

M. TECH. AUTOMOBILE ENGINEERING

with specialization in

Smart Mobility

(in Collaboration with GARC)

(Duration: 2 Years)

REGULATION 2024

(in line with NEP 2020)

REGULATION, CURRICULUM & SYLLABUS

(Applicable for students admitted from 2024 onwards)

DEPARTMENT OF AUTOMOBILE ENGINEERING SCHOOL OF ENGINEERING AND TECHNOLOGY HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

Academic Regulations

For

M.Tech. Degree Programme

(Effective from Academic Year 2024-25)

Choice Based Credit System (CBCS)

Under NEP

Applicable for the students admitted from 2024-2025.

"TO MAKE EVERY MAN A SUCCESS AND NO MAN A FAILURE"

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I. PREAMBLE

Post Graduate Education and Research in Engineering and Technology has always been a strong force that drives the nation towards establishing a better tomorrow for all. At present, Sustainable Development Goals (SDG), is an urgent call for action by all countries especially by Higher Education Institutions (HEIs). The primary objective of post graduate education and research in Engineering and Technology is to enhance knowledge, skills and competency of Engineers as required by industry.

This post graduate programme is spread over two years in four semesters and includes practical integrated courses, MOOC course and Department electives. As per National Education Policy recommendations, the focus is more on research and innovation. This program provides a wide exposure to industry practices, real time case studies, research contributions leading to publications and patent filing. Engineers with a global concern can make a significant difference in the world we live in.

II. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

1. "Programme" means Degree Programme, M.Tech. Degree Programme.

- 2. "Discipline" means specialization or branch of M.Tech. Degree Programme
- 3. "Course" means a theory or practical subject that is normally studied in a semester,
- 4. "Vice Chancellor of HITS" means the Head of the Institution.
- 5. "Registrar" is the head of all general Administration of the Institute.
- "Dean" means the authority of the University who is responsible for all Programmes and implementation of relevant rules of these Regulations pertaining to the Post Graduate Academic Programmes.
- "Controller of Examinations (CoE)" means the authority of the University who is responsible for all activities related to the University Examinations, publication of results, award of grade sheets and degrees.
- "Dean Student Affairs" is responsible for all student related activities including student discipline, extra and co – curricular activities, attendance and meetings with class representatives, Student Council and parents.
- 9. "HoD" means the Head of the Department concerned.
- 10."Institute" means Hindustan Institute of Technology and Science (HITS), Chennai.
- 11."TCH" means Total Contact Hours refers to the teaching learning periods.
- 12. "DEC" means Department Exam Committee
- 13."BoS" means Board of Studies
- 14. "BoM" means Board of Management
- 15."ACM" means Academic Council which is the highest authoritative body for approval for all Academic Policies.
- 16. "Faculty Coordinator" (FC) is a faculty of a department who in charge of the PG students of a specialization, who takes care of the attendance, internal marks and the general conduct of the students of that specialization.

- 17. "CIA" is Continuous Internal Assessment which is assessed for every student for every course during the semester
- 18."ESE" is End Semester Examination which is conducted by the Institute at the End of the Semester for all the courses of that semester
- 19. "AICTE" means All India Council for Technical Education
- 20. "UGC" means University Grants Commission
- 21. "MHRD" means Ministry of Human Resources Development, Govt. of India
- 22."RA" Grade due to lack of minimum attendance
- 23."ES" means Engineering Science Courses
- 24. "PC" means Programme Core Courses
- 25. "DE" means Departmental Elective Courses
- 26. "EEC" means Employability Enhancement Courses
- 27. "TP" means Theory with Practical Course
- 28. "TH" means Theory Course
- 29. "PR" means Practical Course
- 30. "PJ" means Project Phase
- 31. "IN" means Internship

III. INSTITUTE VISION, MISSION AND OBJECTIVES

The Motto of the Institution is "To make every man a success and no man a failure".

The Vision of the Institution is "To be an international institute of excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society"

The Mission of the institution is

- To create an ecosystem that promotes learning and world class research.
- To nurture creativity and innovation.
- To instill the highest ethical standards and values.
- To pursue activities for the development of the Society.
- To develop national and international collaborations with institutions and industries of eminence.
- To enable graduates to become future leaders and innovators.

Value Statement

Integrity, Innovation and Internationalization

Further, the Institution always strives

- To train our graduates with the latest and the best in the rapidly changing fields of Architecture, Engineering, Technology, Management studies, Science and Humanities, Laws and Liberal Arts.
- To develop graduates, with a global outlook, possessing Knowledge, Skills and Attitude and capable of taking up challenging responsibilities in the respective fields.
- To mold our graduates as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of Architecture, Engineering, Technology, Management studies, Health Science, Law, Design, Science and Humanities, Liberal Arts and Allied disciplines.

Aims and Objectives of the Institution are focused on

- Providing state of the art education in Architecture, Engineering, Technology, Applied Sciences, Law, Health Sciences, Design, Liberal Arts, and Management studies.
- Keeping pace with the ever changing technological scenario and help the graduates to emerge as competent professionals, fully aware of their commitment to the society and the nation.
- To inculcate a flair for Research, Development and Entrepreneurship.

ACADEMIC REGULATIONS FOR M. Tech. Programme (Effective from Academic year 2024 - 25)

R.1.0. Admission

R.1.1. The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute based on the guidelines issued by the UGC/AICTE/ Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the M. Tech. programme will be decided by the Board of Management of the Institute as per the directives of AICTE/ UGC / MHRD, Government of India, considering the market demands. Some Seats are also made available for Non Resident Indians and foreign nationals, who satisfy the admission eligibility norms of the Institute.

R.1.2. Eligibility for Admission

- The selected candidates will be admitted to the M.Tech. programme after he/she fulfils all the admission requirements set by the Institute and after payment of the prescribed fees.
- Candidates for admission to the first semester of the master's degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan Institute of Technology and Science.
- In all matters relating to admission to the M.Tech. Programme, the

decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

R.1.3. Lateral Entry for Engineering / Technology graduates (Admission to Second Year)

The candidate who earned minimum 40 credits at post graduate level in the Academic Bank of Credits (ABC) in applied field or area through reputed institutions as accepted by the Board of Management of the Institution, as equivalent thereto are eligible for admission to the 3rd Semester of the M. Tech degree programme.

However, the candidate is required to attain the additional credits, if required and as recommended by "Course Mapping Committee" and approved by the Vice Chancellor, by registering the course with the prescribed fee.

- **R.1.4.** The candidate must fulfill the prescribed admission requirements / norms of the Institution.
- R.1.5. At any time after admission, if found that a candidate has not fulfilled one or many of the requirements stipulated by the Institution, or submitted forged certificates, the Institution has the right to revoke the admission and forfeit the fee paid. In addition, legal action may be taken against the candidate as decided by the Board of Management.
- **R.1.6.** If at any time after admission, it is found that a candidate has not fulfilled one or many of the requirements stipulated by the Institute, or submitted forged certificates, the Institute has the right to revoke the admission of the candidate and will forfeit the fee paid and legal action may be taken against the candidate as decided by the board of Management.
- **R.1.7.** Admission norms for working Professional:

Separate admission guidelines are available for working / experienced professionals for candidates with industrial / research experience who desire to upgrade their qualification as per recommendation of Credit Transfer Committee.

R.2.0. Structure of the M. Tech. Degree Programme

- **R.2.1.** The M. Tech programme in all streams of specialization will be structured on a credit-based system following the semester pattern with continuous evaluation
- **R.2.2.** The University permits regular as well as external registration (part time) for those in employment
- **R.2.3.** The programme of instruction for each stream of specialization will consist of :
 - i. Core courses (compulsory)
 - ii. Elective courses
 - iii. Laboratory / Seminar / Mini Project / Design / Case Study / Internship and
 - iv. Project work and dissertation/Thesis
- **R.2.4.** Every stream of specialization in the programme will have a curriculum and syllabi for the courses approved by the ACM. Curriculum revisions, when required, will be proposed by a committee nominated by the Dean. All revisions shall be recommended by the BOS of the concerned departments / Schools and approved by the ACM
- **R.2.5.** The curriculum for any stream of specialization shall have a minimum total of 80 credits for successful completion of the M.Tech. programme.
- R.2.6. The complete programme will be four semesters duration. The academic programmes in each semester for any stream of specialization may consist of course (core and/or electives) work and / or laboratory / seminar / project / internships / thesis as specified in the approved curriculum.
- **R.2.7.** Credits will be assigned to the courses based on the following general pattern:
 - i. One credit for each lecture period

ii. One credit for each laboratory or practical session of two periods

- **R.2.8.** A student will have to register for all the core courses listed in the curriculum of his/her selected area of specialization and successfully complete all of them.
- **R.2.9.** Elective courses will have to be taken from the courses offered in a particular semester from among the list of approved courses as per the curriculum.
- **R.2.10.** Departments/Schools have to offer all the core courses (PC) prescribed in the curriculum for any semester. Enough elective courses shall also be offered in line with the curriculum. Number of elective courses and other courses, if any, from the curriculum, to be offered in any semester can be decided by the Dean based on the requirement/pre-registration data.
- R.2.11. Departmental Elective (DE) courses enable the students to take up a group of courses of their interest in specialization offered by the parent Department / School.
- R.2.12. Employment Enhancement Courses (EEC): These courses offered in certain semesters which are pertaining to Employment Enhancement of the students includes Project, Design Project, Internship
- **R.2.13.** Online / MOOC Courses under SWAYAM and other recognizing online platforms will be considered as equivalent to courses mapped with the prior approval of Dean / Vice Chancellor through Head of the Department.
- R.2.14. A student who has acquired the minimum number of total credits of 80, for the award of the degree will not be permitted to register for more courses to improve his cumulative grade point average (CGPA) after completion of the course and project requirements.

However, during the third/fourth semester, along with the project, a student can register for a maximum of two courses in addition to the project/thesis as per curriculum. These two additional courses permitted will be inclusive of any courses in which he/she has failed in

the earlier semesters or inclusive of any courses he/she is planning to audit.

Students who take courses in the third or fourth semesters will not be normally permitted to do their project work/thesis outside as per Clause 13.0.

- **R.2.15.** The medium of instruction, examination, seminar and project reports will be English.
- R.2.16. For students admitted on external registration, the normal duration will be6 semesters. Here the maximum duration is 7 semesters.
- **R.2.17.** The University permits a regular student to change over to external registration during the programme, under specific circumstances like initiating a start up venture or to take up a job as per Clause 9.0.
- **R.2.18.** A pass is mandatory in all core courses. In case of failure in an elective course, there is the provision to choose another elective listed in the curriculum.
- R.2.19. On their request, ACM shall examine the academic records and permit candidates with B. Tech. (Honors) who have earned credits for any relevant graduate level courses to transfer credits towards the M. Tech. programme.
- R.2.20. Candidates who received B.Tech. (Honors) degree just prior to their M. Tech. admission are permitted to transfer up to 9 credits. For those who received the B.Tech. (Minors) degree within three years prior to their M. Tech. admission are permitted to transfer up to 6 credits.
- **R.2.21.** The maximum number of lecture-based courses and laboratory courses in any semester shall not exceed 5 and 2 respectively. The maximum credits in a semester shall be 22.
- **R.2.22.** Extension of Programme: The normal duration of the programme shall be four semesters. In case of prolonged illness or other personal exigencies, the university may allow a student who has earned credits for

at least one semester to extend the programme up to the maximum duration of Eight semesters.

- **R.2.23.** Students who have earned credits for the courses listed in the first two semesters are permitted to transfer their registration as external candidates if they take up a job. However, they must complete the programme within eight semesters.
- R.2.24. A student must earn a minimum number of credits under each category as shown in Table 1 and also a minimum total of 80 credits for the award of M. Tech. degree.

SI. No.	Categor	y Courses	No. of Course s	Credits	Credits in Percentag e	Total
1	CORE	Professional Core (TH / TP)	5	20	25 %	40%
2	COURSES	Department Elective (DE)	4	12	15 %	
3	ALLIED COURSES	Engineering Science (ES)	1	4	5 %	5 %
		Leadership Skills for Engineers	1	1	1 %	
4	EMPLOYMENT ENHANCEMEN T COURSES	Research and Publication Ethics	1	3	4 %	55 %
		Internship	1	2	2.5 %	
		Project Work (Phase 1 & 2)	2	38	47.5 %	
		TOTAL	15	80	100%	100 %

Table 1. Credits Under Each Category

3.0. Student Discipline

Every student is required to observe utmost discipline and decorum both inside and outside the campus and do not indulge in any activity which may affect adversely the prestige and reputation of the Institution and fellow students.

- **3.1.** Any act of indiscipline of a student reported to the Head (Student affairs) and Head of the Department will be referred to a Discipline Committee constituted for the purpose. The Committee will enquire into the charges and decide on a suitable punishment if the charges are substantiated. The committee will also authorize the Head (Student Affairs) to recommend to the Vice-Chancellor for the implementation of the decision. The student concerned can appeal to the Vice-Chancellor, whose decision will be final.
- **3.2.** Ragging in any form is a criminal and non-bailable offence. The current State and Central legislations provide stringent punishments including imprisonment.
- **3.3.** If the involvement of any student is established in ragging, offending fellow students/staff, Damaging the institutional properties / defaming the institution's reputation, abusive post(s) in social media, discriminatory abuse, violation in dress code and other harassment of any nature to the fellow students/staff, he/she will be liable to serious disciplinary action includes rustification from university based on the recommendation of the disciplinary committee.
- **3.4.** If any Student involves in other in-disciplinary activities like cases under POSH Act, Possession or Usage of Drugs / Alcohol, physical assault, fights, illegal activities, FIR Filed against him/her for criminal activities, convicted by any court etc. such student will be liable for severe disciplinary action including dismissal from the Institution and the case may be referred to Law enforcement agencies as applicable for further action.
- **3.5.** Students are strictly prohibited from formation of groups based on racism, radical philosophy, communal outfits, etc. Defaulters will be liable for severe disciplinary action including dismissal from the Institution.

3.6. Every student of the Institution, along with their parent, shall give an undertaking at the beginning of every academic year in this regard and the same should be submitted at the time of registration for the academic year.

R.4.0. Programme Coordinator

To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned department/School will assign a 'Programme Coordinator' for each M. Tech. programme.

In Departments/schools offering more than one M. Tech. programmes, one of the Programme Coordinators will act as the Coordinating Programme Coordinator who will coordinate general matters of all M. Tech. programmes in the Department/schools.

R.4.1. Faculty Advisor

Faculty Advisors are assigned by the respective department to a certain number of students to help the students in planning their selection of courses and programme of study and for getting general advice on the academic programme, Such Faculty Advisor will continue to mentor the students assigned to him for the entire duration of the programme.

R.4.2. Students shall first approach their Program Coordinator for all kinds of academic advice, course registrations, leave and all academic related matters in the Institute. Whenever required, he/she shall provide necessary advice to the students. Program Coordinator shall make appropriate recommendations or remarks on the applications submitted by the students before forwarding to HoD/other concerned officials. Program Coordinator will keep the complete record of academics, attendance/leave, disciplinary actions if any, and any other relevant data of the students assigned to him/her.

R.5.0. Class Committee

R.5.1 Every section / batch of the B. Tech. Degree programme will have a Class Committee consisting of Faculty and students. The constitution of the Class Committee will be as follows:

- a. Senior Faculty not associated with teaching a course for the particular class shall be nominated by the Head of the Department to act as the Chairman of the Class Committee as approved by the Dean.
- b. Course coordinator of each of the lecture based courses (for common courses).
- c. Class teacher of the class.
- d. All Faculty handling the courses for that class in the semester.
- e. Workshop Superintendent (for first two semesters); as applicable.
- f. Four students from the respective class nominated by Head of the Department
- g. Faculty Advisors of the respective class.

R.5.2. Course Committee

A course committee shall be constituted by the HOD for all the common courses, with the faculty who are teaching the courses and with a Professor of the core department as the Chairman. The Course committee shall meet periodically to ensure the quality of progression of the course in the semester.

R.5.3. HoDs meeting with the students

- a. The HoD shall convene a closed meeting prior to each class committee and course committee meeting with the following members.
 - i. HoD / Program Coordinator
 - ii. Senior Faculty not associated with teaching a course for the class
 - iii. Class Teacher
 - iv. Five student representatives nominated by the class teacher/ HoD.
- b. The above committee shall discuss the academic and other issue, if any, and obtain independent feedback on all faculties on the Teaching Learning Processes, to take necessary action. The minutes of the meeting along with student representation and the corrective actions shall be forwarded to the Dean by the HoD.

R.5.4. Basic Responsibilities of Class Committee and Course committee

- a. The points of discussion during the above HoDs meeting shall be discussed in the Class committee and Course Committee meetings.
- b. To review periodically the progress of the students.
- c. To discuss issues concerning curriculum and syllabi and the conduct of the classes.
- d. To inform the students about the method of assessment as recommended by the Department Examination Committee ("DEC") at the beginning of the semester. Each class committee / course committee will communicate its recommendations and the minutes of the meetings to the Head of the Department, Dean and the Head (Student Affairs).
- e. To conduct meetings at least thrice in a semester as per the Academic Plan issued by the Dean.
- f. To review the academic performance of the students including attendance, internal assessment and other issues like discipline, maintenance etc.

R.6.0 Registration and Enrolment

- R.6.1 A student will be eligible for registration of courses only if student satisfies the regulation clause 12.0 (progression) and clause 16.0 (Maximum duration), and has cleared all dues to the Institution including Hostel, Library and other applicable fees up to the end of the previous semester provided that student is not debarred from enrolment on disciplinary grounds or for other reasons.
- R.6.2 The institution follows a Choice Based Credit System. Accordingly, the students shall be given the option for selecting their DE courses, and credits. The student is given the option of selecting the number of credits to undergo in a semester, subject to the curriculum requirements of minimum and maximum credits prescribed.
- R.6.3 Except for the first year, registration for a semester shall be done during a specified week before the start of the semester as per the Academic Schedule.

- R.6.4 Late registration/enrolment will be permitted by the respective Dean for genuine cases, on recommendation by the Head of the respective department, with a late fee as decided from time to time.
- **R.6.5** The student shall make the choice of course in consultation with the Faculty Advisor.
- R.6.6 Students shall have to pay additional fee as prescribed, for registering in certain elective courses under Departmental Electives courses offered by certain specific Departments and for higher level Foreign Languages, as decided from time to time.

R.7.0 Minimum Requirement to Continue the Programme

If a student earns RA (due to lack of minimum attendance) in all theory courses prescribed in a semester, he/she will be detained and will not be allowed to proceed to the next semester. He/she has to re-register for the courses in the following academic year only.

R.8.0. Temporary Discontinuation

- **R.8.1.** A student may be permitted by the Dean to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other medical reasons, based on the recommendation from Program Coordinator and HoD.
- **R.8.2.** In case of ill health or other medical reasons, students must produce a medical certificate from a Registered Medical Practitioner stating that he/she is not in a position to continue with the studies temporarily specifying the period, and the same should be duly endorsed by the Institute Medical Officer. Normally, a student shall be permitted to discontinue from the programme only for a maximum duration of two semesters.
- **R.8.3.** Before joining back to the programme, the student should submit the fitness certificate from the medical practitioner who treated him/her, with endorsement from the Institute Medical Officer.

R.8.4. In case of change in the curriculum/syllabus, a student has to register for the approved equivalent courses (meeting the same credits) as per the revised curriculum/syllabus in line with the advice of Program Coordinator, whenever he/she is allowed to continue the programme after the period of discontinuation.

R.9.0. Discontinuation from the Programme to Take up a Job

R.9.1. Students may be permitted to discontinue the programme and take up a job provided they have completed all the course work (except major project) prescribed in the approved curriculum, subject to the rules and regulations for the award of the financial support in force in the Institute.

The project work/thesis can be done during a later period either in the organization where they work if it has R & D facility, or in the Institute. Students desirous of discontinuing their programme at any stage after the successful completion of course work (except major project) with the intention of completing the major project work/thesis at a later date should submit application with details (copy of employment offer, plan of completion of their project etc.) to the Dean through Program Coordinator and HoD.

- R.9.2. When the students are planning to do the project/thesis in the organization with R & D facility where they are employed, they shall submit a separate application as per rule R.13.4. When students are doing project/thesis along with the job in the organization (with R & D facility) where they are employed, the project work shall be completed in four semesters normally (two semesters of project work/thesis along with the job may be considered as equivalent to one semester of project work at the Institute). Extensions may be granted based on requests from the student and recommendation of guide / Program Coordinator such that he/she will complete the M.Tech. programme within five years from the date of admission as per R.16.0. Method of evaluation and grading of the project/thesis will be the same as per R.23.0 and R.25.0, respectively.
- **R.9.3.** When the students (who have been permitted to discontinue the programme to take up a job) are planning to do the project/thesis in the

Institute, they shall submit an application (along with the permission to carry out the project work at the Institute from the employer) to the Dean (PGS) with recommendation of Program Coordinator and HoD for permission to do the project / thesis. The project work/thesis shall be done as full-time students in the Institute and can be completed in two semesters.

R.9.4. For those students who discontinue the programme as per R.9.0, financial support from the Institute (if any) will not be available from the date of discontinuation. Fees to be paid will be decided, as per the Institute rules, by the Vice Chancellor.

R.10.0. Semester Abroad Programme

R.10.1. Students who are allowed to undergo internship or Training in Industries in India or abroad during their course work or attend any National / International Institute under Semester Abroad Programme (SAP) up to a maximum of two semesters will be granted credit transfer for the Course Work/project work done by them in the Industry /International Institute as per the recommendations of the credit transfer committee. The leave period of the students for international internships / Semester Abroad programme etc., will be accounted for attendance.

R.11.0. Attendance

- **R.11.1.** The faculty handling a course must finalize the attendance, three calendar days before the last instructional day of the course and submit to the HoD through the class teacher.
- R.11.2. A student with less than 75% attendance in TCH (Total Contact Hours) in any course, will not be permitted to appear for the end-semester examination in that particular course, irrespective of the reason for the shortfall of the attendance. The student is however permitted to avail additional Academic Leave up to 10% towards special OD for attending academic related activities like, Industrial Visits, Seminars, Conferences, Competitions etc., with the prior approval of the HoD or on genuine medical reasons. On reporting back, the student shall submit the relevant

documents for proof to the HoD for approval of the additional academic leave.

- R.11.3. A student with an attendance ("TCH" Total Contact Hours) below 75% (65% for genuine medical conditions / Special on Duty leave) in any course will fall under the category "RA", which means Repeat the Course for want of attendance. Students under "RA" category will <u>not</u> be permitted to attend the Regular End Semester Examinations for that course and Continuous Internal Assessment (CIA) marks obtained in the respective course will be treated as null and void.
- R.11.4. The list of such students under "RA" will be notified by the respective Departments at the end of the course work for each semester. The students with RA courses shall repeat the course as per the procedure vide Clause 14.0
- R.11.5. Additional condonation may be considered for specific and genuine cases which includes approved leave for attending select Sports Camps or for cases requiring prolonged medical treatment or critical illness involving prolonged hospitalization.
- R.11.6. For such select Sports Camps prior permission for leave shall be obtained by the respective faculty coordinator / Director of sports from the designated authority, before deputing the students.

For medical cases requiring prolonged medical treatment / critical illness, submission of complete medical history and records with prior intimation from the parent / guardian regarding the health condition, progress of treatment, etc., to Head (Student Affairs) is mandatory. The assessment of such cases will be done by the attendance sub – committee based on the merit of the case and put up their recommendation to the Vice – Chancellor / designated authority. Such additional condonation is permitted only twice for a student in the entire duration of the programme.

The Vice-Chancellor based on the recommendation of the attendance sub - committee may then accord additional condonation of attendance, only if

the Vice-Chancellor/Designated deems it fit and deserving. But in any case, the additional condonation cannot exceed 10% of TCH.

R.12.0. Assessment Procedure

Every course shall have two components for assessment namely,

- **a.** Continuous Internal Assessment "CIA": This assessment will be carried out throughout the semester as per the Academic Schedule.
- b. End Semester Examination "ESE": This assessment will be carried out at the end of the Semester as per the Academic Schedule. In the End Semester Examination ("ESE") the student should secure the prescribed minimum mark in each course in the ESE as given in the Table 3 for passing.
- c. There are no separate minimum marks prescribed for CIA for any course.

The weightages for the various categories of courses for CIA and ESE is given in Table 2.

