Learn the harnessing techniques of Biomass, geothermal and ocean energy
CO-4: Familiarize with energy storage methods

UNIT – I:

UNIT – II:
Solar PV Conversion: The PV Cell-Crystalline Solar cells - Thin film and amorphous solar cells, Module, Array. Equivalent Electrical circuit- Open circuit voltage and Short circuit current, I-V, P-V Curves. Developments in efficient non silicon solar cells

UNIT – III:

UNIT – IV:

UNIT – V:
Geothermal Energy: Resources, types of wells, methods of harnessing the energy
Tidal and Wave Energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT – VI:
Energy Storage:
Electro Chemical Storage: lead-acid- nickel cadmium-nickel-metal-hydride and lithium type batteries-Principle of operation, Types, Advantages and disadvantages.

TEXT BOOKS:

REFERENCES:
B.Tech.  

(19OE1ME05) 3D PRINTING AND DESIGN

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To understand the need and know about the applications of 3D Printing
- To understand the need of liquid and solid based 3D Printing systems
- To know about the laser-based 3D Printing systems and importance of CAD for 3D Printing
- To understand post-processing, inspection and testing involved in 3D Printing

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Summarize the importance of 3D Printing
CO-2: Explain the process involved in liquid and solid based 3D Printing Systems
CO-3: Explain about the laser-based 3D Printing systems and CAD for 3D Printing
CO-4: Plan post-processing techniques and perform inspection and testing in 3D Printing

UNIT – I:
Applications: Brief overview of applications in Aerospace, Automotive, Biomedical, Defense, Construction, Jewelry, Coin and Tableware Industry.

UNIT – II:

UNIT – III:
Solid Based 3D Printing Systems: Introduction, Principle, Processes and Applications of Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM).

UNIT – IV:

UNIT – V:
CAD for 3D Printing: CAD data formats, CAD model preparation, Part orientation and support generation, Overview of 3D Printing softwares like MAGICS and MIMICS only.
UNIT – VI:
Inspection: Introduction, Significance, Inspection techniques like Dimensional measurement along X, Y and Z axes, visual inspection of the surface finish (overall aesthetics and intact features), flatness or warp check, and FOD (foreign objects or debris) check.

TEXT BOOKS:

REFERENCES:
COURSE PRE-REQUISITES: Programming through C

COURSE OBJECTIVES:
- To understand the basics of computing with Embedded Systems
- To expose the students to various smart sensors
- To make the students familiar with the programming concepts of Embedded development board
- To understand the basics of Internet of Things and Cloud of things

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Familiar with architectural and programming issues of Embedded Systems
CO-2: Able to select proper smart Sensor for a specific measurement application
CO-3: Analyze various protocols for Internet of Things
CO-4: Apply Internet of Things to different applications in the real world

UNIT – I:
Embedded System Design: Numbering and Coding Systems, Digital Premier, Inside the Computer
Embedded system - Definition, Characteristics of embedded computing applications, Design challenges, Requirements, Specification, Architecture design, Designing hardware and software components, system integration.

UNIT – II:
Smart Sensors & Applications: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation.

UNIT – III:

UNIT – IV:

UNIT – V:
Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT enabled Technologies – Wireless Sensor Networks,
Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Deployment Templates, M2M, IoT vs M2M.

UNIT – VI:

TEXT BOOKS:

REFERENCES:
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To understand and analyze the basic concepts of artificial intelligence
- To identify, explore the complex problem-solving strategies and approaches
- To analyze the concepts of basic concepts of neural networks and learning process
- To explore and analyze the methodology used in machine learning and computer vision

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand and apply the basic concepts of artificial intelligence and its use cases, lives
CO-2: Explore the various search strategies and approaches for problem solving
CO-3: Correlate the fields related to AI, and articulate various learning paradigms
CO-4: Describe several issues and ethical concerns surrounding AI

UNIT – I:
Introduction to AI: What is AI-On Overview, History of AI, Applications and Examples of AI, AI Concepts, Terminology, Key fields of AI. AI Issues, Concerns, and Ethical Considerations.

UNIT – II:

UNIT – III:
AI as Knowledge Exploration: Introduction to Propositional Logic, Rules of Inference, First Order Logic (FOL) Syntax, Semantics, Entailment, Tools to represent knowledge.

UNIT – IV:
AI as a Learning Task: Introduction to Learning, Learning types -Supervised, Unsupervised, Reinforcement Learning, Machine learning, Deep Learning, The link between AI, ML, DL.