Table 2 Weightage of the CIA and ESE for various categories of the courses

No	Category of Courses	CIA weightag e	ESE Weightag e	Minimum ESE marks to be obtained (50% of ESE)	Passing minimum (CIA + ESE) (out of 100)
1.	Theory Course	50%	50%	25	50%
2.	Theory Course with Practical Components	50%	50%	25	50%
3.	Department Elective (DE)	50%	50%	25	50%
4.	Practical Course	50%	50%	25	50%
5.	Internship	-	100%	25	50%

Project and Viva 6. Voce	50%	50%	25	50%
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d. Improvement of CIA Marks

The students who fail in a course ("F" Grade) due to less CIA marks but having required attendance and other eligibility to appear for ESE is allowed to improve his/her CIA marks by undergoing the fresh internal evaluation procedure and appear for ESE whenever it is offered in the subsequent semester(s) as detailed in clause 19.3.

e. Procedure for improvement in CIA Marks

Students who wish to improve their CIA marks in a particular course shall register for the same with the respective HoD / Course faculty whenever the course is offered in the subsequent semester(s). The student has to remit the prescribed fee at the time of registration and undergo the internal assessment improvement procedure as prescribed by the course faculty with the approval of HoD. Student can write the ESE in the subsequent semester(s) and the revised internal assessment mark (CIA) will be considered for processing the results. **This will be considered as arrear (supplementary) examinations**. The improved CIA mark in the subsequent attempt(s) is limited to a maximum of 30 marks out of 50 (60%) only. The number of courses for which a student can register for internal improvement scheme at a time is restricted to a maximum of 5. The student, if so desired, will be allowed to attend repeat classes for RA as mentioned in clause 14.0 with the approval of course faculty.

f. Each faculty shall maintain a separate Academic assessment record for all courses handled by him/her and the same shall be submitted to the HoD for periodical verification. The faculty shall deposit the Assessment records with the HoD at the end of each semester for safe custody.

R.12.1. Theory Course Assessment weightages

The general guidelines for the assessment of Theory Courses shall be done on a continuous basis as given in Table 3a.

No.	CIA/ ESE	Assessment (Theory Course)	Weightage	Duration
1.		First Periodical Assessment	25%	2 periods
2.	CIA	Second Periodical Assessment including Quiz, Seminar, Group Discussion, Open book test, Model building, Mini Project, case study, Field visit and other assessment components as approved by the Department Examination Committee (DEC)	25%	
3.	ESE	End Semester Examination	50%	2 to 3 hours

Table 3a: Weightage for Assessment – Theory Course

R.12.2. Practical Course

For practical courses, the assessment will be done by the course teacher on a continuous basis as given in Table 3b.

- a. Continuous Internal Assessment (CIA) -- 50%
- b. End Semester Examination (ESE -- 50%

Table 3b: Weightage for Assessment – Practical Course

No	Assessment		Duration
NO.	(Practical Course)	weightage	Duration

1.	CIA	Weekly assignment / Observation / lab records and viva as approved by the Department Examination Committee (DEC)	50%	
2.	ESE	End Semester Examination	50%	2 to 3 hours

R.12.3. Theory Courses with Practical Component

For theory courses with practical component, assessment will be be done on a continuous basis as given in Table 3c.

a.	Continuous	Internal	Ass	ess	ment (CIA)	 50%
-	-					

 End Semester Examination (ESE) 		50%
--	--	-----

Table 3c : Weightage	for assessment -	Theory courses	with practical	Component

No.		Assessment (Theory courses with practical Component)	Weightage	Duration
1.		First Periodical Assessment (Theory)	25%	2 periods
2.	CIA	Practical Assessments Weekly assignment / Observation / lab records and viva as approved by the Department Examination Committee (DEC)	50%	-
3.	ESE	End Semester Examination (Theory)	25% ^{\$}	2 to 3 hours
4.		End Semester Examination (Practical)	25% ^{\$}	2 to 3 hours

^{\$} Minimum 12.5 marks (i.e. 50%) from ESE (Theory) and 12.5 marks (i.e. 50%) from ESE (Practical) to pass the ESE.

R.12.4. Internship

A student must compulsorily attend Summer / Winter internship for a minimum period of one month. In lieu of Summer / Winter internship, the student is permitted to register for undertaking case study / project work under a faculty of the institution and carry out the project for minimum period of one month. In both the cases, the internship report in the prescribed format duly certified by the faculty in-charge shall be submitted to the HoD. The End Semester Examination evaluation will be done through presentation and viva by duly constituted examination panel by CoE. The course will have a weightage of one credit or as prescribed in the respective curriculum.

R.12.5. Project Work

Project work is assessed as phase 1 and Phase 2. During Phase 1 the problem identification, literature review and overall project planning and scheduling to be completed. During Phase 2, the project design, implementation and testing to be completed. For post graduate programme, individual project work is recommended, and group projects will be permitted only after assessing the quantum of work involved. However not more than two per team can join to carry out the final year project work. Project work will be assessed through appropriate rubrics as prescribed by the DEC with the approval of HoD. The general guideline for assessment of for final year Project / Dissertation / comprehension / Internship, the assessment will be done on a continuous basis as given in Table 3e.

No.	Review / Examination scheme	Weightage
1.	First Review	10%
2.	Second Review	20%
3.	Third Review	20%
4.	Project report and Viva – Voce (ESE)	50%

Table 3e : Assessment of Project work

Note: Rubrics shall be prescribed by the DEC with the approval of HoD.

For the final year project and Viva – Voce end semester examination, the student shall submit a Project Report in the prescribed format specified by the Institution. The first three reviews will be conducted by a committee constituted by the Head of the Department. The End semester assessment will be based on the project report and a viva on the project conducted by a committee committee constituted by the Registrar / Controller of examination. This may include an external expert.

R.13.0. Project Work/thesis in Industry or other Organizations

- R.13.1. and Sponsored candidates from Research Development Organizations/Industries which have facilities for research work in the area proposed, may be permitted to carry out their project work/thesis in the parent or similar Organizations/Industries, only if they have successfully completed the course work prescribed in the approved curriculum and received permission from the parent Organizations/Industries for the same.
- **R.13.2.** Students who receive fellowship in a research project in an organization or internship in an industry can pursue their main project work/thesis at the organization/industry only if they have successfully completed the course work prescribed in the approved curriculum.
- **R.13.3.** All other categories of students are permitted to do the project work/thesis in R&D Organizations/Industries which have facilities for research work in the area proposed, only under the following conditions:
 - They have completed successfully the course work prescribed in the approved Curriculum, and
 - (ii) Facilities required for the Project work/Thesis are available continuously in the Organization/Industry (A certificate stating the facilities available in the proposed organization and the time period for which the facilities shall be made available to the student, issued by a competent authority from the Organization/Industry shall be submitted by the student along with the application).

R.13.4. Program Coordinator and HoD shall examine the requests submitted

from all such students with the recommendation from Program

Coordinator along with following documents:

- (i) Details of the proposed work
- (ii) Work plan of completion of project
- (iii) Name of R&D Organization/Industry in which the project/thesis is to be carried out
- (iv) Letter from the competent authority from the Organization/Industry granting permission to do the project/thesis with or without fellowship/internship.
- (v) Name and designation of an external guide from the proposed Organization/Industry (Scientists or Engineers with a minimum post graduate degree in the related area) and his/her profile with consent.
- (vi) Name of a faculty member of the Institute as internal guide with his/her consent.
- (vii) Certificate issued by the competent authority from the Organization/Industry clearly stating the facilities available in the proposed organization and the time period for which the facilities shall be made available to the student. (Only for students as per R.13.3). Dean will grant the approval based on the recommendations from BOS.
- **R.13.5.** The students who are permitted to do the project work/thesis in an industry as per R.13.1 will have to pay the tuition and other relevant fees to the Institute as per rules. They will not be eligible to receive any financial support from the Institute during this period, if they are receiving any financial support from the organization/ industry in which they are doing the project work.

R.13.6. Flexibility in Assessment

The respective Departments under the approval of the Department Examination Committee (DEC) may decide the mode of assessment, based on the course requirements. The continuous internals assessment can be either written exam or other modes of assessment such as quiz, working model demonstration, Circuit design, Software design and demonstration, mini project etc. as per the domain of specialization. However, the mode of assessment to be discussed and finalized in the first-class committee meeting and the same to be communicated to the COE within the first ten working days of the semester.

R.14.0. Repeat Classes Procedure for RA

- a. The students shall register for the RA courses at the beginning of every semester by paying the requisite fee and attend the repeat classes for RA course during the last period of the timetable or by attending special classes with the course faculty or by attending any other special schedule as approved by the Dean/HoD and shall gain the requisite eligibility to attend the End Semester Examination (ESE). The odd semester courses will be offered in the odd semester and the Even semester courses will be offered in the even semester. The student is permitted to register for a maximum of five RA courses under this option.
- b. The Continuous Internal Assessment Marks obtained by the student during their regular semester for the course in which they have been categorized as RA will become null and void. The students shall attend the RA classes and take up fresh Continuous Internal Assessments during the repeat classes and gain required attendance and CIA marks
- c. The students under "RA" category, who have secured the requisite attendance as applicable vide clause 14.a and obtained internal assessment marks, by successfully completing the End of day courses or by attending special classes with the course faculty during the semester, are eligible to register for the End Semester Examinations for that course whenever the examination is conducted. This examination will be treated as arrear (supplementary) examination.
- d. **Detention:** A student who secures RA in all the Theory / Elective / Theory with Practical component courses prescribed in a semester shall repeat the semester by re-registering for the respective semester in the next academic year. However, student is permitted to appear for arrear (supplementary) examinations, if any, as per eligibility.
- e. Summer Semester: With the specific approval of the Vice Chancellor / Designated Authority and as per the requirements / availability of the required time slot and other resources, the Institution may conduct a special Summer Semester after the regular ESE in April/May usually,

for students having RA courses in both Even and Odd semesters and conduct the summer semester examinations for the eligible students. However, it is the sole discretion of the vice chancellor to permit such summer semester schedules.

- f. Student who has obtained "RA" for any course but appeared for the ESE examination in that course under any circumstance, the marks obtained will be considered as "null and void". The result of the particular course will be marked "RA" in the semester grade sheet, and he/she has to gain the requisite eligibility to attend the End Semester Examination (ESE) for the course vide clause 14.a.
- g. Student shall remit all payments due to the Institution within the prescribed dates, (unless and otherwise special approvals are obtained by any student for extension of payment dates) failing which their names, roll numbers will be blocked in the institution's registry / ERP till the dues are cleared. Students having arrears in fee (Tuition fee / Hostel fee or any other) payment to the institution will be prevented from appearing for current semester ESE. However, they can appear for the Examinations in their arrear courses.

R.15.0. Grading

R. 15.1 A grading system as shown in Table 4 will be followed.

Range of Marks	Letter Grade	Grade Points	Remarks
90 - 100	S	10	OUTSTANDING
80-89	A+	09	EXCELLENT
70-79	A	08	VERY GOOD
65-69	B+	07	GOOD
60-64	В	06	ABOVE AVERAGE
55-59	C	05	AVERAGE
50-54	P	04	PASS

Table 4: Grading system

< 50	F	00	TO REAPPEAR FOR END- SEMESTER EXAMINATION
	AB	00	Absent for the End Semester Examination
	RA	00	Repeat the course due to Lack of minimum attendance (below 75%) in regular course (Clause 11.3)
	DE	00	DETAINED (DE) "RA" in all courses of a semester. The student is detained and must repeat the entire semester as per the Clause 14 d - Detention

R.16.0. Maximum Duration of the Programme

A student is, normally, expected to complete M.Tech. programme in four semesters. The maximum duration to complete the programme is eight semesters from the date of admission. This is excluding the period of temporary discontinuation or any other periods of absence permitted. For candidates admitted in multiple entry scheme, this period will be reduced to the semester in which they get admitted.

A student may complete the programme at a slower pace than the regular pace, but in any case, in not more than additional two years from the minimum duration of the programme excluding the semesters withdrawn as per clause R 8.0.

A student completing the M.Tech. programme during the extended period than stipulated duration will not be eligible for any Institution Ranks.

R.16.1. Temporary Withdrawal from the Programme

- A student is permitted to take a break, up to a maximum of 2 semesters, during the entire programme to clear the backlog of arrears (supplementary).
- b. A student may be permitted by the Vice-Chancellor to temporary break from the entire programme for a maximum of two semesters for reasons of ill health, start–up venture or other valid reasons as recommended by

a committee consisting of Head of Department, Dean and Head (Student Affairs).

R.17.0. Multiple Exit

The students can exit after the completion of one academic year (two semesters) with the PG Diploma Certificate in a discipline or a field as listed in Table 5.

No.	Exit	Year	Minimum Credit Requirements	Eligibility for Exit
1.	P.G. Diploma	After First Year	40	Successful completion of all Courses in I & II Semesters without any arrears at the time of exit. If required, few additional courses to be completed before the award of PG Diploma Certificate.

Table 5: Multiple Exit

R.18.0. Declaration of Results

A student shall secure the minimum marks as prescribed in Clause 12.0 (Table 3) in all categories of courses in all the semesters to secure a pass in that course.

R.19.0. Repeat Examinations

R.19.1. Students who fail to secure a pass ("F" grade) in their regular end semester examination in any course(s) may be provided with an opportunity to register and appear for the repeat Examinations conducted immediately after the announcement of results. The students shall submit the prescribed registration forms along with repeat examination fee as per the timeline specified by COE.

- R.19.2. The students who fail to secure a pass on being absent in their End Semester Examination for any regular course due to genuine reasons are also permitted to appear for the Repeat Examinations.
- R.19.3. During the even semester, the Repeat Examinations will be conducted for even semester courses only and during the Odd semester it will be conducted for Odd semester courses only. However, Vice Chancellor shall permit to conduct Odd and Even semester repeat examinations together in any semester.
- **R.19.4.** The schedule for the Repeat Examinations will be notified through the Academic Calendar which will be published at the beginning of every academic year/semester(s) which depends on the availability of time slots in a semester and other resources. This will not be treated as arrear (supplementary) examination.
- **R.19.5.** However, it is the sole discretion of the Vice Chancellor to permit such repeat examinations.

R.20.0. Arrear (Supplementary) Examinations:

If a candidate secure "F" / "RA" / "DE" / "AB" in any course as applicable, due to not satisfying the minimum passing requirement – as per clause 14, student shall register for Arrear (supplementary) examinations by paying the prescribed examinations fee, in the subsequent semesters whenever it is offered. During the even semester, the supplementary exams will be conducted for even semester courses and during the odd semester the supplementary exams will be conducted for odd semester courses. Student need not attend the contact classes again. The Internal Assessment marks secured by the candidate will be retained for all such attempts. However, student under RA category must attend the contact classes and earn the required CIA and attendance.

R.20.1. Revaluation of Answer Scripts

Student can apply for the revaluation of End semester examination answer script (Regular / Supplementary) in a theory / theory with practical course, after the declaration of the results, on payment of a prescribed fee.

R.20.2. Revaluation is not permitted for Practical, Design Project / Internship / Comprehension courses.

However, based on genuine grievances as approved by the Examination Grievance Committee, a student may be permitted to apply for revaluation in the above courses. **Revaluation is not permitted for repeat examinations and online examinations.**

- **R.20.3.** After 3 years, i.e., completion of one year (2 semesters) from the normal duration of the programme, the internal assessment marks obtained by the student will not be considered in calculating the passing requirement. A candidate who secures 50% in the end semester examination only will be declared to have passed the course.
- R.20.4. Student who earns required credits for the award of degree after 3 years for M.Tech. programme (on expiry of extended period of 2 semesters over and above normal duration of course) will be awarded only second class (Clause 23.1) irrespective of the earned CGPA. However, the period approved under temporary withdrawal, if any, from the programme (Clause 8.0) will be excluded from the maximum duration as mentioned above.

R.21.0. GPA and CGPA

GPA is the ratio of the sum of the product of the number of credits Ci of course "i "and the grade points P_i earned for that course taken over all courses "i" registered and successfully completed by the student to the sum of Ci for all "i". That is,

$$GPA = \frac{\sum C_i P_i}{\sum C_i}$$

CGPA will be calculated in a similar manner, in any semester, considering all the courses enrolled from the first semester onwards. CGPA/ GPA will be rounded to first decimal point.

- **R.21.1.** The Grade card will not include the computation of GPA and CGPA for courses with letter grade **F**, **RA**, **AB** and **DE** until those grades are converted to the regular grades.
- **R.21.2.** A course successfully completed cannot be repeated.

R.21.3. Conversion of CGPA to Percentage Marks

The CGPA can be converted to percentage of marks as follows:

CGPA x 10 = Percentage of marks.

R.22.0. Grade Sheet

R.22.1. Letter grade

Based on the performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and corresponding grade points are given in Table 4.

- R.22.2. Student is considered to have completed a course successfully and earned credits if student secures a letter grade other than "F", "RA" "AB" and "DE" in that course.
- **R.22.3.** After results are declared, grade sheet will be issued to each student which will contain the following details:
 - a. Program and discipline for which the student has enrolled.
 - b. Semester of registration.
 - c. The course code, name of the course, category of course and the credits for each course registered in that semester
 - d. The letter grade obtained in each course
 - e. Semester Grade Point Average (GPA)
 - f. The total number of credits earned by the student up to the end of that semester in each of the course categories.
 - g. The Cumulative Grade Point Average (CGPA) of all the courses taken from the first semester.

R.23.0. Class/Division

R.23.1. Classification is based on CGPA and is as follows:

CGPA ≥ 8.0: First Class with distinction $6.5 \le CGPA < 8.0$: First Class $5.0 \le CGPA < 6.5$: Second Class.

- **R.23.2.** Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance with effect from first semester, within the minimum duration of the programme.
- **R.23.3.** The award of 'First Class' is further subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses within 3 years for M. Tech programmes.
- R.23.4. The period of authorized discontinuation of the programme as per Clause9.0 will not be counted for the purpose of the above classification.

R.24.0. Academic Bank of Credits

- **R.24.1.** The Academic Bank of Credits (ABC), a national-level facility is adopted to promote the flexibility of the curriculum framework and interdisciplinary/multidisciplinary academic mobility of students across the Higher Education Institutions (HEIs) in the country with appropriate "credit transfer" mechanism.
- R.24.2. Student who have completed a portion of courses in other approved Institutions of repute and earned required credits under ABC shall be admitted to the appropriate admission level of the programme (vide Clause:
 2) based on the recommendation of the credit transfer committee on a case-to-case basis and approved by the Vice Chancellor. The credit transfer committee shall suggest additional credits as required for admission in to the appropriate level of admission in the programme after assessing the credit equivalence of the already earned credits by the student. The Credit Transfer Committee consists of Registrar, Controller of Examinations, Dean,
HoD of the respective department, Representative from Office of International Affairs and the Department level credit transfer coordinator.

R.25.0. Eligibility for Award of the M.Tech. Degree

- **R.25.1.** A student shall be declared to be eligible for the award of the M.Tech. Degree if he/she has:
 - i. registered and successfully credited all the core courses of M. Tech.
 - ii. successfully acquired the credits in the different categories as specified in the approved curriculum of M. Tech. (corresponding to the discipline of his/her study) within the stipulated time.
 - iii. completed the normal duration of the programme for M. Tech.
 - iv. no dues to any departments/sections of the Institute including hostels, and
 - v. no disciplinary action pending against him/her.

The award of the degree shall be recommended by ACM and approved by the Board of Management of the Institute.

Students who completed the M. Tech. programme and are eligible for the award of the Degree can get the following documents from Registrar based on individual application, after the declaration of results: consolidated Grade Card, Provisional Degree, Course Completion, Transfer and Migration Certificates. Degree certificate will be issued during convocation as per the notifications issued by the Institute.

R.26.0. Power to Modify

Notwithstanding all that has been stated above, the Academic Council is vested with powers to modify any or all of the above regulations from time to time, if required, subject to the approval by the Board of Management.



VISION AND MISSION OF THE INSTITUTE

<u>MOTTO</u>

"To Make Every Man A Success and No Man A Failure"

VISION

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

MISSION

- To create an ecosystem that promotes learning and world class research.
- To nurture creativity and innovation.
- To instill highest ethical standards and values.
- To pursue activities for the development of the Society.
- To develop national and international collaborations with institutes and industries of eminence.
- To enable graduates to become future leaders and innovators.

VALUE STATEMENT

Integrity, Innovation, Internationalization

DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION OF THE DEPARTMENT

To enable the graduates to be successful in their career as an Automobile Engineer.

MISSION OF THE DEPARTMENT

- M1 : To inculcate knowledge in Automobile Engineering
- **M2** : To impart skills and training on the advancements in Automobile Engineering such as Automotive Electronics, Autonomous Vehicles, etc.
- **M3** : To instill the highest ethical standards to be a Professional Automobile Engineer for social development.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- **PEO 1** : Expertise in analysing and providing solutions which are technically feasible and economically affordable and socially sustainable to real life problems in various Automobile Engineering systems.
- **PEO 2** : To enable the graduates to exhibit leadership skills and enhance their abilities through lifelong learning.
- **PEO 3** : Motivate the students to undertake research activities and to adapt to the latest trends in technology for sustainable development in Automobile Engineering field.

PROGRAMME OUTCOMES (POs)

- **PO1:** Independently carry out research /investigation and development work to solve practical problems.
- PO2: Write and present a substantial technical report/document.
- **PO3:** Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
- **PO4:** Analyse and Design complex engineering problems, and design system components or processes by applying appropriate advanced principles of engineering activities and using modern tools and having sustainable development.
- **PO5:** Function effectively as a member or leader in diverse teams to carry out development work, produce solutions that meet the specified needs with frontier technologies and communicate effectively on complex engineering activities.

Program Specific Outcomes: (PSOs)

- **PSO1**: Design, analyse, fabricate and test advanced automotive systems that enable students to compete globally in future sustainable mobility, focusing on enhanced comfort, safety, and driving experience.
- **PSO2**: Capable of driving innovations in vehicle technologies including the development and integration of autonomous systems, connected vehicle technologies and sustainable mobility, to enhance the efficiency, safety and user experience of modern transportation.

PEOs and POs:

M.Tech. Automobile Engineering Program Outcomes (POs) leading to the achievements of the objectives (PEOs) are summarised in the following table.