UNIT – V:
UNIT – VI:

TEXT BOOKS:

REFERENCES:
3. Artificial Neural Networks, Yegnanarayana B., PHI
(19OE1CS10) BLOCKCHAIN TECHNOLOGY ESSENTIALS

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To introduce and get the technological overview of blockchain technologies
- To study the foundation of Blockchain Technology and demonstrate the various types of Blockchain
- To explore the application area of Blockchain Technology
- To introduce smart contract, consensus algorithm and Security Mechanism
- Introduction to available platforms to implement Blockchain Technology

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand and explore the Blockchain Technology
CO-2: Describe smart contract concepts
CO-3: Explore different types of Blockchain
CO-4: Develop the platforms to implement Blockchain Technology

UNIT – I:
Fundamental of Blockchain Part I: Introduction to Centralized, Decentralized and Distributed system, computer network peer to peer connection
Fundamental of Blockchain Part II: History of Blockchain, Various technical definitions of Blockchain. Generic elements of a blockchain: Block, Transaction, Node, Why It’s Called “Blockchain”, Characteristics of Blockchain Technology, Advantages of blockchain technology, Limitations of blockchain as a technology

UNIT – II:
Concept of Blockchain Technology Part I: Applications of blockchain technology, Tiers of blockchain technology Blockchain 0, Blockchain 1, Blockchain 2, Blockchain 3, Generation of Blockchain X, smart contract
Concept of Blockchain Technology Part II: Types of blockchain: Public blockchain, private blockchain, hybrid blockchain, examples of Public, private, hybrid blockchain and it merit and demerit.

UNIT – III:
Technical Foundations Part I: Component of block, Structure of Block chain, Technical Characteristics of the Blockchain, genesis block, Nonce

UNIT – IV:
Consensus Algorithm: Proof of work (PoW), Proof-of-Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of authority (PoA), Confidentiality, Integrity, Authentication,
Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, CAP theorem and blockchain

**UNIT – V:**
E-Governance and other contract enforcement mechanisms, Financial markets and trading, Trading, Exchanges, Trade life cycle, Order anticipators, Market manipulation.

**Crypto Currency:** Bitcoin, Bitcoin definition, Keys and addresses, Public keys in Bitcoin, Private keys in Bitcoin, Bitcoin currency units

**UNIT – VI:**
**Implementation Platforms:** Hyperledger as a protocol, Reference architecture, Hyperledger Fabric, Transaction Flow, Hyperledger Fabric Details, Fabric Membership, Fabric Membership

**TEXT BOOKS:**
2. Blockchain Basic, Daniel Drescher, A Press

**REFERENCES:**
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To classify based on coordinate system and control system
- To acquire knowledge on different types of Power Sources and Sensors
- To classify different types of Manipulators, Actuators and Grippers
- To acquire knowledge on kinematics and Vision systems used for different Robots
- To acquire knowledge on the basics of Drones

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Acquire knowledge on different types of Power Sources (actuators) and Sensors, Manipulators, Actuators and Grippers
CO-2: Acquire knowledge on different applications of various types of robots
CO-3: Analyze the direct and the inverse kinematic problems and calculate the manipulator dynamics
CO-4: Acquire knowledge on the applications of Machine Vision in Robotics
CO-5: Acquire Knowledge on the basics of Drones

UNIT – I:

UNIT – II:
Sensors and Actuators:
Sensors: Sensors characteristics, Position sensors, velocity sensors, acceleration sensors, torque sensors, micro switches, lighten infrared sensors, touch and tactile sensors, proximity sensors, range finders.
Actuators: Characteristics of activating system, comparison of activating system Hydraulic devices, Pneumatic devices, electric motors, magneto-strictive actuators.

UNIT – III:
Manipulators and Grippers:

UNIT – IV:
Kinematics: Matrix representation of translational and Rotational motion – Homogeneous Transformation-DH representation of standard configuration Robots-
Inverse Kinematics. Joint space vs. Cartesian space-Basics of Trajectory planning in joint and Cartesian space.

UNIT – V:
Robot Vision: Low level and High-level vision, Image acquisition, Illumination Techniques, Imaging Geometry, Some Basic Relationships between Pixels, Segmentation, Description, Segmentation and Description of 3-D Structures, Recognition, Interpretation.

UNIT – VI:
Basics of Drones: Theory behind how drones work, individual components that makeup a drone, basic concepts involved radio-controlled model flying, building a complete quad copter drone from scratch

TEXT BOOKS:

REFERENCES:
1. Robotics Technology and Flexible Automation, Deb S. R., John Wiley
2. Robots and Manufacturing Automation, Asfahl C. R., John Wiley
4. Drones for Beginners, Udemy
COURSE PRE-REQUISITES: Basic Knowledge of Computers, Basic Knowledge of Networking and Internet

COURSE OBJECTIVES:
- To identify the key components of cyber security in network
- To describe the techniques in protecting Information security
- To define types of analyzing and monitoring potential threats and attacks
- To access additional external resources to supplement knowledge of cyber forensics and laws

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand, appreciate, employ, design and implement appropriate security technologies
CO-2: Demonstrate policies to protect computers and digital information
CO-3: Identify & Evaluate Information Security threats and vulnerabilities in Information Systems
CO-4: Understanding computer forensics and analyzing them

UNIT – I:

UNIT – II:
Who are the cyber criminals, Classification of cybercrimes, E-mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/ Salami Technique, Data Diddling, Forgery, Web Jacking, Newsgroup Spam/ Crimes Emanating from Usenet Newsgroup, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, E-mail Bombing/Mail Bombs, UseNet Newsgroup as the Source of Cybercrimes, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft.