Programme Educational		Programn	ne Outcom	es (POs)		Programn Outcom	ne Specific les (POs)
Objectives (PEOs)	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2
I	2	1	2	2	2	2	3
II	3	2	2	1	2	3	2
III	2	1	3	2	1	2	3

		SI. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
		1	GMA52001	Applied Engineering Mathematics	1.8	2	1.6	1.8	1.4	1.2	1.4
	1	2	EAT52001	Vehicle Electrification and Hybridization	2	1.6	1.4	2.2	1.8	1.8	1.6
	STEF	3	EAT52002	Modelling and Simulation of Vehicle Systems with a case study	2.4	2.2	1.4	1.4	1.4	1.6	1.4
	SEME	4	EAT525**	Department Elective– 1							
		5	EAT525**	Department Elective– 2							
		6	GLS52001	Leadership Skills for Engineers	2.8	2	1.2	2	2.6	1.8	1.4
EAR 1		1	EAT52003	Crashworthiness and Automotive Safety	2.6	2.6	1.8	1.8	0.2	2	1.8
Υ	8	2	EAT52004	AI for Automotive Applications	1.8	2	1.4	1.6	1.4	1.4	1.6
	STER	3	EAT52005	AI for Autonomous and Connected Vehicles	1.8	2	1.2	2.2	1.2	1.4	1.6
	EMES	4	EAT525**	Department Elective– 3							
	S	5	EAT525**	Department Elective– 4							
		6	GGE52001	Research and Publication Ethics	1.8	2	1.4	2.2	1.4	1.4	1.6

		SI. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
		1	EAT525xx	Department Elective– 5							
~	ER 3	2	EAT525xx	Department Elective– 6							
EAR :	IESTI	3	EAT52800	Internship	2	2	3	3	3	1.33	1.67
X	SEN	4	EAT52801	Project Work-Phase - I	3	2.33	2	2.33	2.33	2	2.33
	SEMEST ER 4	1	EAT52802	Project Work-Phase - II*	3	3	2	2	2.4	2.6	2.4

DEPARTMENT ELECTIVES

		SI. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
			EAT52512	AI for Smart Transportation	2.4	2.2	1.4	1.4	0.8	1.6	1.4
	R 1	1		OR							
	ESTE		EAT52513	Automated Driving System	2	1.8	1.4	1.4	1.4	1.6	1.4
	SEME		EAT52502	Hydrogen Energy for Smart Mobility	1.6	1.8	1.4	1.4	1.4	1.8	1.4
		2		OR							
			EAT52515	Intelligent Driver Assistance Systems with AI	1.6	2	1.4	1.2	1.4	1.4	1.4
AR 1	AES R 2	1	EAT52516	Connected Vehicle Technology	2.6	1.2	2.2	1.2	1.6	2.4	1.8
ΥE	SEN	I		OR							

		EAT52517	Electronic Model Based System Design	1.6	1.8	1.4	1.4	1.4	1.8	1.4
		EAT52506	Vehicle Ergonomics and Styling	1.6	1.8	1.6	1.4	1.4	1.8	1.4
	2		OR							
		EAT52519	Light Weight Materials for sustainable mobility	1.6	1.8	1.6	1.4	1.4	1.8	1.4
33		EAT52520	Thermal Management for Automotive System for Automotive Vehicles							
STEF	3		OR							
SEME		EAT52509	IOT for Automotive Applications							
		EAT52522	Mechatronics in Automotive Applications and Testing							
	4		OR							
		EAT52523	Cyber security for Vehicle Applications							

Courses with SDG Mapping

Content included in one or more of:

Course description, Course outcomes, Assessments, Lecture Programs, Class room activities, take away assignments

Substatial Content	Covered in 50% or more
Moderate Content	Covered in less than 50%

	Covered in assessments and other class room activities
Limited Content	only
No Content	

Semester I

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	SDG 1 No Poverty	SDG 2 No Hunger	SDG 3 Good Health	SDG 4 Quality Education	SDG 5 Gender Equality	SDG 6 Clean Water and Sanitation	SDG 7 Renewable Energy	SDG 8 Good Jobs and Economic Growth	SDG 9 Innovation and Infrastructure	SDG 10 Reduced Inequalities	SDG 11 Sustainable Cities and Communities	SDG 12 Responsible Consumption	SDG 13 Climate Action	SDG 14 Life Below Water	SDG 15 Life on Land	SDG 16 Peace and Justice	SDG 17 Partnership for the Goals
1	BS	GMA52001	Applied Engineering Mathematics																	
2	PC	EAT52001	Vehicle Electrification and Hybridization																	
3	PC	EAT52002	Modelling and Simulation of Vehicle Systems with a case study																	
4	DE	EAT525**	Department Elective– 1																	
5	DE	EAT525**	Department Elective– 2																	

			Leadership									
6	EEC	GLS52001	Skills for									
0			Engineers									

Semester-II

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	SDG 1 No Poverty	SDG 2 No Hunger	SDG 3 Good Health	SDG 4 Quality Education	SDG 5 Gender Equality	SDG 6 Clean Water and Sanitation	SDG 7 Renewable Energy	SDG 8 Good Jobs and Economic Growth	SDG 9 Innovation and Infrastructure	SDG 10 Reduced Inequalities	SDG 11 Sustainable Cities and Communities	SDG 12 Responsible Consumption	SDG 13 Climate Action	SDG 14 Life Below Water	SDG 15 Life on Land	SDG 16 Peace and Justice	SDG 17 Partnership for the Goals
1	PC	EAT52003	Crashworthiness and Automotive Safety																	
2	PC	EAT52004	AI for Automotive Applications																	
3	PC	EAT52005	Al for Autonomous and Connected Vehicles																	
4	DE	EAT525**	Department Elective– 3																	
5	DE	EAT525**	Department Elective– 4																	

			Research and									
6	EEC	GGE52001	Publication									
0			Ethics									

Semester -III

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	SDG 1 No Poverty	SDG 2 No Hunger	SDG 3 Good Health	SDG 4 Quality Education	SDG 5 Gender Equality	SDG 6 Clean Water and Sanitation	SDG 7 Renewable Energy	SDG 8 Good Jobs and Economic Growth	SDG 9 Innovation and Infrastructure	SDG 10 Reduced Inequalities	SDG 11 Sustainable Cities and	SDG 12 Responsible Consumption	SDG 13 Climate Action	SDG 14 Life Below Water	SDG 15 Life on Land	SDG 16 Peace and Justice	SDG 17 Partnership for the Goals
1	DE	EAT525**	Department Elective– 5																	
2	DE	EAT525**	Department Elective– 6																	
3	EEC	EAT52800	Internship																	
4	EEC	EAT52801	Project Work- Phase - I																	

Semester-IV

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	SDG 1 No Poverty	SDG 2 No Hunger	SDG 3 Good Health	SDG 4 Quality Education	SDG 5 Gender Equality	SDG 6 Clean Water and Sanitation	SDG 7 Renewable Energy	SDG 8 Good Jobs and Economic Growth	SDG 9 Innovation and Infrastructure	SDG 10 Reduced Inequalities	SDG 11 Sustainable Cities and Communities	SDG 12 Responsible Consumption	SDG 13 Climate Action	SDG 14 Life Below Water	SDG 15 Life on Land	SDG 16 Peace and Justice	SDG 17 Bartnesschin for the Goals
1	EEC	EAT52802	Project Work- Phase - II*																	

Department Electives:

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	SDG 1 No Poverty	SDG 2 No Hunger	SDG 3 Good Health	SDG 4 Quality Education	SDG 5 Gender Equality	SDG 6 Clean Water and	SDG 7 Renewable Energy	SDG 8 Good Jobs and Economic	SDG 9 Innovation and	SDG 10 Reduced Inequalities	SDG 11 Sustainable Cities and	SDG 12 Responsible Consumption	SDG 13 Climate Action	SDG 14 Life Below Water	SDG 15 Life on Land	SDG 16 Peace and Justice	SDG 17 Partnership for the Goals
1	DE	EAT52512	AI for Smart Transportation																	
2	DE	EAT52513	Automated Driving System																	

3	DE	EAT52502	Hydrogen Energy for Smart Mobility									
4	DE	EAT52515	Intelligent Driver Assistance Systems with Al									
5	DE	EAT52516	Connected Vehicle Technology									
6	DE	EAT52517	Electronic Model Based System Design									
7	DE	EAT52506	Vehicle Ergonomics and Styling									
8	DE	EAT52519	Light Weight Materials for sustainable mobility									
9	DE	EAT52520	Thermal Management for Automotive System for									

			Automotive Vehicles									
10	DE	EAT52509	IOT for Automotive Applications									
11	DE	EAT52522	Mechatronics in Automotive Applications and Testing									
12	DE	EAT52523	Cyber security for Vehicle Applications									

M. TECH. AUTOMOBILE ENGINEERING

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: In the light of the fact that a typical Model Two-year Post Graduate degree program in Engineering has about 80 credits, we have adopted 80 credits.

C. Structure of PG Program: The structure of PG program shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	COURSE CATEGORY	Course Category	Breakup of Credits
1	BS	Basic Science Courses	4
2	PC	Programme Core Courses	20
3	DE	Department Elective Courses	18
4	EEC	Employment Enhancement Courses	44
		TOTAL	86

CURRICULUM COURSE DISTRIBUTION (BASED ON CREDITS)

Semester	BS	PC	DE	EEC	Total Credits per semester
1	4	8	6	1	19
2		12	6	3	21
3			6	20	26
4				20	20
Total Credits	4	20	18	44	86

CURRICULUM COURSE DISTRIBUTION (BASED ON COURSE COUNT)

Semester	BS	РС	DE	EEC	Total Courses per semester
1	1	2	2	1	6
2		3	2	1	6
3			2	2	4
4				1	1
Total Courses	1	5	6	5	17

CREDIT COUNT

Semester	Credits
1	19
2	21
3	26
4	20
Total	86
Credits	

CURRICULUM STRUCTURE

	M.TECH. AUTOMOBILE ENGINEERING (SMART MOBILITY) CURRICULUM - 2024-2025 (NEP R 2024)														
SL. NO	SEM	COURSE CATEGORY	COURSE TYPE	COURSE CODE	NAME OF THE COURSE	L	т	Р	С	S	тсн				
1	I	BS	ТН	GMA52001	Applied Engineering Mathematics	4	0	0	4	0	4				
2	I	PC	ТР	EAT52001	Vehicle Electrification and Hybridization	2	1	2	4	2	5				
3	I	PC	ТР	EAT52002	Modelling and Simulation of Vehicle Systems with a case study	2	1	2	4	2	5				
4	I	DE	TP	EAT525**	Department Elective-1	2	0	2	3	2	4				
5	I	DE	TP	EAT525**	Department Elective-2	2	0	2	3	2	4				
6	I	EEC	ТР	GLS52001	Leadership Skills for Engineers	1	0	1	1	0	2				
					Total	13	2	9	19	8	24				
L	– Lectur	e T – Tutorial	P – Pr	actical C	C – Credit S – Self Study	/ ТС	H – 1	otal C	Contac	t Hou	rs				

	Semester-II														
SL. NO	SEM	COURSE CATEGORY	COURSE TYPE	COURSE CODE	NAME OF THE COURSE	L	т	Р	С	S	тсн				
1	=	PC	ТР	EAT52003	Crashworthiness and Automotive Safety	2	1	2	4	2	5				
2	П	PC	ТР	EAT52004	AI for Automotive Applications	2	1	2	4	2	5				
3	=	PC	ТР	EAT52005	AI for Autonomous and Connected Vehicles	3	0	2	4	2	5				
4	Ш	DE	TP	EAT525**	Department Elective-3	2	0	2	3	2	4				
5	Ш	DE	TP	EAT525**	Department Elective-4	2	0	2	3	2	4				
6	Ш	EEC	TH	GGE52001	Research and Publication Ethics	3	0	0	3	0	3				
					Total	14	2	10	21	10	26				
Ŀ	L – Lecture T – Tutorial P – Practical C – Credit S – Self Study TCH – Total Contact Hours														

Note: During summer vacation, minimum 15 days internship is mandatory and will be assessed in Semester III

	Semester-III														
SL. NO	SEM	COURSE CATEGORY	COURSE TYPE	COURSE CODE	NAME OF THE COURSE	L	т	Р	С	S	тсн				
1	111	DE	TP	EAT525**	Department Elective- 5	2	0	2	3	2	4\$				
2		DE	TP	EAT525**	Department Elective-6	2	0	2	3	2	4 \$				
3		EEC	IN	EAT52800	Internship	#			2	0	#				
4		EEC	PJ	EAT52801	Project Work-Phase - I	0 0 36		36	18	0	36				
					Total	4	0	40	26	4	44				

L – Lecture T – Tutorial P – Practical C – Credit S – Self Study TCH – Total Contact Hours

Internship to be carried out in summer vacation after 2nd semester and evaluation in 3rd semester
\$ Industry Integrated Courses are handled at the extensive working hours in Industry

	Semester-IV										
SL. NO	SEM	COURSE CATEGORY	COURSE TYPE	COURSE CODE	NAME OF THE COURSE	L	т	Р	с	S	тсн
1	IV	EEC	PJ	EAT52802	Project Work-Phase - II*	0	0	40	20	8	40
					Total	0	0	40	20	8	40
L	L – Lecture T – Tutorial P – Practical C – Credit S – Self Study TCH – Total Contact Hours										

* Presentation in indexed conf./ acceptance for publication in journal / patent filing or publication is mandatory

	LIST OF DEPARTMENT ELECTIVES										
SL. NO	SEM	COURSE CATEGORY	COURSE TYPE	COURSE CODE	NAME OF THE COURSE	L	т	Ρ	с	S	тсн
				EAT52512	AI for Smart Transportation						
1	I	DE 1	TP		OR	2	0	2	3	2	4
				EAT52513	Automated Driving System						
				EAT52502	Hydrogen Energy for Smart Mobility						
2			тр		OR	2	0	2	2	n	4
2		DE 2	IP	EAT52515	Intelligent Driver Assistance Systems with Al	2	U	2	5	Z	4
				EAT52516	Connected Vehicle Technology						
3	3 II D	DE 3	TP	OR		2 0	2	3	2	4	
				EAT52517	Electronic Model Based System Design						
				EAT52506	Vehicle Ergonomics and Styling						
4	Ш	DE 4	TP		OR	2	0	2	3	2	4
				EAT52519	Light Weight Materials for sustainable mobility						
5		DE 5	тр	EAT52520	Thermal Management for Automotive System for Automotive Vehicles	2	0	2	3	2	Л
J		DLJ	IF		1	2	0	2	5	2	4
				EAT52509	IOT for Automotive Applications						
6		DE 6	ТР	EAT52522	Mechatronics in Automotive Applications and Testing	2	0	2	3	2	4
				EAT52523	Cyber security for Vehicle Applications						
L I.	– Lectur	e T – Tutorial	D – Pr	actical (Credit S – Self Study	, тс	н – т	otal (`ontar	t Hou	rs

Sem	Cred its
Ι	19
Ш	21
	26
IV	20
Total	86

S. No.	COURSE CATEGORY	Course Category	Breaku p of Credits
1	BS	Basic Science Courses	4
2	РС	Programme Core Courses	20
3	DE	Department Elective Courses	18
4	EEC	Employment Enhancement Courses	44
		TOTAL	86

COURSE TYPE					
	Theory with				
TP	Practical				
	Course				
ты	Theory				
In	Course				
PJ	Project				
IN	Internship				

<u>Syllabus</u>

Semester I

COURSE TITLE			APPLIED EN	GINEERING MA	THEMATICS	_)	CREE	DITS	4
	(Common for ALL except MCA, CSE and IT)				Г)				
COURSE CO	DE	GM	A52001	COURSE		BS	1	-T-P-S	4-0-0-0
				CATEGOR	Y I				
Version			2.0 Approval Details 41 ST ACM				LE	LEVEL	BIL-4
				ASSESSME	NT SCHEME		•		
				CIA					
First Periodi Assessmer	ical nt	Second Periodical AssessmentSeminar/ Assignments/ ProjectSurprise Test / QuizAttendar				endance	ESE		
15%			15% 10% 5% 5%						50%
Course		To imp	To impart fundamental knowledge in various fields of Advanced Engineering						
Descriptio	n	Mathematics and its applications.							
Course Objective	2	 To apply the concept of calculus of variation. To recognize Laplace Transform Techniques. To recognize Fourier Transform Techniques. To solve partial differential equation problems. 							
		Up	oon completio	on of this cours	se, the studer	nts will be	e able	to	
		1 . An	alyse the Fun	ctional depend	lent on funct	ions of in	deper	ident variab	es.
Course		2. So	lve the partia	l differential ec	quations usin	g Laplace	Trans	form.	
Outcome	•	3. So	lve the partia	l differential ec	quations usin	g Fourier	Trans	form.	
		4. Co	mpute nume	rical solutions u	using explicit	and impl	icit me	ethods.	
		5. Im	plement the	concepts of Pro	bability and	Random	Variak	oles.	
Prerequisites	s: Bas	sics in Di	fferential Equ	ation ,Partial	Differential E	quations	and S	statistics	
CO, PO AND	PSO	MAPPIN	G						
СО	P	0-1	PO-2	PO-3	PO-4	PO	-5	PSO-1	PSO-1
CO-1		3	2	1	2	1		1	1
CO-2 2 2 2 2 2 2						2	2		

CO-3	1	3	2	2	1	1	2	
CO-4	2	2	2	2	2	1	1	
CO-5	1	1	1	1	1	1	1	
1: Weakly related, 2: Moderately related and 3: Strongly related								
MODULE 1: CALCULUS OF VARIATIONS								
Concept of variation and its properties- Euler's Equation-Functional dependent on first and								
higher order derivatives - Functional dependent on functions of several independent variables-								
Isoperimetric problems – Direct Methods-Ritz and Kantorovich methods.								
Suggested Reading: Basic Calculus								
MODULE 2: LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS								
Laplace	transform: Defini	tions, propert	ies -Transform	of error funct	ion, Bessel's f	unction, Dirac		
Delta fu	inction, Unit Ste	p functions –	- Convolution	theorem – I	nverse Laplac	e Transform:		
Complex	k inversion formu	ila – Solutions	to partial diff	erential equat	tions: Heat eq	uation, Wave	CO-2	
equation	n				·	·	BTL-3	
Suggest	ed Reading: Part	ial Differential	Equations, Ha	alf range sine s	series.			
MODULE	3: FOURIER TRA	NSFORM TECH	INIQUES FOR	PARTIAL DIFF	ERENTIAL EQ	JATIONS	(12L)	
Fourier	transform: Defin	itions, proper	ties – Transfo	rm of elemen	tary function	s, Dirac Delta		
function	– Convolution	theorem –	Parseval's ide	entity– Soluti	ons to partia	differential	CO-3	
equation	ns: Heat equatior	n. Wave equat	ion. Laplace a	, nd Poison's ea	uations.		BTL-3	
Suggest	ed Reading: Basi	c integration .						
MODULE	4: NUMERICAL S		PARTIAL DIFFI	ERENTIAL EQU	JATIONS		(12L)	
Solution	of Laplace and F	Poisson equati	ion on a recta	angular regior	n by Liebmani	n's method –		
Diffusion	equation by the	explicit and (Crank Nicolson	n – Implicit m	ethods – Solu	tion of wave	CO-4	
equations	s by explicit scher	me Cubic splin	e interpolatio	n.			BTL-4	
Suggeste	d Reading : Partia	l Differential E	Equations					
MODULE	5: PROBABILITY	AND RANDON	VARIABLES				(12L)	
Discrete	and Continuous	random var	iables - Stan	dard distribut	tions - Binon	nial, Poisson,		
Geometri	c, Normal, Trans	stormation of	one dimensio	nal random v	ariables- Two	o dimensional	CO-5	
	d Readings - Joint, N	knowledge o	n probability	Introduction t	o probabi lity	regression.	BIL-4	
TEXT BOO	DKS	- Kilowicube o	in probability,		o probability:		<u> </u>	
	Gunta A S(20)	06) Calculus of	f Variations wi	th Application	s Prontico Ha	ll of India(P) t	td 6th	
1.	print. New De	lhi.			is, Frencice Ha		<i>,</i> u., u.i	
2	Sankar Rao. K	2004) <i>,</i> Introd	uction to Parti	ial Differential	Equations, Pr	entice Hall of I	ndia(P)	
2.	Ltd.,5th print,	New Delhi.						
3.	Keith M. Walke	r(2013),Applie	ed Mechanics f	or Engineerin	g Technology,	Pearson New I	nternational	
DEFEDEN	Edition.							
REFEREN			- de la Celence	and Frankram	in a Kanana Du			
1.	Grewal, B.S., NU		ous in science		ing, Kanna Pu	blications, nev	v Deini.	
Ζ.	Nawazish Ali Sh			Analysis, Uni				
3.	Viswanaunam. Systems Prenti	re-Hall Inc. III	nner Saddle Bi		deling of Auto		acturing	
Systems, Prentice-Hall, Inc. Upper Saddle River, NJ,USA.								
	https://www.go	ogle co in/bo	oks/edition/In	troduction To	The Calculu	is of Variatio	 /	
1.	EmlQDwAAQBA	J?hl=en&gbp	v=0			<u></u>	-	
2.	https://www.m	aplesoft.com/	/products/ebo	oks/advanced	engineering	mathematics/	'toc.aspx	
3.	https://www.e-	booksdirector	y.com/listing.	php?category	=679			
MOOC								
1.	https://onlineco	ourses.nptel.a	c.in/noc19_m	a34/preview				

COURSE TITLE	VEHICLE E	LECTRIFICA		ID HYBRIDIZATION	CREDITS		4			
COURSE CODE	EAT52001	COURS CATEGO	E ORY	РС	L-T-P-S	2.	1-2-2			
Version	1.0	Approv Details	al	41 ACM	LEARNING LEVEL	6 E	BTL-3			
ASSESSMENT SCHEME										
CIA ESE							ESE			
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Prac Assess	tical ments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendan	ice Theory	Theory Practical			
15%	15%	10	9%	5%	5%	25%	25%			
Course Description	Course This course gives in-depth knowledge on Electric and hybrid Vehicles, Electric motor drives and Power Electronics, Battery Technology and Charging Technology of Electric Vehicles and Future Trends on Electric Vehicles.									
Course Objective	 To compare the concepts of Hybrid and Electric Vehicles. To categorize the Electric machines and Power Electronics To analyse Battery Technology of Electric Vehicles To appraise the Charging Technology of Electric Vehicles To diagona the fitture treads in Electric Vehicles 									
Course Outcome	Upon co 1. Interpro 2. Categor 3. Analyse 4. Assess 5. Discuss	ompletion of et the conce ize the Elec Battery Te he Chargin on the futu	of this co epts of h ctric mac chnology g Technc ure trend	urse, the students w ybrid and Electric Ve hines and Power Ele v of Electric Vehicles plogy of Electric Vehi s in Electric Vehicles	rill be hicles. ctronics cles					
Prerequisites: Systems	Knowledge or	basics of E	lectrical,	Electronics, Mecha	nical, Mechatı	ronics, Automo	bile			
CO, PO AND P	SO MAPPING									
СО	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2			
CO-1	3	2	2	3	2	3	3			
CO-2	2	2	2	2	3	2	1			
CO-3	2	2	-	2	2	-	2			
CO-4	2	-	2	2	-	2	1			
CO-5	1	2	1	2	2	2	1			
Module 1: Intr	oduction to E	lectric and	Hybrid \	/ehicles			6L+3T+ 6P)			
Historical Jour Electric Hybrid Lab Componen 1. To bu	Historical Journey of Electric and Hybrid vehicles - Economic and Environmental Impact of Electric Hybrid Vehicle - Well-to-Wheel Emissions of EVs. CO-1 Lab Component BTL-2									

	2. To evaluate Power and Energy of Electric Vehicle	
Soft	ware/Equipment Required	
MAT	LAB with Simulink	
Mod	ule 2: Electric Machines and Power Electronics	(6L+3T+ 6P)
EV F Elect Lab	Power Electronics - Electric Machines - Inverter/VFD - Speed Control - Losses in Power tronics, Battery and Electric Machines. Component 1. To model traction motors 2. To develop Matter Control Units	CO-2 BTL-3
6 - 4	2. To develop Motor Control Units	
	Ware/Equipment Required	
Mad	LAB with Siniscape tool	
IVIOC	lule 3: Battery Technology for Evs	(6L+31+ 6P)
Batto Man Lab	ery -working principles & Battery losses - Lithium-ion Batteries - Battery pack and Battery agement system - Battery Production and Reuse. Component 1. To model batteries and develop battery management systems (BMS)	CO-3
		BTL-3
Soft MAT	ware/Equipment Required IAB with Simscape tool	
Mod	lule 4: Charging Technology of EVs	(6L+3T+ 6P)
AC c limit Lab	harging - Type 1,2,3 - DC charging - CHAdeMO, Tesla, CCS, GB/T - Fast charging and its ations - Smart charging and Applications - Vehicle to Grid (V2G) Technology Component	CO-4 BTL-3
	1. Case study of ABB Charging Technology	
Mod	I. Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles	(6L+3T+ 6P)
Mod Wire Char	Case study of ABB Charging Technology lule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component	(6L+3T+ 6P) CO-5 BTL-3
Mod Wire Char Lab	Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team	(6L+3T+ 6P) CO-5 BTL-3
Mod Wire Char Lab		(6L+3T+ 6P) CO-5 BTL-3
Mod Wire Char Lab TEXT		(6L+3T+ 6P) CO-5 BTL-3 ished by
Mod Wire Char Lab TEXT 1.	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team TBOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 	(6L+3T+ 6P) CO-5 BTL-3 ished by
Mod Wire Char Lab TEXT 1. 2. REFE	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team GOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 	(6L+3T+ 6P) CO-5 BTL-3 ished by
Mod Wire Char Lab TEXT 1. 2. REFE 1.	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team BOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 RENCE BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 	(6L+3T+ 6P) CO-5 BTL-3 ished by 022.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2.	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team Gase Study : Vattenfall solar car team Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 Rence BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 Tom Denton., "Electric and Hybrid Vehicles"2020.	(6L+3T+ 6P) CO-5 BTL-3 ished by 0222.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2. E BO	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team BOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 RENCE BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 Tom Denton., "Electric and Hybrid Vehicles" 2020. 	(6L+3T+ 6P) CO-5 BTL-3 ished by 0222.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2. E BO 1.	 Case study of ABB Charging Technology Lule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team BOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) A. K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 Rence BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 Tom Denton., "Electric and Hybrid Vehicles"2020. OKS https://autocrypt.io/wp-content/uploads/2021/08/electric-vehicle-ebook.pdf 	(6L+3T+ 6P) CO-5 BTL-3 ished by 022.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2. BO 1.	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team BOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 RENCE BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 Tom Denton., "Electric and Hybrid Vehicles" 2020. OKS https://autocrypt.io/wp-content/uploads/2021/08/electric-vehicle-ebook.pdf https://www.routledge.com/rsc/downloads/CRC_Hybrid_Vehicles_Freebook.pdf 	(6L+3T+ 6P) CO-5 BTL-3 ished by 022.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2. E BO 1. 2.	 Case study of ABB Charging Technology Iule 5: Future Trends in Electric Vehicles eless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving ging EVs from Renewable Resources Component Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team Case Study : Vattenfall solar car team BOOKS James Halderman and Curt Ward, "Electric and Hybrid Electric Vehicles", 1st edition, Publ Pearson (2022) K. Babu., "Electric and Hybrid Vehicles", Second Edition, Khanna Publishing., January 20 Rence BOOKS Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680 Tom Denton., "Electric and Hybrid Vehicles"2020. OKS https://autocrypt.io/wp-content/uploads/2021/08/electric-vehicle-ebook.pdf https://autocrypt.io/wp-content/uploads/2021/08/electric-vehicle-ebook.pdf 	(6L+3T+ 6P) CO-5 BTL-3 ished by 0222.
Mod Wire Char Lab TEXT 1. 2. REFE 1. 2. E BO 1. 2. I. 1. 1. 2. I. 1. 2. I. 1. 1.	 Case study of ABB Charging Technology Intersection of the second content of the second conte	(6L+3T+ 6P) CO-5 BTL-3 ished by 0222. -9567-8.

COURSE TITLE	MODELLING AND SIMULATION OF VEHICLE SYSTEMS WITH A CASE STUDY			CREDITS	4
COURSE CODE	EAT52002	COURSE CATEGORY	РС	L-T-P-S	2-1-2-2

Version	1.0	Approval	41 ACM	LEARNING	RNING BTL-3			
ASSESSMENT SO	CHEME	Details		LEVEL				
ASSESSIVILINI SU		CIA			F	SE		
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical		
15%	15%	10%	5%	5%	25%	25%		
Course Description	This course give parameters, m management s	s in-depth knowle odelling battery system and vehic	dge on modelling o electric vehicles, cle dynamic contro	of vehicle perf drivetrain cha ol systems.	ormance racteristic	s, energy		
Course Objectives	 To underst. To model b To describe To know th To know th 	and the modelling attery electric vel the drivetrain ch e concepts of ene e vehicle dynamic	; of vehicle performa nicles. aracteristics. rgy management sy control systems.	stem.	rs.			
Course Outcomes	Course Upon completion of this course, the students will be able to 1. Discuss on the modelling of vehicle performance parameters. 2. Develop the model of battery electric vehicles. 3. Design the drivetrain characteristics. 4. Apply the concepts of energy management system. 5. Develop the vehicle dynamic control systems.							
Prerequisites: B	asic Knowledge o	on electric and ele	ectronics					
CO, PO AND PS	O MAPPING							
со	PO-1 PC	D-2 PO-3	PO-4	PO-5	PSO-1	PSO-2		
CO-1	2 :	1 1	1	1	2	1		
CO-2	3	3 2	2	2	1	2		
CO-3	3	2 1	1	1	2	1		
CO-4	2 3	3 2	2	2	1	1		
CO-5	2				2	2		
Madula 1, Mar	1: Weakly r	elated, 2: Wodera	itely related and 3:	Strongly relate	a ()			
Module 1: Modelling in Performance Parameter(6L+3T+ 6P)Modelling Vehicle Acceleration - Acceleration performance parameters, modelling the acceleration of an electric scooter, modelling the acceleration of a small car.CO-1 BTL-3Lab Component Vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill)CO-1 BTL-3								
MATLAB/SIMUL	INK							
Module 2: Mod	elling of Battery I	Electric Vehicles			(6	5L+3T+ 6P)		
Electric Vehicle climbing force, Driving cycles, R Range modelling Lab Component 1. Develo and Pe	Modelling - Trac Acceleration for ange modelling c g of fuel cell vehic t p a simulation mo rformance	ctive Effort, rollir ce, Total tractive If battery electric les, Range model del to analyse the	g resistance force, effort, Modelling I vehicles, Constant v ing of hybrid electri effect of Rolling Res	Aerodynamic Electric Vehicle elocity range n c vehicles. sistance on veh	drag, Hill Range - nodelling, icle range	CO-2 BTL-3		

2. Efficiency evaluation of a series HEV in city and high-way cycles: study and analyse two series for the series the series and the series of	0
strategies for ICE/Battery power split.	
MATLAB/SIMULINK	
Module 3: Drive Train Characteristics	(6L+3T+ 6P)
Modelling and Characteristics of EV/HEV Powertrains Components- ICE Performance	e
Characteristics Electric Motor Performance Characteristics - Battery Performance	e
Characteristics-Transmission and Drivetrain Characteristics-Regenerative Brakir	σ
Characteristics-Driving Cycles Modelling and Analysis of Electric and Hybrid Electric Vehicle	5
Propulsion and Braking - Longitudinal Dynamics Equation of Motion - Vehicle Propulsion	n CO-3
Modelling and Analysis - Vehicle Braking Modelling and Analysis	BTI-3
Lab Component	
Series HE powertrain mathematical model	
Software/Equipment Required	
MATLAB/SIMULINK	
Module 4: Energy Management	(6L+3T+ 6P)
Handling Analysis of Electric and Hybrid Electric Vehicles - Simplified Handling Mode	s
Energy/Power Allocation and Management - Power/Energy Management Controllers - Rul	2-
Based Control Strategies - Optimization-Based Control Strategies.	CO 4
Lab Component	BTL-2
Computer model of the HEV	DIE-3
Software/Equipment Required	
MATLAB/SIMULINK	
Module 5: Vehicle Dynamic Control	(6L+3T+ 6P)
Control of Electric and Hybrid Electric Vehicle Dynamics - Fundamentals of Vehicle Dynam	с
Control (VDC) Systems, VDC Implementation on Electric and Hybrid Vehicles – Case Studie	5,
Rechargeable Battery vehicles, Hybrid Vehicles, Fuel Cell Powered Bus.	CO-5
Lab Component	BTI-3
Various strategies for improving vehicle energy/fuel efficiency	
Software/Equipment Required	
MATLAB/SIMULINK	
BOOKS	
1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & S	ons
2 Amir Khajenour, Saher Fallah and Avesta Goodarzi, "Electric and Hybrid Vehicles-	
Z. Anni Klajepour, saber raian and Avesta Goodalzi, Electric and Tybrid Venices-	td
2019.	
3. Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology: Mo	leling,
Control, and Simulation", IGI Global, 2018.	
REFERENCE BOOKS	
1 Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology:	
Modelling, Control, and Simulation", IGI Global, 2018.	
2 Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Ce	
Vehicles_ Fundamentals, Theory, and Design, Second Edition", CRC Press, 2017.	
E Resources for Reference	
1. http://ebooks.asmedigitalcollection.asme.org/book.aspx?bookid=277	
2. http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%200	ollection
моос	
1. https://onlinecourses.nptel.ac.in/noc24_ee30/preview	

COURSE TITLE	LEADERSHIP SKILLS FOR ENGINEERS	CREDIT	1

COURSE CODE	GLS52001	COURSE CATEGORY EEC L-T-P-C			1-0-1-0		
Version	1.0	Approval Details			41 ACM	LEARNING LEVEL	BTL-3
ASSESSMENT S	СНЕМЕ						
	-		CIA				
First Periodica	Second	Wee	ekly assignme	nt/	Surprise Test/	Attendance	
Assessment	Periodical	Ob	servation / la	ıb	Quiz etc., as		ESE
	Assessment	rec	ords and viva	as	approved by		
		aga	roved by the I	DEC	the DEC		
15%	15%		10%		5%	5%	50%
Course Description	This course focu activities, simul exercises to bui and ethical lead	uses on o ations ar Id effect Iership c	developing leand nd real-world ive communic apabilities.	dership s case stud cation, tea	kills for engine ies. Students v am manageme	ers through hand vill engage in prac nt, strategic decis	s-on tical ion-making
	1. To apply lea	adership	theories and	models ir	n practical scer	narios.	
Course	2. To enhance	e commu	inication and	interperso	onal skills thro	ugh interactive ex	ercises.
Objectives	3. To develop	team m	anagement a	nd conflic	t resolution st	rategies via simula	ations.
,	4. To practice	strategi	c thinking and	decision	-making in eng	ineering contexts	
	5. To address	ethical i	ssues and pro	tessional	responsibilitie	s through case stu	idies.
Course Outcomes	 Upon completion of this course, the students will be able to Demonstrate the ability to apply various leadership theories and models effectively in engineering-related practical scenarios through simulations and role-playing exercises. Discuss and exhibit advanced communication and interpersonal skills, including active listening, effective verbal and non-verbal communication, and relationship-building, through interactive exercises and peer feedback. Implement effective team management and conflict resolution strategies, showcasing their capability to lead diverse teams and mediate conflicts in engineering contexts through practical simulations. Develop strategic thinking and decision-making skills by developing strategic plans, conducting risk assessments, and making informed decisions in simulated engineering projects. Analyze and respond to ethical issues and professional responsibilities in engineering, applying ethical frameworks and principles to real-world case studies and role-playing 						
Prerequisites:	NIL						
CO, PO AND PS	O MAPPING						I
со	PO-1 P	0-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	3	2	1	2	3	2	1
CO-2	2	2	2	2	2	1	2
CO-3	3	2	1	2	3	2	1
CO-4	3	2	1	2	2	2	2
CO-5	3	2	1	2	3	2	1
	1: Weakly ı	related,	2: Moderatel	y related	and 3: Strongl	y related	-
Module 1: Pra	actical Leadership	Founda	tions				(3L+3P)
Self-assessmen	t using tools (like	e Myers	-Briggs, DISC)	- Differer	nt leadership	styles- Personal	
leadership style identification- mindful Leadership-Setting personal leadership development goals- Leadership challenges in engineering contexts- employers wish list in leadership skills.					CO-1		
Lab Exercises: • Leade	rship style self-ass	essment	t and reflectio	n, Role-pl	ay scenarios to	practice different	BTL-2
leader	ship styles.						
Module 2: Cor	nmunication and	Interpe	rsonal Skills				(3L+3P)

Simul	ations for effective verbal and non-verbal communication- Building rapport and active	
listen	ing drills -Group communication exercises- Networking and building professional	
relatio	onships- Influencing and persuading skills- The ability to lead the people effectively-	CO-2
Confli	ict avoidance and stress management techniques.	BTL-2
Lah E	voreisos	
	Exercises on influencing and nersuading in team settings. Leadership skills in Group	
	discussion	
Mod	ule 3: Team Dynamics and Conflict Management	(3L+3P)
Formi	ing and leading diverse engineering Teams-Team-based problem-solving Exercises-	(0=+01)
Leade	ership roles in team settings- role of feedback and negotiation skills- Conflict scenarios in	
engin	eering Projects-Role-playing conflict resolution strategies- Mediation and negotiation	CO-3
simula	ations.	
		BTL-3
Lab E	exercises:	
•	Team-based engineering challenge, Conflict resolution role-plays.	
Mod	ule 4: Strategic Thinking and Decision Making	(3L+3P)
Devel	oping strategic plans for hypothetical project- Scenario planning and risk management	
exerc	ises -Delegation of tasks -SWOT analysis workshops -Real-time decision-making	
simula	ations -Ethical decision-making in engineering cases -Group discussions on decision-	CO-4
makir	ng processes.	DTI 2
		DIL-3
Lab E	xercises:	
Lab E	xercises: Strategic planning exercise- Real-time decision-making simulation	
Lab Ex	xercises: Strategic planning exercise- Real-time decision-making simulation.	(3I +3P)
Lab Ex • Modu	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering. Bole-playing responses to ethical challenges -	(3L+3P)
Lab Ex • Modu Analy	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - a discussions on professional responsibility -Building a leadership brand -Networking and	(3L+3P)
Lab Ex Mode Analy Group	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning	(3L+3P) CO-5
Lab Ex Modu Analy Group mento	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning.	(3L+3P) CO-5
Lab Ex Mode Analy Group mento	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises:	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group mento Lab Ex	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group mento Lab Ex • TEXT	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group mento Lab Ex TEXT	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and	(3L+3P) CO-5 BTL-3 principles
Lab Ex Mode Analy Group mento Lab Ex TEXT 1.	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley	(3L+3P) CO-5 BTL-3 principles
Lab Ex Modu Analy Group mento Lab Ex • TEXT 1. REFE	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group menta Lab Ex TEXT 1. REFEI	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group mento Lab Ex TEXT 1. REFE	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset Routledge.	(3L+3P) CO-5 BTL-3 principles t (1st ed.).
Lab Ex Mode Analy Group mento Lab Ex TEXT 1. REFEI 1. E- RE	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset Routledge. SOURCES	(3L+3P) CO-5 BTL-3 principles t (1st ed.).
Lab Ex Modu Analy Group menta Lab Ex TEXT 1. REFEI 1. E- RE 1	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset Routledge. SOURCES Important Leadership Skills for Workplace Success (thebalancemoney.com)	(3L+3P) CO-5 BTL-3 principles t (1st ed.).
Lab Ex Mode Analy Group mente Lab Ex TEXT 1. REFE 1. E- RE 1 MOO	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset Routledge. SOURCES Important Leadership Skills for Workplace Success (thebalancemoney.com) CCOURSES	(3L+3P) CO-5 BTL-3
Lab Ex Modu Analy Group mento Lab Ex • TEXT 1. REFEI 1. E- RE 1 MOO	xercises: Strategic planning exercise- Real-time decision-making simulation. ule 5: Ethical Leadership and Professional Development sis of ethical dilemmas in engineering- Role-playing responses to ethical challenges - o discussions on professional responsibility -Building a leadership brand -Networking and orship activities- emotional intelligence -Continuous professional development planning. xercises: Ethical dilemma role-plays-Developing a personal professional development plan BOOKS Arnold, E. E., & Bowman, J. S. (2022). Engineering leadership: Key competencies and for effective leadership (2nd ed.). Wiley RENCES Tate, M. J., & Springer, J. S. (2021). Leadership for engineers: The magic of mindset Routledge. SOURCES Important Leadership Skills for Workplace Success (thebalancemoney.com) oc COURSES https://www.mooc-list.com/tags/english	(3L+3P) CO-5 BTL-3

Semester II

COURSE TITLE	CRASHWO	RTHINESS AND A	CREDITS	4		
COURSE CODE	EAT52003	COURSE CATEGORY	L-T-P-S	2-1-2-2		
Version	1.0	Approval Details	41 ACM	LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						

		CIA				ESE	
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessment	Obse r app s De Ex Com	ervation / lab ecords as roved by the epartment amination mittee "DEC"	Attendance	Theory	Practical
15%	15%	10%		5%	5%	25%	25%
Course Description	 This course is designed to provide students with the most current knowledge in vehicle safety and crashworthiness as practiced by the modern automotive industry. Upon completing this course, students will be equipped with the skills to use both analytical and numerical methods to determine crash dynamics and analyze vehicle behavior during collisions, focusing on energy absorption and deformation. Students will gain familiarity with comprehensive vehicle accident analysis and reconstruction. 						
Course Objectives	 To know about the basics about the fundamentals and design of crashworthiness To understand the safety aspects in the vehicle advanced crashworthiness and frontal impact analysis To Know and understand the safety aspects To know about the various safety equipment in a vehicle To know about the collision systems comfort and convenience system 						
Course Outcomes	 Upon completion of this course, the students will be able to Discuss on the fundamentals and design principles of crashworthiness. Analyse safety aspects in advanced vehicle crashworthiness and frontal impact scenarios. Comprehend and evaluate various vehicle safety aspects. Identify and understand the different safety equipment used in vehicles. Explore and understand collision systems, comfort, and convenience features in vehicles 						
Pre requisite	: Knowledge o	n Vehicle Dyn	amics, Veł	icle Body Struc	tures, FEA.		
CO, PO AND	PSO MAPPING						
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	3	1	1	1	1	2	1
CO-2	4	4	3	3	-	1	3
CO-3	3	2	1	1	-	3	1
CO-4	2	4	3	3	-	1	1
CO-5	Z	۷.	T		-	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related							
Module 1: C	rashworthines	s – Fundamen	tals and De	esign		(6L	+3T+ 6P)
Fundamentals of Structural Crashworthiness and Impact Biomechanics: Collision type and Basic theory (frontal, side, rear, offset, VRU). Plastic behaviour of fundamental vehicle components: Circular, prismatic, beam, Inverbuck tube, inversion tube. Geometrical features for Energy Absorption (EA) - design of automotive structure to optimize EA during impacts. Lab Component 1. Geometrical Designs Software (Equipment Used					CO-1 BTL-2		
Software/Equipment Used							

AUTO CAD software.

Module 2: Fr	ontal Impact Analysis	(6L+3T+ 6P)
Mechanics of	frontal collisions - Frontal impact analysis - acceleration-time characteristics	
modelling-for	ce vs. crush characteristics and using LS DYNA for crash modelling.	
Lab Compon	ent	
1. Setti	ng up of crash simulation in LS DYNA	CO-2
2. Inpu	t parameters and boundary conditions for accurate modeling	BTL-4
3. Runi	ling simulations and interpreting results	
Software/Equ	Alpment Used	
Modulo 2: Int	traduction and Safaty Concents	(61 +2T+ 6D)
Noule 5. In	hodu for sofety concepts	
Design of the	body for safety – active safety and passive safety.	
	rter Car modeling including suspension types, spring damper systems	CO-3
Software/Equ	upment Used	BTL-3
MATLAB.		
Module 4: Sa	fety Equipment	(6L+3T+ 6P)
Seat helt Rec	rulations. Automatic seat helt tightener system. Collansible steering column	
Tiltable steer	ing wheel. Air bags, Electronic system for activating air bags. Bumper design	
for safety. An	tiskid braking system. Regenerative Braking System. Cruise Control. Adaptive	
Cruise Contro	l Devices.	
Lab Compone	ents	CO-4
1. Test	ing seat belt and air bag	BIL-4
2. Exan	nining braking system	
Software/Equ	uipment Used	
ABS, Launchp	ad DS201	
Module 5: Co	Ilision Systems, Comfort and Convenience	(6L+3T+ 6P)
Causes of rea	ar end collision, Frontal and rear object detection, Object detection with	
braking syste	m interactions, Driver Behaviour Detection. Steering and mirror adjustment,	
Central lockin	g and garage door opening, Tyre pressure control, Rain sensor, Environment	
information,	Manual and Automated Wiper, GPS.	
Lab Compone	ent vel Leching	CO-5
1. Cent	Idi LOCKIIIg	DIL- 4
2. Tyre 3. Rain	Sensors and GPS Navigation	
Software/Fou	inment lised	
Matlab, Hyun	dai Creta	
TEXT BOOKS		1
1.	J. Kisilowski, J. Zalewski Modeling of Road Traffic Events, Springer, 2022	
2	C. Lakebrana Dec. V. Narayanamurthy, K. D. V. Simba, Applied Impact Mach	
۷.	C. Laksimana Rao, V. Narayanamurtny, K. R. Y. Simila, Applieu impact Mech	ianics, wiley,
REFERENCES	2010	
1	D. C. Eleming and K. F. Jackson, Crashworthy Composite Structures: Aircraft &	& Vehicle
±.	Applications, DESteach Publications, 2021	
2.	Bosch - "Automotive Handbook" - 9th edition – Wiley-Blackwell, 2014.	
	-,,	
3.	D. E. Struble and J. D. Struble, Automotive Accident Reconstruction: Practices	s and
	Principles, 2 nd edition, CRC Press, 2020	
4.	Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McG	iraw-Hill Inc.,
E Docourres		
	bit neierente	ivo
<u> </u>	https://www.researchgate.net/publication/320520945_improving_automot	.ive_
<u>∠.</u>	nttps.//www.iqytechnicalcollege.com/Auto%20Venicle%20Safety.pdf	
	https://www.maas.list.com/course/cafety_first_ov_maintenance_hast_areat	
1.	https://www.mooc-list.com/course/safety-first-ev-maintenance-best-practi	Les-coursera

	F				CRED	ITS		٨	
COOKSETT		AI FOR A	UTOMOTIVE AP	PLICATIONS	CRED	113		7	
COURSE CODE	EAT5	2004	COURSE CATEGORY	PC	L-T	-P-S	2-:	1-2-2	
Version	1	.0	Approval Details	41 ACM	LEAF	RNING VEL	В	BTL-3	
ASSESSMEN	IT SCHEME								
First Periodical Assessmen (Theory)	Sec Perio t Assess (The	ond odical sment eory)	Practical Assessments	Observation / records as approved by t Department Examination Committee "D	lab the t EC"	ndance	Theory	Practical	
15%	15	5%	10%	5%	5	5%	25%	25%	
Course	This co	urse provi	ides knowledge	on Artificial Intel	ligence in A	utomotiv	ve Applicat	tions and	
Description	n Intellige	ent Transp	ortation						
Course Objectives	2. To 2. To 3. To 4. To 5. To	demonstr discuss or describe t describe t	rate the AI in Au n AI in Automoti the Machine Lea the AI in Safety	tonomous Drivin ve Manufacturin arning Algorithms Regulations, and	g Technolog g and Suppl s used in Al Customer E	sy y Chain Experient	ce		
Course Outcomes Prerequisite	1. Dis 2. De 3. dis 4. De 5. de: 5. de:	 Upon completion of this course, the students will be able to Discuss on Al Automotive industry and Applications Demonstrate the Al in Autonomous Driving Technology discuss on Al in Automotive Manufacturing and Supply Chain Describe the Machine Learning Algorithms used in Al describe the Al in Safety Regulations, and Customer Experience 							
CO. PO AND	PSO MAPPI	ING							
СО	PO -1	PO-2	PO-3	PO-4	PO-5	PSC	D-1	PSO-2	
CO-1	2	2	1	2	1	1		2	
CO-2	2	3	2	2	2	2	2	1	
CO-3	1	2	1	1	1	1	-	2	
CO-4	2	2	2	2	2	2	2	1	
CO-5	2	1	1	1	1	1	_	2	
1: Weakly related, 2: Moderately related and 3: Strongly related									
Module 1:Ir	ntroduction (to Al in Au	tomotive Indus	stry			(6L	.+3T+ 6P)	
Evolution of AI - Introduction of AI Automotive industry -Applications of AI in the Automotive sector - Impact of AI technologies on automotive industry - Machine Learning Techniques - Computer Vision Techniques Laboratory Component • Demonstration of AI tools and its capabilities Software/ Equipment Required						CO-1 BTL-2			

2.

	2 2: Al in Autonomous Driving and Design	6L+3T+ 6P)
Techno	ologies involved in Autonomous Driving Systems – Sensor Technology - Actuators -	
Contro	I Systems and Onboard Computing -NVIDIA AI tools -AI Techniques for Vehicular	
Percept	tion -AI techniques for Decision Making and Control Tasks -AI for Capturing and	
Process	sing Real-Time Data	CO-2
Labora	itory Component	BTL-2
•	Demonstration of NVIDIA AI tools and AI techniques for vehicular perception	
Softwar	re/ Equipment Required	
•	NVIDIA AI tools, TensorFlow and OpenCV	
Module	e 3: Al in Automotive Manufacturing and Supply Chain	6L+3T+ 6P)
Smart	Manufacturing -Integrating AI, IoT and Data analytics -AI in supply chain management	
Robotic	cs and Automation in Assembly Lines -Automated Guided Vehicles (AGVs) -Collaborative	
Robots	-AI for Quality Control Inspection -AI for Monitoring and Maintenance -AI for Detecting	
Anoma	lies and Fail Safes	
Labora	itory Component	CO-3
•	Case Study: General Motors – Dream Catchers	BTL-3
•	Case Study: Continental - Al driven Virtual Simulation Tool	
Softwa	re/Equipment Required	
•	Dream Catchers and Virtual Simulation Tool	
Module	A:Machine Learning Algorithms	(6I +3T+ 6P)
Linear	Regression - Logistic Regression -Decision tree - SVM algorithm Naive Bayes Algorithm -	
	gorithm - K-means -Random Forest Algorithm Dimensionality Reduction Algorithms -	
Gradien	at Boosting Algorithm and AdaBoosting Algorithm	
Labora	itory Component	CO-4
Labora	Demonstration of SVM algorithm and Bandom Forest Algorithm	BTL-2
Softwar	Demonstration of SVM algorithm and Random Forest Algorithm	
SOLWA		
	TensorFlow and Onen()/	
• •	TensorFlow and OpenCV	
Module	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience	(6L+3T+ 6P)
Module Al Auto	TensorFlow and OpenCV e 5: Al in Safety, Regulations and Customer Experience phonomy and Human Control - Rules and Regulations by Society of Automotive Engineers	(6L+3T+ 6P)
Module Al Auto (SAE) -	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) -	(6L+3T+ 6P)
Module Al Auto (SAE) - Europe	TensorFlow and OpenCV 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS)	(6L+3T+ 6P)
Module Al Auto (SAE) - Europe -Cybers	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) Security measures for protecting AI-driven Automotive Systems	(6L+3T+ 6P) CO-5
• Module Al Auto (SAE) - Europe -Cybers Labora	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) Security measures for protecting AI-driven Automotive Systems Interv Component	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora Softwar	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora Softwar	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar •	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers -Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) Europe -Cybers Labora • Softwar • 1.	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience bonomy and Human Control - Rules and Regulations by Society of Automotive Engineers endustry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems tory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO 1. 2.	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers -Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems tory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO 1. 2. REFERE	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting Al-driven Automotive Systems Intory Component Demonstration of Cyber Security Measures for protecting Al-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO 1. 2. REFERE	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience conomy and Human Control - Rules and Regulations by Society of Automotive Engineers industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems http://www.systems ref Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Veh	(6L+3T+ 6P) CO-5 BTL-2 ion ISBN-13: nology in the cles in Smart
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO 1. 2. REFERE 1.	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Donomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting Al-driven Automotive Systems http://component Demonstration of Cyber Security Measures for protecting Al-driven automotive systems ref Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Veh Grid Systems Fundamentals, Technologies, and Solutions, 2024, eBook ISBN: 97804432	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) Europe -Cybers Labora • Softwar • TEXT BO 1. 2. REFERE 1. 2.	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience bonomy and Human Control - Rules and Regulations by Society of Automotive Engineers -Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems tory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Veh Grid Systems Fundamentals, Technologies, and Solutions, 2024, eBook ISBN: 97804432 Intel Corporation "Artificial Intelligence in the Automotive Industry 2021	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • Softwar • TEXT BO 1. 2. REFERE 1. 2. MOOC	TensorFlow and OpenCV 2 5: Al in Safety, Regulations and Customer Experience Denomy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) Security measures for protecting AI-driven Automotive Systems Tey Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems Te/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Veh Grid Systems Fundamentals, Technologies, and Solutions, 2024, eBook ISBN: 97804432 Intel Corporation "Artificial Intelligence in the Automotive Industry 2021	(6L+3T+ 6P) CO-5 BTL-2
Module Al Auto (SAE) - Europe -Cybers Labora • TEXT BO 1. 2. REFERE 1. 2. NOOC 1.	TensorFlow and OpenCV 25: Al in Safety, Regulations and Customer Experience Dromy and Human Control - Rules and Regulations by Society of Automotive Engineers Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - an Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) security measures for protecting AI-driven Automotive Systems tory Component Demonstration of Cyber Security Measures for protecting AI-driven automotive systems re/ Equipment Required TensorFlow and OpenCV DOKS Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edit 978-0-13-604259-4, 2010 S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Tech Automotive Industry: An Overview, Springer International Publishing , 2021 NCES Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Veh Grid Systems Fundamentals, Technologies, and Solutions, 2024, eBook ISBN: 97804432 Intel Corporation "Artificial Intelligence in the Automotive Industry 2021	(6L+3T+ 6P) CO-5 BTL-2 ion ISBN-13: nology in the cles in Smart 38154

COURSE TITLE	AI FOR AUTONOMOUS AND CONNECTED VEHICLES			CREDITS	4
COURSE CODE	EAT52005	COURSE CATEGORY	PC	L-T-P-S	3-0-2-2

Version	1.0	Approval Details	41 ACM	LEARNING	LEARNING LEVEL		BTL-3	
ASSESSMEN	T SCHEME							
		CIA				ES	E	
First Periodica Assessment (Theory)	al Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approve by the Department Examination Committee "DEC"	d t Attendanc	e Th	eory	Practic al	
15%	15%	10%	5%	5%	2	5%	25%	
Course	This course	provides knowled	ge on Automated, Cor	nnected, Intellig	gent Veh	icles ar	nd	
Description	Wireless Te	chnology used in A	utomated and Conne	cted vehicle.				
Course Objectives	 To disc To der Vehicle To des To des To des To des 	 To discuss the concept of Automated, Connected, and Intelligent Vehicles To demonstrate the Sensor Technology for Automated, Connected, and Intelligent Vehicles To describe the Wireless Technology used in Automated, Connected vehicle To describe the Wireless Networking and Applications to Vehicle Autonomy 						
		completion of this of	ourse the students w	vill be able to	5,051			
Course Outcomes	1. Discuss 2. Interpr 3. Design 4. Develo 5. Develo	 Discuss the concept of Automated, Connected, and Intelligent Vehicles Interpret the Sensor Technology for Automated, Connected, and Intelligent Vehicles Design the Wireless Technology used in Automated, Connected vehicle Develop the Wireless Networking and Applications to Vehicle Autonomy 						
Prerequisites	Basic Knowled	lge on sensors, elec	tronics	., .	51			
CO, PO AND	PSO MAPPING	<u> </u>						
СО	PO -1	PO-2 PO	-3 PO-4	PO-5	PSO-1		PSO-2	
CO-1	2	2 1	3	1	1		2	
CO-2	2	3 2	2	2	2		1	
CO-3	1	2 1	2	1	1		2	
CO-4	2	2 1	2	1	2		1	
CO-5	2	1 1	2	1	1		2	
	1: Wea	kly related, 2: Mod	erately related and 3	: Strongly relat	ted			
Module 1: C	onnected and A	utonomous Vehicle	e Technology			(91	L+6P)	
Architecture of Connected Vehicle Technology and Autonomous Vehicle Technology - Automotive Electronics - Basic Control System, Operation of ECUs, Basic Cyber-Physical System -Sensing Systems and Autonomy					CO-1			
• Der	nonstration of A	utomotive Electror	ics Network				BTL-2	
• Der	nonstration of E	CU Architecture						
Software/ Eq	uipment Requi	red						
ECU	and Automotive	e Electronics Netwo	rk layout					
Module 2: Sensor Technology for Automated, Connected, and Intelligent Vehicles					(9	L+6P)		
Radar Technology-Ultrasonic Sonar -Lidar Sensor Technology –Camera Technology- Night Vision Technology - Integration of Sensor Data -Impaired Driver Technology - Sensor Technology for Driver Impairment Detection								
Laboratory (Components						CO-2	
• Der	nonstration of v	vorking of Radar an	d Lidar Sensor				BTL-2	
• Der	nonstration of v	vorking of Camera s	ensor					
Software/ Eq	Juipment Requir	red						
	verview of Wire					/0	91 +6P)	
module 5. O		iess reenhology				13		

Wireld Syster Propa Labor Softwa	ess Data Networks and Autonomy -Block Diagram and its Components, Transmission ns – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Signal gation Physics, Basic Transmission Line and Antenna Theory. ratory Components Demonstration of working of wireless technology (Bluetooth and Wi-Fi) Demonstration of working of Modulation/Encoding, Receiver System Concepts are/ Equipment Required Bluetooth and Wi-Fi Transceiver	CO-3 BTL-3
Modu	le 4: Wireless Networking and Applications to Vehicle Autonomy	(9L+6P)
Wireld – the Netwo Labor Softwa	ess Networking and Applications to Vehicle Autonomy, Basics of Computer Networking Internet of Things, Wireless Networking Fundamentals, Integration of Wireless orking and On-Board Vehicle Networks. ratory Components Demonstration of working of Internet of Things are/ Equipment Required Thingspeak IOT	CO-4 BTL-2
MODU	JLE 5: Vehicle-to-Vehicle Technology	(9L+6P)
Conne Vehicl Case S •Toyo Ford, 0	ectivity Fundamentals, Navigation, Vehicle-to-Vehicle Technology and Applications, le-to-Roadside and Vehicle-to-Infrastructure Applications Study on Advanced Driver Assistance System Technology Dta, Nissan, Honda, Hyundai,Volkswagen, BMW, Daimler, Fiat Chrysler Automobiles, General Motors	CO-5 BTL-2
TEXT B	BOOKS	
1.	G. Mullett, Wireless Telecommunications Systems and Networks, Thomson – Delr ISNB#1-4018-8659-0, 2018	nar Learning,
2.	G. Mullett, Basic Telecommunications: The Physical Layer, Thomson – Delmar Learning, 4339-5, 2017	ISBN#1-4018-
REFER	ENCE	
1.	Steven Van Uytsel, Autonomous Vehicles, 1st Edition, 2021	
MOO	с	
1	https://www.edx.org/learn/automation/rwth-aachen-university-automated-and-connechallenges	ected-driving-

COURSE TITLE	RESEARCH	AND PUBLICATI	ND PUBLICATION ETHICS CREDITS					3
COURSE CODE	GGE52001	COURSE CATE	GORY EEC		L-T-P-S		3	-0-0-0
Version	1.0	Approval Deta	val Details 41 st ACM		LEARNING LEVE			BTL-3
ASSESSMENT SCHEME								
	CIA ESE							
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Assignments / Projects	Quiz /Surprise Test as approved by the Department Examination Committee "DEC"		Attendance	Theory		Practical
15%	15%	10%	5%		5%	2	5%	25%
Course DescriptionThis course is to equip students with a comprehensive understanding of the essential principles and practices in research methodology, including the formulation of research questions, selection of appropriate research designs, data collection and analysis techniques, and interpretation of results. The course also aims to instill a strong foundation in ethical standards and practices in academic and professional research, including plagiarism,								

		authorship, peer review, and responsible publication. By the end of the course, students will be able to conduct rigorous, ethical research and effectively communicate their findings in scholarly publications.						
Cour Objec	rse tive	 To qu To To To To 	 To understand and apply various research methodologies, including qualitative and quantitative approaches. To enhance skills in data collection, analysis, and interpretation. To foster an understanding of ethical principles in research, including plagiarism prevention and responsible authorship. To ensure adherence to ethical guidelines in academic and professional publications. To prepare students for effective communication and dissemination of research findings through scholarly publications. 					
Cour Outco	rse ome	 Upon completion of this course, the students will be able to Apply fundamental research methods and techniques to design, conduct, and analyze research projects. Develop advanced academic writing skills, understand philosophical foundations of research, and adhere to ethical standards. Apply intellectual property rights principles and follow ethical practices Recognize ethical standards in publishing, avoid misconduct, and ensure proper authorship and peer review Learn about ethical publishing, open access models, and effectively use research databases and metrics to evaluate and disseminate research 						
CO, PO		PSO MA		PO 2	PO 4	DO E	DSO 1	
CO-1	F	2	2	PO-3	3	1	P30-1	P30-2
CO-2		2	3	2	2	2	2	1
CO-3		1	2	1	2	1	1	2
CO-4		2	2	1	2	1	2	1
CO-5		2	1	1	2	1	1	2
			1: Weakly rela	ted, 2: Modera	tely related an	d 3: Strongly r	elated	
мори	IF 1 · F	lementa	rv Research M	lethodology	-			(91)
Researc	ch Cor	icent 0	hiective chara	acteristics Ster	os and Signific	ance of Resea	rch Arhitrary	and
CO-1 BTL-2 Concept, Objective, characteristics, Steps and Significance of Research, Arbitrary and Scientific Research, Research approaches. Types of research: Historical, Descriptive, Analytical, Case Study, Quantitative vs. qualitative, Conceptual, Empirical Action Research, Research Methods vs Methodology. Research Problems: Selection and definition of the research problems, formulating a research problem, identifying variables and Constructing hypothesis; Choosing a mentor, lab and research question; maintaining a lab notebook; Selection of problems - stages in the execution of research								
MODU	LE 2: A	cademi	c Writing, Philo	osophy and Eth	ics			(9L)
Technical writing skills - types of reports; layout of a formal report; standard of Journal (Impact Factor, Citation Index), Scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper. Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions				pact ems ition CO-2 BTL-2 tion,				
MODULE 3: IPR and Scientific Conduct (91)				(9L)				
MODULE 3: IPR and Scientific Conduct(9)Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT0				and ario: CO-3 nder BTL-3				

Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications. salami slicing - Selective reporting and misrepresentation of data.				
MODU	Pring publications, salarin sicing - selective reporting and misrepresentation of data.	 01 \		
NODU		91)		
Publica initiativ definiti publica compla	tion ethics: definition, introduction and importance - Best practices / standards setting res and guidelines: COPE, WAME, etc Conflicts of interest - Publication misconduct: on, concept, problems that lead to unethical behavior and vice versa, types - Violation of tion ethics, authorship and contributor ship - Identification of publication misconduct, ints and appeals - Predatory publisher and journals.	CO-4 BTL-2		
MODU	LE 5: Open Access, Publication Misconduct and Research Metrics	(9L)		
Open a copyrig SPPU - Sugges tools. Indexin	access publications and initiatives - SHERPA/RoMEO online resource to check publisher ht & self-archiving policies - Software tool to identify predatory publications developed by Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal ter, etc., Use of plagiarism software like Turnitin, Urkund and other open-source software g databases, Citation databases: Web of Science, Scopus, etc., Impact Factor of journal as per	CO-5 BTL-3		
Journal	Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics.			
REFEREN	ICE BOOKS			
1	Herman Aguinis (2023), Research Methodology Best Practices for Rigorous, Credible, and Ir Research. SAGE Publications	npactful		
2	Carol Ellison (2010) McGraw-Hill's Concise Guide to Writing Research Papers, McGraw-Hill			
3	3 Kothari CR (2016) Research Methodology: Methods and Techniques, New Age Pvt Ltd			
4	4 Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007			
5	The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003			
6	Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Pres	s, 2003		
7	Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Ami Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7	t Ghosh		
8	Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press			
9	Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997			
10	Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.			
11	Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, F 2007.	earson,		
E BOO	KS			
1.	https://wac.colostate.edu/docs/books/try/chapter1.pdf			
2.	https://www.scribbr.com/dissertation/methodology/			
3.	https://ori.hhs.gov/sites/default/files/rcrintro.pdf			
MOOC				
1.	http://nptel.ac.in/courses/107108011/			

COURSE TIT	(To be o	INTERNSHIP (To be carried out in summer vacation after 2 nd semester and evaluated in 3 rd semester)					2
COURSE COE	DE EAT!	EAT52800 COURSE EEC L-T-P-S 0-0-0-0					
Version	1	0	Approval Deta	ails 41 A		ARNING LEVEL	BTL-4
ASSESSMENT	SCHEME				•		
Vi	sit Report, Fe	edback of th	e employer, Pr	esentation &	Viva Voce, N	1CQ Assessm	ient
			10	0%			
Course	This cou	irse aims to	inculcate the	application	of knowledg	e & skill le	arned through
Description	classroo written a	classroom practices. It demands the academic component consisting of research, reflection, written and oral skills of the learner.					
	The cour	The course will enable the students to					
Course	1.	1. Explore career alternatives prior to graduation.					
Objective	2.	2. Integrate theory and practice.					
	3.	Assess intere	sts and abilitie	s in their field	of study.		
	4.	Build a recor	d of work expe	rience.			
	Upon co	mpletion of t	his course, the	students will I	be able to		
Course	1.	Choose appr	opriate moder	n tools used II	n the field of	Automobile	engineering to
Outcome	2	Demonstrate	esources errec	it and profes	sional accou	ve lueas atability whi	le working in a
	۷.	2. Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society.					
	3.	Communicat	e effectively ar	nd to write the	scientific re	port of the le	arnings
Prerequisites	: Basic know	ledge in Mea	surements, Da	ta Analysis, In	terpretation	•	
CO, PO AND	PSO MAPPIN	G					
0	PO-1	PO-2	PO -3	PO-4	PO-5	PSO_1	PSO-2
CO-1	2	2	3	3	3	1	3
CO-2	2	2	3	3	3	2	1
CO-3	2	2	3	3	3	1	1

Weightage of Assessment:

Assessment Scheme	Weightage
Presentation & Viva voce	50 %
Report	20 %
Feedback of the Employer	30%

A committee will be constituted by the HoD with Internship coordinator as head for learning assessment process

Assessment Rubrics

Performance	Excellent(5)	Good(4)	Fair(3)	Poor(2)
Indicators				
Requirement analysis and clarity on problem statement(5)	Requirement well understood and problem statement well defined	Requirement well understood but problem statement not well defined	Understood the requirement and not defined properly	Not properly understood the requirements and problem statement not defined properly
Relevance with Industry /Societal problem(5)	Relevant	Relevant to industry with small modifications	Partially relevant	Irrelevant
Project timeline scheduled(5)	Scheduled and followed strictly	Scheduled and but not followed strictly	Scheduled but not followed	Not Scheduled and not followed
Usage of latest application and software(5)	latest applications and software's are used	Moderate usage of new technology	Slightly outdated	No latest applications and software's used
Design and code efficiency(5)	Excellent design of experiment and all possible outcomes are handled	Effective design but all possible outcomes are not handled	Satisfactory Design	Irrelevant design
Report Preparation(10)	Excellent documentation	Good documentation	Average documentation	Poor documentation
Presentation skills, Fluency and comprehensibility(5)	Excellent communication skills and good comprehensibility	Good confidence , lack of communication skills and average comprehensibility	Less confidence, vocabulary need to be improved and poor comprehensibility	Poor skills
Slide organization and contents time conscious(5)	Content is organized properly and effective time management	Content is organized properly but not effective time management	Content is not organized properly	Poor organization and least time management
Feedback from Industry mentor(5)	Regular /novel idea/Excellent execution of project	Regular /Novel idea/Good execution of project	Regular /existing idea/Good execution of project	Irregular /existing idea/Poor execution of project

COURSE TITLE	PROJ	ECT WORK- PHASE-I		CREDITS	18
COURSE CODE	EAT52801	COURSE CATEGORY	EEC	L-T-P-S	0-0-36-0
Version	1.0 Approval Details		41 ACM	LEARNING LEVEL	BTL-5
ASSESSMENT SCHEME					
FIRST REVIEW	SECOND REVIEW		THIRD REVIEW		PROJECT REPORT & VIVAVOCE
20%	20%		10%		50%

Course Description	This cour practical proposed purpose integrate contribut analysis, a nurturing experience	This course is designed to offer a diverse range of objectives, spanning from design and practical implementation to computational work and research-based projects. Every proposed project presents a pathway to accomplish the desired learning outcomes. The core purpose of this module is to serve as a platform for students to not only develop and integrate their existing knowledge and skills but also to explore and, in certain cases, contribute to new knowledge through literature review, experimentation, or modelling and analysis, as applicable. Moreover, the module places a strong emphasis on recognizing and nurturing students' curiosity and motivation. It strives to provide a gratifying learning experience through close interaction and guidance from an academic supervisor.					
Course Objective	The cours 1. (2. (3. (The course will enable the students to: Undertake theoretical studies, computer simulations and hardware construction based on the literature review performed. Produce progress reports on the work completed and maintain to schedule the time frame of the project Finally deliver a seminar and prepare a report/paper to present in a forum involving paper presentations and demonstration of the operational hardware and software 					
Course Outcome	Upon con 1. (2. 3. /	 Upon completion of this course, the students will be able to 1. Categorize the topic of interest and identify the project domain based on the societal / industry requirements 2. Reproducing the existing system and feasibility of the proposed project 3. Articulate the methodology of the project based on comprehensive Literature survey and break down to point out the methods and strategies for implementation. 					
CO, PO AND F	SO MAPPIN	G					
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	3	1	2	3	2	2	1
CO-2	3	1	2	1	3	2	2
CO-3	3	1	2	2	2	2	1
	1: Weakly related, 2: Moderately related and 3: Strongly related						
The Project Work shall be carried out in the field of Automobile Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor. During this period the supervisor shall guide the students to implement the project. The students shall give periodical presentations of the progress made in the Project Work. Each group shall finally produce a report covering background information, literature survey, problem statement, project work details and conclusions. This final report shall be typewritten form as specified in the guidelines. Assessment Review / Exam.							
		sessment				1	

Assessment	
Review / Exam	Weightage
First Review	20%
Second review	20%
Third review &DEMO	10%
Project Report &viva Voce	50%
TOTAL	100%
constituted by the HoD for the	Review

A committee shall be constituted by the HoD for the Review

Assessment Rubrics

Decemeter	Weightage
	(%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking*	5.0
Technical Knowledge [*]	5.0
Presentation*	10.0
Demonstration*	5.0
Individual Roles Distribution [*] (Individual Objectives in the project work)	5.0
Individual Contributions [*] (Towards the individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	5.0
Report / Thesis	5.0
Publication, Patent, Funding, Competitions	5.0
Peer Assessment*	5.0

* - Attributes for individual contribution

COURSE TITLE	P	ROJECT WORK PHASE-II		CREDITS	20
COURSE CODE	EAT52802	COURSE CATEGORY	EEC	L-T-P-S	0-0-40-8
Version	1.0	Approval Details	41 ACM	LEARNIN G LEVEL	BTL-5
ASSESSMENT SC	HEME				
FIRST REVIEW	SECOND REVIEW		THIRD R	EVIEW	PROJECT REPORT & VIVAVOCE
20%	20%		10%		50%
Course Description	This course encompasses a diverse range of objectives, catering to both design and manufacturing, computational work, and research-oriented projects. Regardless of the chosen project, all participants will have ample opportunities to attain the intended learning outcomes. The primary goal of this module is to furnish students with a platform to foster and consolidate their knowledge and skills, encouraging them to explore and potentially contribute to new knowledge through various means such as literature review, experimentation, or modelling and analysis when relevant. Furthermore, the course places significant emphasis on nurturing curiosity and self-motivation, promoting a fulfilling and engaging experience for students as they engage in close collaboration with				
Course Objective	 The course will enable the students to: 1. Undertake theoretical studies, computer simulations and hardware construction based on the literature review performed. 2. Produce progress reports on the work completed and maintain to schedule the time frame of the project 3. Finally deliver a seminar and prepare a report/paper to present in a forum involving paper presentations and demonstration of the operational hardware and software 				

Course Outcome	Upon completion of this course, the students will be able to
	1. Build and demonstrate the prototype based on the technical knowledge gained
	in the phase 1
	2. Design Engineering solutions to real time problems utilizing system approach
	3. Illustrate and interpret the graphical results obtained
	4. Analyse, Evaluate and compare the performance of the results.
	5. Communicate with Engineers, peer team members and professionals

CO, PO AND PSO MAPPING							
CO	PO-1	PO-2	PO-3	PO-4	PO-4	PSO-1	PSO-2
CO-1	3	3	2	2	2	3	2
CO-2	3	3	2	2	3	2	3
CO-3	3	3	2	2	2	3	2
CO-4	3	3	2	2	3	2	3
CO-5	3	3	2	2	2	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related							

The Project Work shall be carried out in the field of Automobile Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor. During this period the supervisor shall guide the students to implement the project. The students shall give periodical presentations of the progress made in the Project Work.

Each group shall finally produce a report covering background information, literature survey, problem statement, project work details and conclusions. This final report shall be typewritten form as specified in the guidelines. Assessment Review / Exam.

Assessment					
Review / Exam	Weightage				
First Review	20%				
Second review	20%				
Third review &DEMO	10%				
Project Report &viva Voce	50%				
TOTAL	100%				

A committee shall be constituted by the HoD for the Review

Assessment Rubrics

Parameter	Weightage (%)
Title & Objectives	5.0
Review of Literature (RL)	10.0
Design / Implementation	10.0
Methodology	5.0
Planning of Project Work	5.0
Testing Environment / Test Cases	5.0
Analytical thinking [*]	5.0
Technical Knowledge*	5.0
Presentation [*]	10.0
Demonstration*	5.0
Individual Roles Distribution [*] (Individual Objectives in the project work)	5.0
Individual Contributions [*] (Towards the	F 0
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individual objectives in the project work)	5.0
Deliverables	5.0
Team- work	5.0
Report / Thesis	5.0
Publication, Patent, Funding,	E Q
Competitions	5.0
Peer Assessment [*]	5.0

* - Attributes for individual contribution

EVALUATION PARAMETERS FOR ASSESSMENT

To be followed same as approved for Project Phase I

DEPARTMENT ELECTIVES for SMART MOBILITY

Semester-I

DEPARTMENT ELECTIVE-1

COURSE TITL	E	AI FOR SMART TRANSPORTATION							3
COURSE CODE	EAT5251	12 CO CATE	URSE EGORY	DE		L-T-P-S 2-0-2-2			
Version	1.0	App De	proval tails	41st ACM		LEARN LEVE	ING El		BTL-3
ASSESSMEN	T SCHEME								
			CIA					E	SE
First Periodical Assessment (Theory)	Second Periodica Assessme (Theory	d al Pra ent Asses /)	ctical sments	Observation / records as appro by the Departm Examination Committee "D	lab oved nent n EC"	Attend ance	Theo	ory	Practical
15%	15%	1	.0%	5%		5%	25	%	25%
Course Description	This cours technology	se provides kr v	nowledge or	intelligent tran	sport sy	/stem and	lvehicle	e to v	vehicle
Course Objectives	1. To dis 2. To der 3. To des 4. To des 5. To dev	cuss on Intel monstrate te sign ITS funct scribe ITS use velop Vehicle	ligent Transp lecommunic ional areas er needs and e-to-Vehicle	oortation Systen ations in ITS services (V2V) Communi	ns (ITS) cations				
Course Outcomes	Upon 1. Discus 2. Demo 3. Desigr 4. Descri 5. Develo	 Discuss on Intelligent Transportation Systems (ITS) Demonstrate telecommunications in ITS Design ITS functional areas Describe ITS user needs and services Develop Vehicle to Vehicle (V2V) Communications 							
Prerequisites	: Basics of com	nmunication	system						
CO, PO AND	PSO MAPPINO	3							
со	PO -1	PO-2	PO-3	PO-4	PC)-5	PSO-1		PSO-2
CO-1	2	2	1	1	2	2	1		2
CO-2	2	3	2	2	2	2	2		1
CO-3	1	2	1	1	1	L	1		2
CO-4	2	2	1	2	2	2	2		1
CO-5	2	2 1 1 1 1 1 2						2	

	1: Weakly related, 2: Moderately related and 3: Strongly related					
MODU	LE 1: Introduction to Intelligent Transportation Systems (ITS)	(6L+6P)				
Introdu	ction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of					
ITS Obje	ectives, - ITS Data collection techniques - Detectors, Automatic Vehicle Location (AVL),	CO _1				
Automa	tic Vehicle Identification (AVI), Geographic Information Systems (GIS)	BTI-2				
Case St	udy	DIC-2				
•	Intelligent Transportation Systems in India					
MODUL	E 2: Telecommunications in ITS	(6L+6P)				
Telecor	nmunications in ITS – Importance of telecommunications in the ITS system, Information					
Manage	ement, Traffic Management Centers (TMC). Vehicle – Road side communication – Vehicle					
Position	ing System.	CO-2				
Labora	tory Components	BTL-2				
•	Demonstration on Traffic Management Centers (Tamil Nadu Traffic Police Traffic Control					
	Room)					
MODUL	E 3: ITS functional Areas	(6L+6P)				
ITS fun	ctional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler					
Informa	tion Systems (ATIS). Commercial Vehicle Operations (CVO). Advanced Vehicle Control					
Systems	(AVCS). Advanced Public Transportation Systems (APTS). Advanced Rural Transportation					
Systems	5 (ARTS).	CO-3				
Labora	tory Components	BTL-3				
•	Demonstration on Traveler Information Systems and Advanced Vehicle Control Systems					
Tool Use	ed					
•	Traveler Information Systems (Tamil Nadu Traffic Police Traffic Control Room)					
MODUI	F 4: ITS User Needs and Services	(6I +6P)				
mobol		(02:01)				
Travel	and Traffic management Public Transportation Management Electronic Payment					
Comme	rcial Vehicle Operations Emergency Management Advanced Vehicle safety systems					
Informa	tion Management Automated Highway Systems - Vehicles in Platoons – Integration of					
Automa	ted Highway Systems					
Laboratory Components						
•	Demonstration on Automated Highway Systems - Vehicles in Platoons – Integration of	BTL-2				
	Automated Highway Systems					
Tool Use	ed					
•	Automated Highway Systems					
MODUL	E 5: Dedicated short range communications	(6L+6P)				
		(01/01/				
V2V vs	V2L vs V2X vs V2N vs V2P -Importance of opgoing 5G development –GPS receivers and V2V					
–laser l	lluminated Detection and Ranging (LiDAR) –Inertial navigation systems –Characteristics of					
a wirele	ss mesh network –V2V and Cybersecurity					
Laborat	tory Experiments	CO-5				
•	Demonstration on Laser Illuminated Detection and Ranging (LiDAR) and Inertial	BTL-2				
	Navigation Systems					
Tool Us	ad					
100103	LiDAP and INS Sonsor					
TEXT BC						
1	Kan Daul Chan, John Milos, ITS Handhook: Pocommondations for World Poad Association					
1. 2	Susceman L.M. Derenactive on ITS. Artach House Publishers, 2015	(FIANC)				
	ארב אורב אווי, דפו אפנוועפ טוו דוס, או נפנוו הטעצפ צעאוואוופוא, 2015.					
	Notional ITC Architecture Decumentation, UC Department of Transportation, 2017					
1.	National ITS Architecture Documentation, US Department of Transportation, 2017.	- 2017				
2.	Dimitrakopoulos, George: Current Technologies in Venicular Communication, Springe	1, 2017.				
WOOC						
1	https://ocw.mit.edu/courses/1-212j-an-introduction-to-intelligent-transportation-system 2015	ns-spring-				
2	https://www.edx.org/learn/engineering/ecole-polytechnique-federale-de-lausanne-intro	o-to-				
-	traffic-flow-modeling-and-intelligent-transport-systems					

COUI TITI	RSE LE		AUTON	MATED DRIV	'ING SYS	ГЕМ		CREDITS			3
COU COI	RSE DE	EAT	52513	COURSE CATEGORY		DE		L-T-P-S		2-0)-2-2
VERS	ION	:	1.0	APPRC DETA	ILS	41 st AC	м	LEARNIN LEVEL	NG BT		TL-5
				AS	SSESSME	NT SCHEM	E				
				CIA						E	SE
Fir Perioo Assess (Theo	st dical ment ory)	Seco Perioo Assessi (Theo	ond dical ment As ory)	Practical sssessments Comr		rvation / la s as approv Departme amination nittee "DEC	ion / lab approved partment Attend nation ee "DEC"		ce	Theory	Practical
15	%	159	%	10%		5%		5%		25%	25%
Cou Descri	rse ption	This co used h softwar current	ourse will ardware u re stack, P t industry	provide com sed for self- rogram vehi practices for	plete kno driving c cle mode vehicle c	owledge to ars , Identi elling and c levelopme	the fy th ontro nt	undergradua le main comp ol , Analyze t	ite st boner he sa	udents on nts of the s fety frame	commonly self-driving works and
Cou Objec	rse tives	 To impart the knowledge on Self-Driving Hardware and Software Architectures To educate about condition of Object Detection in an Urban Environment To impart the knowledge on Sensor Fusion & Perception To instruct the knowledge on Localization and Planning To aducate about Control & Trainstory Tracking for Autonomous Vabiales 							S		
Cou Outco	Upon completion of this course, the students will be able to 1. Discuss on the Self-Driving Hardware and Software Architectures 2. Interpret the Object Detection in an Urban Environment 3. Design the Sensor Fusion & Perception 4. Develop the Localization and Planning										
Prereq	uisites	Basic Kr	nowledge	on sensors							
СО, РО	AND P	SO MAPI	PING	PC);					PSO	c
COs		1	2	3	//	4		5		1	2
CO-1		3	3	2		2		2		3	1
CO-2		3	2	2		2		1		3	2
CO-3		2	3	3		2		2		2	2
CO-4	-	∠ २	2	2		2 1		<u> ۲</u>		3 2	3 2
		1 - We	akly Corre	lated, 2 - Mo	derately	Correlated	l and	- 3 - Strongly (Corre	lated	5
Modul	e 1 – li	ntroduct	ion to Self	-Driving Har	dware a	nd Softwar	e Arc	chitectures			(6L+6P)
The Re	quirem	ents for	Autonomy	- Self-Drivin	g Hardwa	are and Sof	twar	e Architectur	es		
Safety	Assura	nce for A	utonomou	is Vehicles-V	ehicle Lo	ongitudinal	Cont	rol-Vehicle La	atera	l Control	
Lab Co	mpone	nt									
•	Dem	onstratio	on of Vehic	le Longitudir	nal Contr	ol-Vehicle I	Later	al Control			CO-1
Case St	tudy:										BTL-2
•	Goog	le Waym	no Self Driv	ing Car							
Softwa	re/Equ	ipment	required								
•	Matl	ab Auton	nated Driv	ing Tool							
Module 2 – Computer Vision Technology								(6L+6P)			

Calik Calik Conv Lab (Softw	 ect Detection in an Urban Environment - The Machine Learning Workflow - Sensor & Camera bration - From Linear Regression to feed forward Neural Networks - Image Classification with volutional Neural Networks - Object Detection in Images Component Design Edge detection and object detection algorithms ware/Equipment required MATLAB – Computer Vision Tool 	CO-2 BTL-2
Mod	ule 3 – Sensor Fusion Technology	(6L+6P)
Intro poin	oduction to Sensor Fusion& Perception -The Lidar Sensor- 3D Object Detection - 3D lidar t clouds - Kalman Filters -Extended Kalman Filters -Multi-Tracking Tracking	
Lab (Component	CO-3
	Design object detection algorithms	BTL-3
Soft	ware/Equipment required	
MA	TLAB – Automated Driving Tool, Lidar and Radar Tool Box	
Mod	ule 4 – Localization and Planning Techniques	(6L+6P)
Intro Scan Auto mak	oduction to Localization-Markov Localization- Creating Scan Matching Algorithms- Utilizing Matching in 3D- Scan Matching Localization - Motion Planning & Decision Making for phomous Vehicles - Behavior Planning -Trajectory Generation -Motion Planning -a decision ing framework to plan a vehicle's motion in an urban environment	CO-4
200	Sensor Data Acquisition using Lidar and Radar	BIL-2
Soft	vara/Equipment required	
	TLAR - Digital Signal Processing Tool Lidar and Padar Tool Poy	
Mad	ula F. Control 9. Trainstern Traching, Tashninusa	
Mod	ule 5 – Control & Trajectory Tracking Techniques	(6L+6P)
Mod Cont track of th actio	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations	(6L+6P) CO-5
Mod Cont track of th activ Lab	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the con (steering, accelerator, brake) and the possible perturbations Component	(6L+6P) CO-5 BTL-3
Mod Cont track of th activ Lab (ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm	(6L+6P) CO-5 BTL-3
Mod Cont track of th activ Lab (ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation ne state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required	(6L+6P) CO-5 BTL-3
Mod Cont tracl of th activ Lab (Softw MA	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool	(6L+6P) CO-5 BTL-3
Mod Cont track of th activ Lab (Soft MA	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool	(6L+6P) CO-5 BTL-3
Mod Cont tracl of th activ Lab (Softw MA TEXT 1.	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS	(6L+6P) CO-5 BTL-3
Mod Cont tracl of th activ Lab (Soft MA TEXT 1. 2.	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019	(6L+6P) CO-5 BTL-3
Mod Cont tracl of th activ Lab (Softw MA TEXT 1. 2. REFE	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation ne state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool • BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS	(6L+6P) CO-5 BTL-3 dated and
Mod Cont tracl of th activ Lab (Soft MA TEXT 1. 2. REFE 1.	ule 5 - Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous VehiclesPID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB - Automated Driving Tool • BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022	(6L+6P) CO-5 BTL-3 dated and s-a-service
Mod Cont tracl of th activ Lab (Softw MA TEXT 1. 2. REFE 1. E BO	ule 5 - Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous VehiclesPID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB - Automated Driving Tool • BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022 OKS	(6L+6P) CO-5 BTL-3 dated and s-a-service
Mod Cont tracl of th activ Lab (Soft MA TEXT 1. 2. REFE 1. E BO 1.	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation ne state of the vehicle (position, velocity), the oon (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022 OKS Shaoshan Liu , Liyun Li , Jie Tang , Shuang Wu , Creating Autonomous Vehicle Systems , Claypool Publication 2020	(6L+6P) CO-5 BTL-3 dated and s-a-service Morgan &
Mod Cont tracl of th activ Lab (Softw MA TEXT 1. 2. REFE 1. E BO 1. 2.	ule 5 - Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation he state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022 OKS Shaoshan Liu , Liyun Li , Jie Tang , Shuang Wu , Creating Autonomous Vehicle Systems , Claypool Publication 2020 SreevatsanBhaskaran , Kai Zhou , Andrew Baab , Ronald Calhoun " Autonomous Vehicle Tutorial"Kindle	(6L+6P) CO-5 BTL-3 BTL-3 dated and s-a-service Morgan & le Lidar: A
Mod Cont track of th activ Lab (Softw MA ^T TEXT 1. 2. REFE 1. E BO 1. 2. MOC	ule 5 – Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation ne state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022 OKS Shaoshan Liu , Liyun Li , Jie Tang , Shuang Wu , Creating Autonomous Vehicle Systems , Claypool Publication 2020 SreevatsanBhaskaran , Kai Zhou , Andrew Baab , Ronald Calhoun " Autonomous Vehicle Tutorial"Kindle OC	(6L+6P) CO-5 BTL-3 dated and s-a-service Morgan & le Lidar: A
Mod Cont track of th activ Lab (Softw MA TEXT 1. 2. REFE 1. 2. 1. E BO 1. 2. MOC	ule 5 - Control & Trajectory Tracking Techniques trol & Trajectory Tracking for Autonomous Vehicles –PID Control PID and MPC for trajectory king using the PID controller -controller with non-linear dynamics -Recognize the observation ne state of the vehicle (position, velocity), the on (steering, accelerator, brake) and the possible perturbations Component • Design Path Planning Algorithm ware/Equipment required TLAB – Automated Driving Tool BOOKS Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology, 2019, CRC PRESS Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies and Disruptions: Up Expanded Second Edition 2019 RENCE BOOKS Andreas Herrmann and Johann Jungwirth, Inventing Mobility for All: Mastering Mobility-a With Self-driving Vehicles 2022 OKS Shaoshan Liu , Liyun Li , Jie Tang , Shuang Wu , Creating Autonomous Vehicle Systems , Claypool Publication 2020 SreevatsanBhaskaran , Kai Zhou , Andrew Baab , Ronald Calhoun " Autonomous Vehicle Tutorial"Kindle OC https://www.coursera.org/learn/intro-self-driving-cars	(6L+6P) CO-5 BTL-3 dated and dated and s-a-service Morgan & le Lidar: A

COURSE TITLE	HYDROGEN	ENERGY	FOR SMAF	RT MO	OBILITY	CREDITS		3	
COURSE CODE	EAT52502	COURSE CATEGORY DE L-T-P-S						-2-2	
VERSION	1.0	APPRC	VAL DETA	ILS	41 ACM	LEARNING LEVEL	BTL-4		
ASSESSMENT SCHEME									
	CIA								
First	Second								
Periodical	Periodical	Pra	actical	l	Practical	Attendance	Theory	Practical	
Assessment	Assessment	Asse	ssments		Report		,		
(Theory)	(Theory)				/	/			
15%	15%	1	L0%		5%	5%	25%	25%	
	This course prov	ides a col	mprehensi	ve ov	erview of hy	drogen product	ion, storage	techniques,	
Course	fuel cell and ass	sociated of	challenges.	Stuc	lents will als	o delve into the	e mechanics	of fuel cell	
Description	vehicles, explori	ng their a	rchitecture	e and	gain hands-o	on experience in	analysis and	l modelling,	
	fostering a deep	per under	standing o	f hyd	rogen's role i	n future transp	ortation syst	ems.	
	1. To learn the	e basics o	of hydrogei	n ene	rgy, its produ	uction and stora	ige		
Course	2. To study th	ie hydrog	en mobility	y syst	ems availabl	e			
Objectives	3. To learn the	e working	g concept o	of fue	l cell vehicle	and its compon	ents		
	4. To examine	e the fuel	cell vehicle	e arch	nitecture and	l analyze its per	formance		
	5. To study th	e global s	scenario of	hydr	ogen energy	market in trans	sportation		
	Upon the compl	letion of t	his course	, the	students will	be able to			
	1. Discuss the	basics of	hydrogen (energ	gy, its produc	tion and storag	e along with	the	
	available po	licy frame	ework						
Course	2. Familiarize v	with the h	iydrogen n	nobili	ty systems a	vailable and bui	ld a PEM sin	gle stack	
Outcomes	fuel cell								
	3. Interpret the	e types of	f fuel cell v	ehicl	es available i	n market and p	rovide analy	tical design	
	solutions								
	4. Examine the	e fuel cell	vehicle are	chited	cture and ass	ess its perform	ance		
	5. Analyze the	global sc	enario of h	ydro	gen transpor	tation			
Prerequisites:	Engineering Cher	mistry							
CO, PO AND P	SO MAPPING								
СО	PO-1	PO-2	PO-3		PO-4	PO-5	PSO-1	PSO-2	
<u> </u>	2	1	1		1	1	3	2	
<u> </u>		3 ว	2		1	<u> </u>	1 2		
CO-3	1	۲ 1	1 2		2	2	<u>۲</u>	2 1	
CO-4	2	2	<u>ک</u> 1		<u> </u>	1	2	1	
<u> </u>	1 - Weakly Corre	- 2 -	Moderate	elv Co	rrelated and	1 3 - Strongly Co	rrelated	L 1	
			moucrate	.iy co					
Module 1 – In	troduction to Hyd	drogen En	iergy					(6L+6P)	
Hydrogen as	Green fuel, Hyd	lrogen Pr	oduction-	Differ	rent method	ls, Hydrogen s	torage -		
challenges and	d solution, Policy	framewo	ork - Natio	onal	Hydrogen M	ission, Green a	immonia		
policy, etc., Fu	elling stations, Inf	frastructu	ire require	ment	: – Global & L	ocal Scenario.			
Lab Compone	nt:							60 A	
1 To construct	t a small-scale hvo	drogen ge	nerator us	ing t	he electroche	emical method			
2. Tochno Fran			oworod C-		Judrogon Dr		using	BIL-3	
Z. Techno-Ecol	nomic Analysis of	a solar-P	owered Gr	een I	nyurogen Pro	Souction system	using		
Software /T									
Matlah Simulia	is Requirea:	odol							
	ik, Electrolyzer M	ouel						101 05	
Module 2 – Hy	drogen Mobility	Systems						(6L+6P)	

ICE vs EV, Fuel cell -Introduction, Fuel cell thermodynamics, Reaction kinetics, Pro exchange membrane FC (PEM), Solid oxide fuel cell (SOFC), Fuel cells for automo applications – technology advances in fuel cell vehicle systems – road map to market.	oton otive						
Lab Component:							
1. To build a model car using a single stack PEM fuel cell - Hydrocar	BTL-3						
2. Comparative study of two FCEV vehicles on market – Well to Wheel Analysis							
Software/Tools Required:							
Hydrocar, Power Bl							
Module 3 – Fuel Cell Electric Vehicle (FCEV)	(6L+6P)						
Fuel cell performance characteristics – current/voltage, voltage efficiency and power den kinetic performance, mass transfer effects – MEA components, fuel cell stack, fuel cell cor system, fuel cycle analysis, cooling system, FCEV energy flow analysis.	sity, ntrol						
Lab Component:	CO-3						
1. To model a fuel cell powertrain using Matlab Simscape	BTL-4						
 Analytical solution of a PEM cell cooling using CFD model – Ansys Fluent Software/Tools Required: 							
Matlab Simscape, Ansys Fluent							
Module 4 – Fuel Cell Electric Vehicle Architecture	(6L+6P)						
Drive cycles and operation scenarios Electric motor, DC-DC converter, battery system, drivetrain, Supervisory and feedback control algorithms, Stoichiometric coefficients utilization percentages of fuels and oxygen, mass flow rate calculation, fuel cells in par and serial connection, over-potential and polarizations.	and and allel						
Lab Component:	CO 1						
1 To assess the performance of a PEM fuel cell operated under different humidity levels							
2. To model a PEM coll to Translate current command into hydrogen/air flow commands							
using Simulink							
Software/Tool Required:							
Matlab Simulink, PEM Fuel Cell model							
Module 5 – Global Scenario and Roadmap	(6L+6P)						
FCEV infrastructure, Fuel cell usage for domestic power systems, large scale po generation, economic and environmental analysis on usage of fuel cell, future trends of cells, safety and environmental impacts, economics of transition to hydrogen systems.	fuel						
Lab Component:	CO-5						
1. Hydrogen fuelling infrastructure – Case Study	BTL-3						
2. Socio-Economical challenges in FCEV implementation – Case Study							
Software/Tool Required:							
Power Bl							
TEXT BOOKS							
 Prodip K. Das, Kui Jiao, Yun Wang, Barbir Frano, Xianguo Li, Fuel Cells for Transpo Fundamental Principles and Applications", Woodhead Publishers, Elsevier, 2023. 	rtation:						
 Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri; 'Hydrogen Fuel Cells for R Springer London, 2020. 	.oad Vehicles",						
REFERENCE BOOKS							
1 Dincor C Zamfirocou "Sustainable Hudrogen Production" Elequier 2017							
I. I Differ, C Zammescu, Sustamable Hydrogen Production, Elsevier, 2017.							

2.	B Sorensen, G Spazzafumo, "Hydrogen and Fuel Cells: Emerging Technologies and Applications", 3rd Edition, Academic Press, 2018.
3.	Gregor Hoogers, "Fuel Cell Technology Handbook", 1 st edition, CRC Press 2015.
E BOC	DKS
1.	https://link.springer.com/book/10.1007/978-981-10-7626-8
2.	https://onlinelibrary.wiley.com/toc/16156854/2023/23/1
MOO	c
1.	https://nptel.ac.in/courses/108106170
2.	https://www.youtube.com/watch?v=Eb7pv0oOf_k
3.	https://www.youtube.com/watch?v=62363H_I_Qk

COU TIT	JRSE FLE	INTELLIC	ENT DR	RIVER ASSIST WITH AI	ANCE SYSTEMS	CREDITS	3				
COL CO	JRSE DDE	EAT52515	C CA	OURSE TEGORY	DE	L-T-P-S	2-0-	2-0-2-2			
VER	SION	1.0	AP D	PROVAL ETAILS	41 st ACM	LEARNING LEVEL	BT	L-5			
ASSES	SMENT S	SCHEME					•				
				CIA			ES	<u>SE</u>			
Fi Peric Asses (The	irst odical sment eory)	Second Periodical Prac Assessment Assess (Theory)		Practical ssessments	Observation lab records as approved by th Department Examination Committee "DEC"	/ s ne Attendance	Theory	Practical			
1	5%	15%		10%	5%	5%	25%	25%			
Cou Descr	urse iption	Assistance S Role of AD/ systems are 1. To imp (ADAS)	e will p Systems AS towa e tested part the	ADAS) in ge (ADAS) in ge rds Autonon in Industry knowledge	plete knowledge eneral. role of Mac nous Driving , Sen on Fundamentals	on Understandin chine Learning and sors used in ADAS	g the Advan I Deep Learnin 5 and How va	ced Driver ng in ADAS. rious ADAS			
Cou Obje	urse ctives	 To edu To imp To inst To edu 	cate abo art the <i>i</i> ruct the cate abo	out Advance Advanced Dr ADAS Devel out ADAS sys	d Driver Assistance iver Assistance Sys opment using Mae tems Testing Tech	e Systems stems chine Learning and nniques and Stands	l Deep Learnii ards	ng			
Cou Outc	urse omes	Upon completion of this course, the students will be able to 1. understand the Fundamentals of Advanced Driver Assistance Systems 2. understand the Advanced Driver Assistance Systems 3. understand the Advanced Driver Assistance Systems 4. understand the ADAS Development using Machine Learning and Deep Learning 5. understand the ADAS systems Testing Techniques and Standards									
Prereq	uisites: N	Nil									
CO, PO	AND PS	O MAPPING									
CO:				POs			PS	Os			
COS	1		2	3	4	5	1	2			
CO-1	1		3	2	2	2	3	1			
CO-2	3		2	2	3	1	3	2			

CO-3	2	1	1	1	2	2	2		
CO-4	2	2	3	2	2	3	3		
CO-5		3	1 d 2 Madarat	2 alu Carralatadu	1 Ind 2. Stronghy Co	2	3		
1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated Module 1 – Fundamentals of Advanced Driver Assistance Systems (ADAS)									
Intro ADA Syste	duction to ADAS S towards Autor em) - Ultrasonic S	- General Bloc nomous Driving Sensor – LIDAR -	k Diagram – Co ; - Sensors in · GNSS, GPS, IN	omponents of A ADAS - Autom 1U.	ADAS – need of AD notive Radar - Can	AS - Role of nera (Vision	CO-1 BTL-2		
Module II – Advanced Driver Assistance Systems									
Ada Traf Inte Evas	ptive Cruise Con fic Alert - Forwa lligent Head Ligh ive Steering Supp	trol (ACC) - Rea rd Collision Wa It Control - Oc port – Vehicle T	ar Cross Traffic arning - Blind S cupant Protect urn assistance	Alert (RCTA)- Spot Detection tion System - I	Vehicle Exit Alert - - Parking Assistan Pedestrian Protect	Front Cross ce System - ion System-	CO-2 BTL-2		
Мос	ule III – Advance	d Driver Assist	ance Systems				(6L+6P)		
Trat view - An Nav	fic sign recognition v system - Driver ti lock braking sy gation	on System - Spe Monitoring Sys ystem - Cross \	ed Limit Assist tem - Driver Di Wind Assist - T	- Lane Departu rowsiness dete ïre-pressure N	re Warning - 360° ction - Emergency lonitoring - Head-U	surrounding Brake Assist Jp Display -	CO-3 BTL-3		
Мос	ule IV – ADAS D	evelopment us	ing Machine Le	earning and De	ep Learning		(6L+6P)		
Role - ML exar prin	e of Machine Lear & DL in ADAS - S nples - he suppor ciple component	ning and Deep I ensors and Sen ts vector mach analysis (PCA)-	Learning in ADA sor Fusion - MI ines (SVM) wit he Bayes decis	AS Developmen - & DL in ADAS h histograms of ion rule and K	t - ML & DL in ADAS – Processors – Algo f oriented gradient nearest neighbor (I	6 – Overview prithms with s (HOG) and <nn)< td=""><td>CO-4 BTL-2</td></nn)<>	CO-4 BTL-2		
Мос	ule V– ADAS sy	stems Testing	Techniques an	d Standards			(6L+6P)		
Tes Adv 262	ing of ADAS - Si anced Driver Ass 520 standards - S	mulation, SIL, sistance Systen afety Standards	HIL, DIL - Test ns (ADAS) Cali 5 – certification	ing of ADAS - bration- ADAS policies and G	On Test Tracks an in functional safe overnment policies	d analysis – ety and ISO	CO-5 BTL-3		
TEXT	BOOKS								
1.	Yan Li, Hualian 2022	g Shi "Advanced	d Driver Assista	ince Systems a	nd Autonomous Ve	ehicles" Sprin _ຢ	;er; 1st ed.		
2.	2. Harald Waschl, Ilya Kolmanovsky, Frank Willems, "Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions" Lecture Notes in Control and Information Sciences (LNCIS, volume 476) Springer 2019								
REFE	RENCE BOOKS								
Amit Kumar Mondal, Lentin Joseph "Autonomous Driving and Advanced Driver-Assistance 1. (ADAS): Applications, Development, Legal Issues, and Testing" CRC Press; 1st edition 2021									
E BO	OKS								
1.	Gerardus Bloko January 2021	dyk "Advanced	Driver Assistar	nce Systems (A	DAS) Standard Rec	quirements" 5	starcooks,		
MO	DC								
1.	https://www.uc	lemy.com/cour	se/advanced-d	river-assistance	e-systems/				

DE FOR SEMESTER -II

COURSE TITLE	CONNECTED VEHICLE TECHNOLOGY CREDITS S								3
COURSE CODE	EAT52516	COURSE CATEGOR	SE DE L-T-P-S 2-0-2-2						
Version	1.0	Approval Details			41 st ACM	LE/ LE	ARNING VEL	В	TL-3
ASSESSMENT SCHEME									
	1	C	IA			-			ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practic Assessme	Observation / lab records as Practical approved by the Assessments Department Examination Committee "DEC"					Practical	
15%	15%	10%			5%		5%	25%	25%
Course	This course give	ves in-depth	n know	ledge	on V2X archite	ecture	s, V2X facili	ties for C-I	٢S
Description	application V2	X access lay	/er, an	d V2X	security and p	rivacy	nd VOV has		ione
Course Objective	 To descri To discus To descri To descri To discus 	be intra- an s V2X archit be V2X tran be V2X acce s V2X secur	tecture sport a ess laye ity and	es, C-IT and ne er solu	ie communica S architecture twork layer tions cy	s and	protocol	ей аррпсат	ions
Course Outcome	 Upon completion of this course, the students will be able to Discuss on Intra- and inter-vehicle communication and V2X-based applications Design V2X architecture, C-ITS architectures and protocol Develop V2X transport and network layer Discuss on V2X access layer solutions 								
Pre requisite:	Basics of comm	unication							
CO, PO AND P	SO MAPPING								
СО	PO-1	PO-2	PO	-3	PO-4	P	0-5	PSO-1	PSO-2
CO-1	2	1	1		1		2	2	1
CO-2	3	3	2		2		2	1	2
CO-3	3	2	1		1		3	2	1
CO-4	2	3	2		2		2	1	1
CO-5	2	2	1		1		1	2	2
	1: Weak	y related, 2	2: Mod	eratel	y related and a	3: Stro	ongly relate	d	
MODULE 1: In	troduction to ve	ehicular con	nmuni	cation					(6L+ 6P)
Introduction access techn consideration V2X-based ap Lab Experime • Usag exter	Introduction to vehicular communication: Intra- and inter-vehicle communication; General access technologies; Information dissemination techniques; Security and privacy considerations; V2X today: Standardization Organizations and activities; Industry Alliances; V2X-based applications and services; Deployment status and examples, testbeds, use-cases. Lab ExperimentsCO-1 BTL-3• Usage and configuration of V2X network / facility protocols and their securityCO-1 BTL-3							CO-1 BTL-3	
MODULE 2: V	2X architectures	,							(6L+ 6P)
V2X commur Standardized layer optimiza V2X for auton Lab Experime • Usag	ication require C-ITS application ation in C-ITS; S omous cars; nts e and configura	ments of (ns; Standard tandardized	Cooper dized C l applie 2X net	rative C-ITS a cations work	Intelligent Tr rchitectures a s; Future appl / facility prot	anspo nd pro ication tocols	ort Systems otocol stack ns; V2X mu and their	s (C-ITS), ks; Cross- litimedia; security	CO-2 BTL-3
exter	sions in practice	e (device and	d scen	ario co	onfiguration, b	asic ap	oplications)		

MODULE 3: St	andardized V2X facilities for C-ITS application, network layer solutions	(6L+ 6P)				
V2X facilities	for C-ITS application: CAM, DENM, IVI, PVD, LDM, MAP, SPAT, PSM; Similarities					
and differenc	es between US and EU standards, V2X transport and network layer solutions:					
geographic addressing and routing, Geo-Networking protocol; Basic Transport Protocol;						
GN6ASL, IPv6 over 802.11OCB.						
Lab Experime	nts	DIL-3				
 Usag 	e and configuration of V2X transport and network layer solutions: geographic					
addr	essing and routing					
MODULE 4: V	2X access layer solutions	(6L+ 6P)				
V2X access la	yer solutions: IEEE 802.11p; WAVE; ETSI ITS-G5/DSRC; C-V2X; 5G cellular V2X;					
Heterogeneou	us/hybrid vehicular networking solutions; IoT/V2X integration options; Lab	CO-4				
Experiments		BTL-3				
• V2X a	application development, C-ITS applications in practice					
MODULE 5: V	2X security and privacy	(6L+ 6P)				
V2X security a	nd privacy: Challenges, requirements, threats and theoretical solutions; Standard					
C-ITS Security	reference model; Security header and certificate formats; Hardware Security					
Module; C-ITS	5 Identity and Credential Management; Digital Signature in Geo-Networking;	CO F				
Service Specific Permissions; PKI architecture						
Lab Experiments						
• Dem	onstration on C-ITS Identity and Credential Management; Digital Signature in Geo-					
Netw	vorking					
TEXT BOOKS						
1.	Vehicular Communications and Networks: Architectures, Protocols, Ope	eration and				
	Deployment: Wai Chen, ISBN-13: 978-1782422112, 2015.					
2.	Vehicular Networking: Christoph Sommer, Falko Dressler, ISBN-13: 978-1107046	719, 2015.				
REFERENCE BO	DOKS					
1	Intelligent Transportation Systems: Technologies and Applications: Samuel Morga	an, ISBN-13:				
	978-1632403148, 2015.					
2	Autonomous Driving: Technical, Legal and Social Aspects: Markus Maurer, J. Chris	tian				
	Gerdes, Barbara Lenz, Hermann Winner, ISBN-13: 978-3662488454, 2016.					
E Resources f	or Reference					
1.	Autonomous Vehicles: Intelligent Transport Systems and Smart Technologies: Nic	cu Bizon,				
	Lucian Dascalescu, Naser Mahdavi Tabatabaei, ISBN-13: 978-1633213241, 2014.					
MOOC						
1.	https://www.udemy.com/course/c-v2x-cellular-vehicle-to-everything-5g					
2.	https://builtin.com/articles/v2x-vehicle-to-everything					

COURSE TITLE	ELECTRON	IIC MODEL BASE	D SYSTEM DESIGN	CRED	3	
COURSE CODE	EAT52517	COURSE CATEGORY	DE	L-T-P-S		2-0-2-2
Version	1.0	Approval Details	41 st ACM	LEARNING LEVEL		BTL-3
ASSESSMENT	SCHEME					
		CIA			I	ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course pr Model-Based S	ovides knowledg System Design Te	e on Model-Based System echnique and In Loop Te	ems Engineerin esting Techniqu	es (MBSE) Te	echnique ,

Course Objectives	 To disc To den To des To den To den To disc 	 To discuss the Model-Based System Design Techniques To demonstrate the Mathematical Modeling and M Script To describe the concept of Electronics Control Units and System on Chip To demonstrate the Model-Based System Design Using Simulink To discuss the concept of In Loop Testing Techniques 					
Course Outcomes	S. To discuss the concept of the coop resting rechniques Upon completion of this course, the students will be able to 1. Discuss the Model-Based System Design Techniques 2. Demonstrate the Mathematical Modeling and M Script 3. Describe the concept of Electronics Control Units and System on Chip 4. Demonstrate the Model-Based System Design Using Simulink 5. Discuss the concept of In Loop Testing Techniques						
CO. PO AND	PSO MAPPIN	IG					
CO	PO -1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	2	2	1	3	1	1	2
CO-2	2	3	2	2	2	2	1
CO-3	1	2	1	1	2	1	2
CO-4	2	2	1	2	1	2	1
CO-5	2	1	1	2	2	1	2
	1: W	eakly related,	2: Moderate	y related and	3: Strongly re	lated	
MODULE 1:	Model-Based	System Desig	n Techniques				(6L+6P)
Model-Based Systems Engineering (MBSE) and its applications - The concepts of ECU design for automotive applications- V-Model for Automotive ECU 's Architecture – Model in loop, Software in loop, Processor in Loop, and Hardware in loop testing Techniques. Lab Experiments • Introduction to Simulink • Modeling Control Algorithm Software Used MATLAB- Simulink MODULE 2: Electronics Control Units and System on Chip					CO-1 BTL-2 (6L+6P)		
Architecture of an advanced microcontroller -analog and digital Interfaces-Controllers for ECUs: Understanding different ECUs in an automobile-challenges and design requirements of ECU design - selection of sensors and interfaces for ECU design. System on Chip Architecture and its functions- Demonstration of Raspberry Pi architecture and interfaces Lab Experiments • Real-time Data Acquisition using Raspberry Pi • Speed Control using Raspberry Pi Software Used					CO-2 BTL-2		
MODULE 3:N	Nathematical	Modelling and	d M Script				(6L+6P)
MODULE 3:Mathematical Modelling and M Script Mathematical Modelling - numeric and symbolic modeling approaches - curve fitting, statistics, optimization, ODE and PDE solving, calculus, core mathematical tools, Basic control algorithms to a real physical system- Deploy a control algorithm on a real-time target - Apply verification and validation methods to a model of physical systems -Use Design of Experiment methods to create models of physical systems Lab Experiments • Modelling ODE and Control algorithms • Deploy a control algorithm on a real-time target Software Used					CO-3 BTL-3		
MODULE 4: N	Model-Based	System Desig	n Using Simuli	ink			(6L+6P)
Model-Base	d Design for a	small system	Control Algori	thm Developm	nent using Sim	ulink - Motor	CO-4
Model - Gei	nerator Mode	l - Controller I	Model – Sim D	riveline - Plant	and Controlle	er Implement	BTL-2

on Sin	gle Target - Implement controller on MPC566 or MPC5554 target - Use Freescale RAppID	
Toolbo	ox or Math Works 555 Toolbox - Controller on Freescale Target - Plant on Real-Time Target	
Lab E	xperiments	
•	 Modelling Motor Model, Generator Model and Controller Model 	
	 Implement controller on MPC566 or MPC5554 target 	
Softw	vare Used	
MATL	AB- Simulink , Simscape	
MODU	JLE 5: In Loop Testing Techniques	(6L+6P)
Setup	a Test controller on a real system -Model Verification -Data Collection of Physical Model	
Respo	nse -Comparison of Physical Plant Response to Model Response - Design of Experiments	
to Col	lect Experimental Data on Motor and Generator- Automatically Generate Test Schedule	
to Obt	tain Data - Run Experiments and Collect Data - Generate Models for Components -Table-	CO-5
Looku	p - Curve Fits - Model Refinement and Re-Verification	BTL-2
Lab E	xperiments	
•	Setup a Test controller on a real system	
Softw	vare Used	
MATL	AB- Simulink	
TEXT E	BOOKS	
1	Patrice Micouin, Model Based Systems Engineering: Fundamentals and Methods, ISBN:	978-1-118-
1.	57959-6 , 2014,Wiley-ISTE	
2	John M. Borky, Thomas H. Bradley John M. Borky, Effective Model-Based Systems Engine	ering, ISBN:
Ζ.	9783030070823,2020, Springer	
REFER	ENCE	
1	Dov Dori, Model-Based Systems Engineering with OPM and SysML, Springer-Verlag New	York, 1st ed.
1.	2016	
	Priyanka Patankar, Swapnil Kulkarni , MATLAB and Simulink In-Depth: Model-based I	Design with
	Simulink and Stateflow, User Interface, Scripting, Simulation, Visualization and Debug	ging, Kindle
	Edition	
моос		
1.	https://www.udemy.com/course/creating-models-and-generating-code-with-matlabsime	ulink
2	https://www.mathworks.com/academia/courseware/intro-to-model-based-system-desig	<u>gn</u>

COURSE TITLE	VEHICLE	ERGONOMICS AND ST	RGONOMICS AND STYLING CREDITS 3				
COURSE CODE	EAT52506	COURSE CATEGORY	DE	L-T-P-S	2-0-2	-2	
VERSION	1.0	APPROVAL DETAILS	41 ACM	LEARNING LEVEL	BTL-	5	
ASSESSMEN	T SCHEME				-		
		CIA			ESE		
First Periodical Assessment	Second Periodical Assessment	Practical Assessments	Practical Report	Attendance	Theory	Practic al	
(Theory)	15%	10%	5%	5%	25%	25%	
Course Descriptio n	This course deve centric designs t course also inclu 3D design rende	15%10%5%25%25%This course develops student expertise in automotive ergonomics and styling to create user- centric designs that blend aesthetic appeal with optimal comfort and functionality. The course also includes practical components of clay modelling, anthropometric measurement, 3D design rendering to foster creativity and hands-on experience25%25%					
Course Objectives	 To familiaria To learn the To compare To design ve 	ze with the concept of a e art of sketching, sculp e and study different fac ehicle interior and ensu	automotive erg ting, clay mode ctors influencin tre compactnes	onomics Iling in vehicle c g seating and vis s for urban tran	lesign sibility ergonoi sportation	nics	

	5. To stu	ıdy different vir	tual ergonom	ics evaluatio	n techniques			
	Upon the o	Upon the completion of this course, the students will be able to						
	1. Demo	1. Demonstrate basic driver information acquisition using anthropometry						
Course	2. Sketch	2. Sketch and experiment different form of vehicle exterior and interior designs						
Outcomes	3. Apply	3. Apply anthropometric data and evaluate comfort for seating and visibility						
	4. Desigr	4. Design and construct new vehicle models with functionality, packaging and comfort						
	5. Apply	virtual ergonor	nic technique	s and evaluat	e vehicle desig	gns		
Prerequisite	s: Engineeri	ng Graphics						
CO, PO AND	PSO MAPPI	NG						
со	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	
CO-1	2	1	1	1	1	3	2	
CO-2	1	3	2	2	2	1	1	
CO-3	2	2	1	1	1	2	2	
CO-4	1	1	2	2	2	1	1	
0-5		∠	⊥ Modoratoly	L Correlated (L and 2 Strong	2 V Correlated	L	
	1 - Weak			Correlated	anu 5 - Strong	ly correlated		
MODULE 1 -	Introductio	on to Automotiv	ve Ergonomic	5			(01+05)	
Driver infor	mation acq	uisition, Anthr	opometry –	Need, Data	collection me	ethodology,		
Different po	stural cons	iderations, Bio	omechanical o	lata, Psycho	logical factors	s – stress,		
attention, In	terior featu	res and conver	niences—Use	of modern t	echnology, Sa	fety issues,		
Spaciousnes	s, Ventilatio	n, Temperatur	e control, Du	ist and fume	e prevention,	Ergonomic		
research me	thods.						CO-1	
Lab Compon	ent:						BTL-3	
1. Anthropor	metric Meas	urement for Dr	iver's Seat cor	nfort				
2. Comparat	ive Evaluatio	on of Men & Wo	omen drivers o	on comfort				
Software/To	ol Required	:						
Matlab								
MODULE 2 -	Automotiv	e Styling and Fo	orm Studies				(6L+6P)	
Vehicle Desi	ign - Funda	mentals of pe	erspective dra	wing. Auton	notive Sketchi	ng. Styling		
process, Car	proportion	s, Form studie	s, Speed For	ms, Clay Mo	delling, 2D sv	vstems, 3D		
systems, Me	asuring Proc	edures, Subject	t and Sampling	g size selectio	on, Introductio	n to human		
body, Measu	irement of H	lands/Feet/Full	, posture, App	- lying Anthro	pometry data.			
Lab Compon	ent:						CO-2	
1 3D Persne	ctive sketch	ing of a vehicle	model from d	ifferent angle	25		BTL-4	
2 Sculpt a sr	nall-scale m	odel of the veh	icle exterior w	ith focus on	form and cont	ours		
Software/Te				itii iocus oii		0013		
Autodock Ali		• nting Tools						
		for Costing or					(61+60)	
	Ergonomic	s for seating an		<u> </u>		11. C		
Seating dim	ensions- int	erior ergonom	Nics- seat cor	ntort- suspe	nsion seats-	split frame		
seating-back	, Regulation	is- driver's vis	ibility- tests	tor visibility-	- methods of	Improving		
visibility and	space- Das	n board equipi	ment and arra	angement, m	Irror and cock	cpit design,		
visibility, ma	n-machine s	system, electro	nic displays, c	commercial v	enicie cabin e	rgonomics-		
		ut-goods venio	Lie layout.				CO-3	
Lab Compon	ent:						BTL-4	
1. Digital ren	dering of int	terior parts usir	ng Autodesk A	lias/CATIA				
2. Comparat	ive analysis o	of 3 vehicles (sa	ime segment)	for seating e	rgonomics			
Software/To	ol Required	:						
Autodesk Ali	as							

мо	DULE 4 – Vehicle Packaging and Interior Design	(6L+6P)
Pass	senger Compartment, Floor Pan, Technical requirements, Dash board equipments	
arra	ngement, Positioning of operational controls, Force Analysis, Seating and position – ECE	
Reg	ulations, Human Factors, Navigation systems, pedal positioning, R-Point, AHP,	
Mar	nnequin positioning of 2-D pattern, car entry/exit, Boot lid packaging, Loading/Unloading	CO-4
ana	iysis.	BTL-4
Lab	Component:	
1. D	esign a compact electric vehicle for urban commuting	
Soft	ware/Tool Required:	
Auto	odesk Alias, CATIA	
мо	DULE 5 – Virtual Ergonomics Evaluation Technique and its Application	(6L+6P)
Use	r research customer's explicit needs and latent needs, Evaluation techniques – DHM,	
CAD	generated environment, Fundamentals and Traditional approach, Comfort/Discomfort	
and	reach evaluation, Accommodation and Clearance/Interference, Vision analysis,	
Sust	ainability.	CO-5
Lab	Component:	BTL-5
1. V	irtual Evaluation of the vehicle designed in the previous module.	
Soft	ware/Tool Required:	
Auto	odesk Alias	
TEX	T BOOKS	
1	Julian Happian-Smith; Transport Research Laboratory (TRL) Introduction to Modern Veh	icle Design,
	Publisher: Elsevier, 2021	
2.	Nikolaos Gkikas, Automotive Ergonomics Driver-Vehicle Interaction, routledge, Taylor &	Francis
DEE		
1	Tony Lewin "How to Draw Cars like a Pro" Motorbooks International 2012	
	Thom Taylor, Lisa Hallett, "How to Draw Cars like a Pro", Motorbooks International; 2Re	v Ed edition,
2.	2016	,
3.	Fenton John, "Handbook of automotive body and system design", Wiley-Blackwell, 2015	5
4.	J. Brian Peacock, WaldemarKarwowski, "Automotive ergonomics", Taylor & Francis ltd, 2	2014
EBC	DOKS	
1	https://link.springer.com/book/10.1007/978-3-658-33941-8	
2	https://www.taylorfrancis.com/books/mono/10.1201/b11237/ergonomics-automotive-	-design-
	process-vivek-bhise	
3	https://books.google.co.in/books?id=GajMBQAAQBAJ&printsec=copyright&redir_esc=y	#v=onepage&
	q&t=talse	
	UL https://anlinesources.phtol.ac.in/noc10_de01/proview	
	https://onimecourses.npter.ac.in/noct9_ueot/preview	
2.	https://www.linkedin.com/learning/topics/automotive-design	
3	https://isieindia.com/courses/3-days-virtual-program-in-human-ergonomics-in-vehicle-	design/
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COURSE	LIGHT W	LIGHT WEIGHT MATERIALS FOR SUSTAINABLE MOBILITY CREDITS 3								
COURSE CODE	EAT5251	9 COURS	E ORY		DE		L-T-P-	S		2-0-2-2
Version	1.0	Approv Details	/al		41 st ACM	1	LEARI LEVE	NING -		BTL-3
ASSESSMENT	SCHEME									
			CIA						E	SE
First Periodical Assessment (Theory)	Second Periodica Assessme (Theory	Second Observation / lab Second Practical approved by the Assessment Assessments Department (Theory) Examination Committee "DEC"							Practical	
15%	15%	10)%		5%		5%	25%	6	25%
Course Description	The fundar affordabilit techniques creative pr	mental princi ty and susta , contempora oduction and	ple being inability ary mater I testing p	g necess for inter rials, sin procedu	sary to com elligent mo nulation tec ures.	prehend bility. Ir hniques	lightweig novative tailored t	ght mat design o a give	eria co n m	ls based on ncepts and aterial, and
Course Objective	 Provid and a 2. To exp on en 3. To im 4. Under 5. To le treatm 	 Providing a brief summary on the selection standards, the economics of the materials, and application of the property chart. To expose the structure, property relations of nonferrous alloys with special emphasis on engineering applications. To impart knowledge on materials and their applications in automotive applications Understand the types of corrosion and its testing methods. To learn various techniques to cure corrosion, wear and friction using surface treatments 								
Course Outcome	Upon com 1. Under 2. Acqui suitab 3. Know of con 4. Gain a 5. Learn	pletion of this rstand the var re knowledg pility for mobi the various re nposite mate an insight ove various proce	s course, f rious moc e on prir lity einforcen rials r the vari ess and te	the stud de of m nciples nents u ious typ echniqu	dents will be aterials sele of materia sed in comp bes of corros	e able to ection ba Il proper posite ma sion, effe ed for su	sed on in- rties and aterials ar ects and fa rface trea	dustrial their d Analy iilure du tment.	req appl vze t ue to	uirements. ications on he strength o corrosion.
CO, PO AND I	SO MAPPINO	6	I			1			_	
СО	PO1	PO2	PO3	3	PO4	PO!	5	PSO1		PSO2
CO1	2	3	3		2	-		3		3
CO2	3	2	2		2	3		2		2
CO3	3	-	3		-	2		3		3
CO4	-	2	3		3	2		3		3
CO5	3	2	3		3	3		3		3
	1: We	akly related,	2: Mode	rately r	related and	3: Stron	gly relate	d		
MODULE 1: I	MATERIAL SEL	ECTION IN D	ESIGN	-				1	(6	6P)
Relation of materials selection to design, general criteria for selection, performance characteristics of materials, materials selection process, design process and materials selection, economics of materials, recycling and materials selection. CO-1 Practical component: CO-1 1. Identify the materials based on Ashby charts BTL-3 2. Ecological Design Audit and selection of hybrid materials Software/Equipment Required Software /: Appre Granta Selector Appre Granta Selector										
MODULE 2: L	ightweight ma	aterials							(6	L+ 6P)

1	Lightweight materials: aluminum, magnesium, titanium alloys, and its					
properties, ap	plications.					
Practical comp	ponent:					
1. Analy	sis the grain size and phase analysis	CO-2				
2. Micro	structure behaviour of materials	BTL-3				
Software/Equ	ipment Required					
Equipment: O	ptical Microscope					
Software : Xpe	ert High pro Plus					
MODULE 3: Co	omposite Materials and Analysis of strength	(6L+ 6P)				
Classification a	nd characteristics of Composite materials - Advantages and application					
of composites	- Functional requirements of reinforcement and matrix. Analysis of					
mechanical str	ength and thermal analysis.					
Practical comp	ponent:	60 3				
1. Mech	anical behaviour of composite materials	CO-3				
2. Thern	nal Analysis of composite materials	BTL-3				
Software/Equ	ipment Required					
Equipment: H	ardness. Impact tester					
Software : The	ermal analysis using Ansys software					
MODULE 4: Co	prrosion Analysis	(6L+ 6P)				
Purpose of co	rrosion testing - corrosion testing equipment's suscentibility tests for	(0=+ 01)				
intergranular (corrosion - Stress corrosion test. Salt sprav test humidity and porosity					
tests accelera	ted weathering tests. ASTM standards for corrosion testing					
Practical com	nonent:	CO-4				
	ursion Corrosion Test	BTL-2				
1. IIIIIIe 2. Salt o	pray correction Test	DIL-3				
2. Salt S	2. Salt spray corrosion Test					
Software/Equ	alt spray testing chamber					
	art spray testing chamber					
INIODOLE 5. 30		(CI + CD)				
Woor registant	coatings and Surface treatments – Techniques – DVD – CVD – Bhysical	(6L+ 6P)				
Wear resistant	t coatings and Surface treatments – Techniques – PVD – CVD – Physical	(6L+ 6P)				
Wear resistant CVD – Ion im	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick	(6L+ 6P)				
Wear resistant CVD – Ion im coatings – Nar	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings.	(6L+ 6P)				
Wear resistant CVD – Ion im coatings – Nar Practical comp	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings.	(6L+ 6P) CO-5				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings.	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick no-engineered coatings. Conent: coating resistant Coating	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick no-engineered coatings. conent: coating resistant Coating ipment Required	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV	coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings. Conent: coating resistant Coating ipment Required /D / CVD coating Chamber	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc	c coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings. Conent: coating resistant Coating ipment Required /D / CVD coating Chamber ratch Test analyzer	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS	 coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings. coonent: coating resistant Coating impent Required /D / CVD coating Chamber ratch Test analyzer 	(6L+ 6P) CO-5 BTL-3				
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Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2.	Chander Preatment Coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick too-engineered coatings. Sonent: Scooling Scooling Instant Coating Scooling Instant Coating Scooling (D / CVD coating Chamber Scooling Scooling Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOO	Chander Prekennen coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick no-engineered coatings. Soonent: Scoonent:	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOC	Chander Prekennen coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings. Coonent: coating resistant Coating ipment Required /D / CVD coating Chamber ratch Test analyzer Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate OKS	(6L+ 6P) CO-5 BTL-3 Materials, CRC Press, rials, Wiley-ISTE, 2022				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOO 1	Coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick to-engineered coatings. Coonent: Coonent: Coording Chamber Content Coating Chamber Condent Required (D / CVD coating Chamber Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate Chamber Composite Materials for Automotive Apple Integrity and Crashworthiness" John Wiley & Sons Ltd. 2014	(6L+ 6P) CO-5 BTL-3 Materials, CRC Press, rials, Wiley-ISTE, 2022 ications - Structural				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOO 1	Change Treatment Coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick no-engineered coatings. Donent: coating resistant Coating ipment Required (D / CVD coating Chamber ratch Test analyzer Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate DKS Ahmed Elmarakbi, "Advanced Composite Materials for Automotive Appl Integrity and Crashworthiness", John Wiley & Sons Ltd, 2014.	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOC 1 2	Character reatment coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick no-engineered coatings. coonent: coating resistant Coating ipment Required (D / CVD coating Chamber ratch Test analyzer Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate KS Ahmed Elmarakbi, "Advanced Composite Materials for Automotive Appl Integrity and Crashworthiness", John Wiley & Sons Ltd, 2014. Munmaya K Mishra, Biao Duan, The Essential Handbook of Polymer Terr	(6L+ 6P) CO-5 BTL-3 Materials, CRC Press, rials, Wiley-ISTE, 2022 ications - Structural ms and Attributes,				
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Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOO 1 2 E Resources fo 1. 2. MOOC	A coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick too-engineered coatings. Soonent: Tootating Tresistant Coating Tresistant Coating Tresistant Coating Tresistant Coating Chamber Tratch Test analyzer Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate DKS Ahmed Elmarakbi, "Advanced Composite Materials for Automotive Appl Integrity and Crashworthiness", John Wiley & Sons Ltd, 2014. Munmaya K Mishra, Biao Duan, The Essential Handbook of Polymer Terr CRC Press, 2024 Or Reference https://archive.nptel.ac.in/courses/113/104/113104082/	(6L+ 6P) CO-5 BTL-3				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equi Equipment: PV Sc BOOKS 1. 2. REFERENCE BOC 1 2 E Resources for 1. 2. MOOC	A coatings and Surface treatments – Techniques – PVD – CVD – Physical plantation. New trends in coating technology – DLC – CNC – Thick too-engineered coatings. Donent: coating resistant Coating technology – DLC – CNC – Thick too-engineered coating tresistant Coating tresistant Coating tresistant Coating tresistant Coating tresistant Coating Chamber ratch Test analyzer Chander Prakash, Sunpreet Singh, J. Paulo Davim, Functional and Smart 2020 Kaushik Kumar, Bathini Sridhar Babu, J. Paulo Davim, Light Weight Mate DKS Ahmed Elmarakbi, "Advanced Composite Materials for Automotive Appl Integrity and Crashworthiness", John Wiley & Sons Ltd, 2014. Munmaya K Mishra, Biao Duan, The Essential Handbook of Polymer Terr CRC Press, 2024 Dr Reference https://archive.nptel.ac.in/courses/112/104/112104122/ https://archive.nptel.ac.in/courses/113/104/113104082/	(6L+ 6P) CO-5 BTL-3 Materials, CRC Press, rials, Wiley-ISTE, 2022 ications - Structural ms and Attributes,				
Wear resistant CVD – Ion im coatings – Nar Practical comp 1. PVD c 2. Wear Software/Equ Equipment: PV Sc BOOKS 1. 2. REFERENCE BOO 1 2 E Resources fo 1. 2. MOOC 1. 2	in the frequency of the second sec	(6L+ 6P) CO-5 BTL-3 Materials, CRC Press, rials, Wiley-ISTE, 2022 ications - Structural ms and Attributes, <u>Dursera</u>				

DE FOR SEMESTER –III

COURSE TITLE	THERM/ SYS	AL MANAGE TEM FOR AL	EMENT F	OR A IVE \	UTOMOTIVE VEHICLES		CREDITS			3			
COURSE CODE	EAT52520	COURS	e Dry		DE		L-T-P-S		2-0-2-2				
Version	1.0	Approv Details	al		41 st ACM		LEARNIN LEVEL	G	B	BTL-3			
ASSESSMENT	SCHEME												
			CIA						E	ESE			
First Periodical Assessment (Theory)	Second Periodical Assessmen (Theory)	Prac t Assess	tical ments	Ol aj Co	oservation / la records as oproved by th Department Examination ommittee "DE	ab ne C"	Attenda	nce	Theory	Practical			
15%	15%	10	%		5%		5%		25%	25%			
Course Description	Students w with vehic other relat	vill learn ab le cab inter red topics.	out hea ior clim	t tra ate (nsfer in this control, auto	cour mot	se and be ive and s	e able mart	to apply engine co	it to issues oling, and			
Course Objective	 To know about automobile thermal management To design thermal controls To develop battery thermal management system To analyze issues with automotive HVAC systems To develop cooling cycles in car air-conditioning 												
Course Outcome	Upon comp 1. Discuss 2. Design 3. Develo 4. Analyz 5. Apply a	letion of this s on automo thermal cor p battery th e issues with and develop	s course, bile ther ntrols ermal m n automo cooling	the mal anag otive cycle	students will management ement systen HVAC system s in car air-co	be ab n s nditio	oning						
Prerequisite	Basic Knowle	dge on Ther	rmodyna	mics	, Heat transfe	r and	l basic con	npute	r skills				
CO, PO AND	PSO MAPPING												
CO	PO1	PO2	PO3		PO4		PO5	F	PSO1	PSO2			
<u> </u>	3	3	3		3		2		3	2			
CO2	2	2 1	2		2		3		2	3			
CO4	1	2	2		2		2		2	3			
CO5	2	2	3		3		2		2	2			
	1: We	- akly related	, 2: Mod	erate	ely related an	d 3: 9	- Strongly re	elated					
MODULE 1:	Automobile	thermal m	anagem	nent			07		(6L+ 6P)				
Overview, H	eat transmiss	sion via fins	s, unstea	ady	conduction,	Heat	exchang	ers:	C	0-1			
building and	design techr	niques.		•			0		B	TL-3			
MODULE 2:	Thermal con	trols							(6L+ 6P)				
Thermal con control of E offered by H	ntrols and he Vs and the VAC systems	eat resourc infrastruct	es in th ure sup	ne e port	ngine compa ing charging	artm g, ca	ent, ther bin, serv	mal ices	C	0-2 ГL-3			

MODULE 3:	Battery thermal management system	(6L+ 6P)
Battery the	rmal management system, Thermal comfort - The rating for	CO-3
thermal com	nfort in car interiors.	BTL-3
MODULE 4:	ssues with automotive HVAC systems	(6L+ 6P)
Issues with a	automotive HVAC systems: vintage vehicles, electric vehicles	CO-4
		BTL-3
MODULE 5: C	cooling cycles in car air conditioning	(6L+ 6P)
The princip	les of operation for cooling cycles - Cooling cycles in car air	
conditioning	g design.	
Software req	uired	CO-5
1. ANSYS flu	BTL-3	
TEXT BOOKS		
1.	T. Yomi Obidi, Thermal Management in Automotive Applications, SAE In	nternational (2015)
2.		
	Vincent Lomort, Gerard Olivier, Thermal Energy Management in Vehic	les, Wiley
	Publications, 2018.	
REFERENCE B	UUKS	
1	P.A. Lakshmi Narayanan and Avinash Kumar Agarwal, Hand book of The	rmal Management of
	Engines, Springer series, 2018.	
2	Yogesh jaluria, Design and optimization of Thermal Systems, CRC Press.	

COURSE TITLE	IOT FOR	AUTOMOTIVE	APPLICATIONS	CREDITS		3
COURSE CODE	EAT52509	COURSE CATEGORY	DE	L-T-P-S	2-(0-2-2
Version	1.0	Approval Details	41 ACM	LEARNING LEVEL	B	TL-3
ASSESSMENT	SCHEME					
		CIA			I	ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	This course gives Things, IoT Proto and In-vehicle	in-depth know pcols ,Platforms Infotainment an	ledge on IoT Architecture And Programming, IoT b d Telematics	es, Component ased Fleet Mar	s In Intern nagement	et Of and CV2X,
Course Objective	 To describe To discuss t To discuss t To describe To describe To discuss l 	the IoT concept he Components he IoT Protocols IoT based Fleet n-vehicle Infotai	and Architectures in Internet of Things Platforms and Program Management and CV2X nment and Telematics	nming		
Course Outcome	Upon completion 1. Gain knowle 2. Acquire knowle 3. Obtain knowle	n of this course, edge on the IoT wledge on Com wledge on IoT P	the students will be able concept and Architectur ponents in Internet of Tl cotocols, Platforms and F	e to es hings Programming		

	4. Attair 5. Obtai	n knowledge o n the knowled	n IoT based Fl Ige on In-vehi	eet Managem cle Infotainme	ent and CV2X nt and Telema	atics			
Pre requisite: Basic knowledge on IOT									
CO, PO AND	PSO MAPPIN	G							
СО	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2		
CO-1	2	1	1	1	1	2	1		
CO-2	3	3	2	2	2	1	2		
CO-3	3	2	1	1	1	2	1		
CO-4	CO-4 2 3 2 2 1								
CO-5 2 2 1 1 2									
	1: W	eakly related.	2: Moderate	v related and	3: Strongly re	lated			
Module 1: In	troduction to	Internet of T	hings	,			(6L+ 6P)		
Evolution of I	nternet of Thi	ings – Enabling	Technologies	s – IoT Architec	tures: oneM2	M IoT World			
Forum (IoTW	(F) and Alterna	ative IoT Mode	s – Simplified	loT Architectu	ire and Core lo	T Functional			
Stack – Fog. I	Edge and Clou	id in IoT	iii oiiiipiirea						
Lab Compon	ent						CO-1		
• Intro	oduction to A	rduino platfor	m and program	mming			BTI-3		
 Intro 	oduction to R	asnherry PI nl:	atform and ny	thon program	ming		512.5		
Software/Fg	uinment Rea	uired	in and py	then program	5				
• Ardu	uino platform	and program	ming Rasnher	ry PI platform	and nython n	rogramming			
				ry riplationni		logrammig	(6I + 6P)		
Functional B	ocks of an Io	Fcosystem –	Sensors Actu	ators and Sm	art Objects – (Control Units			
- Communica	tion modules	(Bluetooth 7	ighee Wifi Gl	PS GSM Modu	ules)	control onits			
Lab Compon	ent			, com moue	licsy				
• Inte	rfacing Arduir	no to Zighee m	nodule				CO-2		
Interfacing Arduino to CSM module						BTL-3			
Interfacing Arduino to Bluetooth Module						DIL-3			
Interfacing Arduino to Bluetooth Module Software/Equipment Required									
Software/Eq	uipinent keq	and program	mina						
Modulo 2: Pi		forms and Bro	aramming				$(61 \pm 6D)$		
IOT Protocolu				liroloss Sonsor	Notworks Bi	a Data	(01+ 02)		
Applytics Ck	s - IFVO, OLOVV	FAN, MQTT, C	Systems IOT	doplovmont f	or Pacaborry	gDala Di /Arduino			
Allarytics, Cit	hitocturo – Pr	ig, Ellibeuueu	Jatorfacing		DI Raspuerry	onding and			
	nale Using GP	UC Pins - Con	necting to the	- Accessing G		enung anu			
Lab Compon	nais Using GP		lecting to the	ciouu.			CO 3		
	ent rfacing conco	rs to Basabara					CU-3 PTL 2		
• Inte	municate her	is to Raspberr	y Fi a and Dasabar		wireless mod	li uno	DIL-3		
• Con	uinmont Pog	ween Ardum	J and Raspber	ry Prusing any	wireless med	lum			
Soltwale/Eq	uipment keq	and program	ming Deceber	m. Di platfarm	and nuthan				
 Arut 	ano plationi	anu program	ning, Kaspber	ry Pr plationn					
			nt and CV2V						
Floot Manag	of based Field	time lesstie		M/sight // /s	lumo trockin	a Trucks'	(0L+ 0P)		
Fleet Manag	gement- Real	-time locatio	n monitoring	- weight/vo	nume trackin	g - Trucks			
periornance	statistics - Ru	ute managen	ent - Driver m	lanagement - n		ZA (Cellulai			
Lab Compon	erytning)						CO A		
	ent un a cloud plat	tform to log th	a Floot Mana	annont data					
 Setup a cloud platform to log the Fleet Management data Log Data using Bashberry PL and upload to the cloud platform 					DIL-3				
Log Data using Raspberry PI and upload to the cloud platform									
Software/Eq		uireu form and nuth		ing					
		iorin and pyth	on programm	iirig					
	n-venicie inic				Duadiativa au	alution InT	(0L+ 0P)		
intelligent In					tice	aiylics - 101			
iniused semi-	-autonomous	cars - m-venio	le motainme	int and Telema	ucs		CO-5		
Lab Commer	ont						BTL-3		
	CIIL	<u></u>	fatalana ant a	nd Tolomotics	IoT with Docal				

Software/Eq	uipment Required					
Rasp	oberry PI platform and python programming					
TEXT BOOKS						
1.	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT					
	Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",					
	CISCO Press, 2017					
2.	2. Samuel Greengard, The Internet of Things, The MIT Press, 2015					
REFERENCE B	OOKS					
1	Perry Lea, "Internet of things for architects", Packt, 2018					
2	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications					
	and Protocols", Wiley, 2015					
E Resources						
1.	1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities					
	Press, 2015					
2	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition					
MOOC						
1.	https://www.arduino.cc/ https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet					
2.	https://builtin.com/articles/v2x-vehicle-to-everything					

COURSE TITI F	MECHA	MECHATRONICS IN AUTOMOTIVE APPLICATIONS						3
COURSE	EAT525	COURS	E ORY	DE	L-T-P-S		2-0-2-2	
Version	1.0	Approv Details	val	41 st ACM	LEARNIN LEVEL	G	BTL-3	
ASSESSMENT	SCHEME							
			CIA				ESE	
First Periodical Assessment (Theory)	Secon Periodi Assessm (Theor	d cal Prac ient Assess y)	tical a ments C	bservation / la records as pproved by the Department Examination pmmittee "DEC	b Attendar	nce	Theory	Practical
15%	15%	10)%	5%	5%		25%	25%
Course Description	vehicle as well as test equipment. An automobile and its components are tested on various test equipment for measuring its performance and road worthiness.							
Course Objectives	2. To d 3. To d 4. To a 5. To d	 To develop vehicle testing equipment To design power train, emission testing and transmission systems To analyze structural dynamic testing To develop vehicle safety components test 						
Course Outcomes Prerequisite	Upon con 1. App 2. Dev 3. Desi 4. Ana 5. Dev Basic Knov	 Upon completion of this course, the students will be able to Apply on advanced automotive systems Develop vehicle testing equipment Design power train, emission testing and transmission systems Analyze vehicle structural dynamic testing Develop vehicle safety components test Basic Knowledge on						
CO, PO AND PSO MAPPING								
СО	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2
CO1	3	3	3	3	2		3	2

CO2	2	2	1	2	3	2		3
CO3	2	1	3	2	2	3 3		3
CO4	2	2	2	2	3	2 3		3
CO5	2	2	3	3	1	2		2
1: Weakly related, 2: Moderately related and 3: Strongly related								
MODULE 1:	ADVANCED	AUTOMOTIVE	SYSTEMS			(6	L+ 6P)	1
Basics of Tele	ematics, BAS,	ASR, ACC, Aut	o Air-conditio	ning, Automo	tive diagnosis	and		
detection, Auto transmission electronic control, MOST, D2B.							CO-1	
Electronic steering control theory, Vehicle suspension control theory, Electronically						ally	B	TL-3
controlled windows and doors & airbag technology, Electronic navigation system.								
MODULE 2:	VEHICLE TES	TING				(6	L+ 6P)	
Testing of Po	wertrain, au	tomatic trans	mission, braki	ng forces, Bra	kes and tire r	oad		
friction, rolli	ing resistance	e and the fa	actors affection	ng it, Excitat	ion sources-r	oad		
roughness.	0			0				
Tire wheel a	ssembly, dri	iveline excitat	ion, engine/ti	ransmission, s	steering syste	ms-	С	0-2
steering syst	tem linkages	, forces and	moments, Ti	ransient rollo	ver Tractive	and	B	TL-3
cornering pro	operties of tir	es, Vehicle tes	st parameter a	and homologat	tion requireme	ent,		
test tracks tv	pes and para	meter identific	cation for vehi	cle test. data a	cauisition syst	em		
and mountin	g of test equi	ipment onto t	he vehicle.					
MODULE 3: F	POWERTRAIN	. EMISSION T	ESTING & TRA	ANSMISSION S	YSTEMS	(6L	+ 6P)	
Vehicle pow	vertrain syst	ems & com	ponents. Fue	Consumptio	n-Engine ene	rgv	. ,	
consumption	. Vehicle ma	nagement syst	tem-engine &	emission cont	rol manageme	ent.		
vehicle fuel c	onsumption.	dvnamomete	rs and the me	asurement of	torque.	,		
Combustion	process and	analysis, chass	is and rolling	road dynamor	neters, princi	oles		
of particulate	emission me	easurements.	measurement	of unregulated	d gas compone	ents	С	0-3
and diesel ex	haust gas pa	rticles. Vehicle	exhaust emis	sion tests and	procedures.		BTI-3	
Vehicle tran	smission sve	stems: hasic	design nrinci	nles commer	cial vehicle :	and	-	
nassenger ca	r transmissio	ns Electronic	transmission	control emissi	on standards	and		
statutory requirements, current trends in nowertrain testing, software for nowertrain								
control test standards						uni		
MODULE 4: STRUCTURAL DYNAMIC TESTING						(6L+ (6P)	
Types of	shakers- m	echanical. e	lectrodynamic	. electrohyd	Iraulic, mult	iple	.,	
electrodynan	nic Types of	tests- mecha	nical shock s	inusoidal aut	omotive rand	lom		
vibrations		tests meena	incur shoek, s					
Vibration so	irces & effer	rts Displacem	ent sensors &	recorders st	atic and dyna	mic	C	0-4
calibration a	cceleromete	rs and their ty	nes				B	TL-3
Measuremer	t and analys	is of sine ran	dom & SoB vil	bration Failur	es and reliahi	lity		
Failure Mode	Fffect Analy	sis[FMFA] ran	dom vibration	testing stand	ards	iicy,		
			ENTS TEST			(61 + 6	D)	
Test on all types of Lights, Bullis and Deflectors, Test for head restraints, Test on Eucl								
tanks Tosts	n Seat helt	Bumper impar	rt tost	or field restre	inits, rest on r	uer	ſ	0-5
Flammability	Weatheror	neter (hot c	old) LIV test	Thermal cycli	ic tost Tosts	on	R.	U-J TI -3
Flammability, weatherometer (not, cold), ov test, mermai cyclic test, rests on BIL-S							TL-5	
	Eundamon	tals of vohiclo	dynamics by	Thomas D. Gill	ocnio Rublich	or: SAE		
1.	Fundamentais of venicle dynamics by Inomas D. Gillespie, Publisher: SAE					- Machadi		
2. venicle powertrain systems, integration and Optimization by David Crolla, Benrooz Mashadi								
5 Engine Testing by Anthony J. Martyr, Publisher: Butterworth-Heinnemann								
						oom:		
1	Pvt. Ltd.					learning		
² Vehicle noise, vibration and sound quality by Gangsheng Chen by SAE International								

COURSE	CYBER SECURITY FOR VEHICLE APPLICATIONS CREDITS					3
COURSE	EAT52523	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2	
Version	1.0	Approval Details	41 st ACM	LEARNING LEVEL	BTL-3	
ASSESSMENT	SCHEME	I		1		
		CIA				ESE
First Periodical Assessment (Theory)	Second Periodical Assessment (Theory)	Practical Assessments	Observation / lab records as approved by the Department Examination Committee "DEC"	Attendance	Theory	Practical
15%	15%	10%	5%	5%	25%	25%
Course Description	Automotive cyber security involves protecting vehicle electronic systems, communication networks, control algorithms, software, individuals, and data from malicious assaults, damage illegal access or manipulation					
Course Objective	 To understand the nature of threats and cyber security management goals and technology To impart knowledge on In-Vehicle Network Technologies To learn various techniques on routing protocols and sensor data To understand the landscape of hacking and perimeter defense mechanisms. 					
Course Outcome	 Upon completion of this course, the students will be able to Gain knowledge on the nature of threats and cyber security management goals and framework Apply knowledge in developing on In-Vehicle Network Technologies Discover knowledge to develop Autonomous Vehicle and sensor management Attain knowledge on Ethical Hacking and security management Obtain the knowledge on order law in India 					
Prerequisite :	Basic Knowledge	on Network tech	nologies and Databas	e management	systems	
CO, PO AND P	SO MAPPING					
со	PO1	PO2 PO3	3 PO4	PO5	PSO1	PSO2
CO1	3	3 3	3	2	3	2
CO2	2	2 -	2	3	2	3
CO3	2	- 3	2	2	3	3
CO4	-	2 2	2	3	2	3
CO5	2	2 3	3	-	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related						
MODULE 1: Introduction to Cybersecurity (6L+ 6P)						(6L+ 6P)
Introduction to Autotronics, Modern automotive control and communications systems from a cyber-security perspective. Practical component: 1. Security mechanisms and architectures 2. Hardware security modules Software Required Open Systems Interconnection (OSI)					:0-1 TL-3	
MODULE 2: Introduction to In-Vehicle Network Technologies (6)					(6L+ 6P)	
CAN, LIN, Flex Ray, K-Line, Automotive Ethernet, and CAN FD. different IVN types, ports and networks. OBDII and EOBD technologies Practical component: 1. Connection with different mode of Networks				CO-2 BTL-3		

2. V2V and V2	1 Communions				
Software Req	uired				
V2V and V21 9	Simulator				
MODULE 3: Se	(6L+ 6P)				
vehicular mob	ility modeling, physical layer considerations, routing protocols,				
autonomous	ehicles sensors technologies, sensor data fusion techniques,				
Practical com	ponent:	CO-3			
1. 3-axis accel	erometer	BTL-3			
2. 3-axis geom	nagnetic sensor	DIE-3			
Software Req	uired				
sensor fusion	software BSX				
MODULE 4: Et	thical Hacking	(6L+ 6P)			
Security Fund	amental, Hacker and Cracker, information Gathering, Determining the				
Network Rang	e, Identifying Active Machines, OS Fingerprinting Services, Mapping the				
Network Attac	ck Surface				
Practical com	ponent:	CO-4			
2. OS finger	printing services	BTL-3			
3. Mapping	of Networks				
Software Req	uired				
Network Topo					
MODULE 5: C	(6L+ 6P)				
Cyber law in	India, Overview of Rules Issued Under the It Act, 2000, Electronic				
Commerce, E	electronic Contracts, Cyber Crimes, Cyber Frauds. Rules for Safe				
Operations of					
Legislative Re	CO-5				
Case Study	BTL-3				
1. Case studie	s on cyber crimes				
2. Case studie					
BOOKS					
1.	Alim H. Ali, Network Architect's Handbook, Packt Publishing, 2024				
2.	2. Daniel Lowrie, Hands-on Hacking, Packt Publishing, 2024.				
3	3 Pavan Duggal, Textbook On Cyber Law, second edition, Universal Law, 2016.				
REFERENCE BO	DKS				
1 Joseph Ingeno, Software Architect's Handbook, Packt Publishing, 2018					
2 Dr. Ahmad MK Nasser, Automotive Cybersecurity Engineering Handbook, Packt Publishing,					
	2023.				
E Resources f	or Reference				
1.	https://nptel.ac.in/courses/106/105/106105217/				
2. https://archive.nptel.ac.in/courses/106/105/106105160/					
моос					
1.	https://www.mooc-list.com/course/automated-cyber-security-inciden	t-response-coursera			
2	2 https://www.coursera.org/learn/security-at-the-edge-first-course-1#modules				