UNIT – III:
UNIT – IV:
**Security Threats:** Introduction to security threats-Virus, Worms, Trojan horse, Bombs, Trap Door, E-Mail Virus, Virus Life cycle, How virus works?, Malware, Network and Services attack- Dos attacks, Types of Dos attacks, Methods of attacks, Examples of attacks-SYN flooding, TCP flooding, UDP flooding, ICMP flooding, Smurf, Ping of death, Tear drop, Security threats to E-commerce-Electronic payment system, Credit card/Debit cards, Smart cards, E-money, Electronic Fund Transfer, E-commerce security System, Electronic Cash, Digital Signatures

UNIT – V:
**Introduction to Computer Forensics:** computer crimes, evidence, extraction, preservation, etc. Overview of hardware and operating systems: structure of storage media/devices; windows/Macintosh/ Linux -- registry, boot process, file systems, file metadata. Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files. Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary &cache files, Computer Forensic tools, Network Forensic. Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.

UNIT – VI:
**Fundamentals of Cyber Law:** Evolution of the IT Act, Genesis and Necessity, Salient features of the IT Act, 2000, various authorities under IT Act and their powers, Penalties & Offences, amendments, Impact on other related Acts Cyber Space Jurisdiction - Jurisdiction issues under IT Act, 2000- Traditional principals of Jurisdiction - Extra-terrestrial Jurisdiction- Case Laws on Cyber Space Jurisdiction Sensitive Personal Data or Information (SPDI) in Cyber Law (a) SPDI Definition and Reasonable Security Practices in India (b) Reasonable Security Practices – International perspective

**TEXT BOOKS:**
1. Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunit Belpure, Wiley

**REFERENCES:**
4. Cyber Law in India, Farooq Ahmad, Pioneer Books
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
• To learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration
• To explore data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication
• To understand the basic knowledge of algorithms and reasonable programming experience and some familiarity with basic linear algebra and basic probability and statistics
• To identify the importance of recommendation systems and data visualization techniques

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data
CO-2: Discuss the significance of exploratory data analysis (EDA) in data science and to apply basic tools (plots, graphs, summary statistics) to carry out EDA
CO-3: Apply basic machine learning algorithms and to identify common approaches used for Feature Generation
CO-4: Analyze fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine and to Build their own recommendation system using existing components

UNIT – I:
Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datatification - Current landscape of perspectives - Skill sets needed - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

UNIT – II:
Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: Real Direct (online real estate firm) - Three Basic Machine Learning Algorithms-Linear Regression - k-Nearest Neighbors (k-NN) - k-means

UNIT – III:
One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam
UNIT – IV: 
**Data Wrangling**: APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

UNIT – V: 

UNIT – VI: 
**Data Visualization**: Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset - Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

TEXT BOOKS:
1. Doing Data Science, Straight Talk From The Frontline, Cathy O’Neil and Rachel Schutt, O’Reilly, 2014

REFERENCES:
2. Foundations of Data Science, Avrim Blum, John Hopcroft and Ravindran Kannan
4. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, 3rd Edition, 2011 (ISBN 0123814790)
COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To understand the layout of an automobile and functionalities chassis elements
- To provide the concepts of automotive electrical systems and electric & hybrid vehicles
- To present various intelligent automotive systems and levels of vehicle autonomy

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Explain the functionalities of automotive systems and subsystems
CO-2: Discuss the concepts of automotive electrical systems and electric & hybrid vehicles
CO-3: Describe various intelligent automotive systems and levels of vehicle autonomy

UNIT – I:
Introduction: Classification of automobiles, layout of an automobile and types of bodies.
Automotive Chassis: Introduction to chassis systems - engine, cooling, lubrication, fuel feed, ignition, electrical, driveline - clutch, transmission, propeller shaft, differential, axles, wheels and tyres, steering, suspension and braking.

UNIT – II:

UNIT – III:
Electrical System: Simple automotive wiring diagram and components of electrical system, starting system – starter circuit, standard Bendix and over running clutch drive, charging system – alternator, cut-outs and regulators, ignition system - conventional and electronic ignition system.

UNIT – IV:
Electric and Hybrid Vehicles: Electric vehicle – Layout, components, configurations, advantages and limitations. Hybrid vehicle - Concepts of hybrid electric drivetrain based on hybridization and powertrain configuration, architecture of series, parallel and series-parallel hybrid electric drivetrains, modes of operation, merits and demerits.

UNIT – V:
Intelligent Vehicle Systems: Automotive navigation, night vision, head-up display, airbag, seat belt tightening system, immobilizers, adaptive cruise control, forward collision warning, lane departure warning and anti-lock braking system.
UNIT – VI:

Autonomous Vehicles: Levels of automation, research, challenges, commercial development, sensor systems, sensor suits, environmental challenges, graceful degradation, V2V and V2I communication, sharing the drive, integrity, security, verification and policy implications.

TEXT BOOKS:

REFERENCES: