HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

M. TECH. AUTOMOBILE ENGINEERING

with specialization in

Automotive Technology

(Duration: 2 Years)

REGULATION 2024

(in line with NEP 2020)

REGULATION, CURRICULUM AND 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.
6. “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.
7. “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.
8. “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 fulfills 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 fulfil 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 be 6 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 startup 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.

Table 1. Credits Under Each Category

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

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 **not** 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 weightage	ESE Weightage	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%
6.	Project and Viva Voce	50%	50%	25	50%

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.

Table 3a: Weightage for Assessment – Theory Course

No.	CIA/ ESE	Assessment (Theory Course)	Weightage	Duration
1.	CIA	First Periodical Assessment	25%	2 periods
2.		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

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 (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 Assessment (CIA) -- 50%
b. 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.	CIA	First Periodical Assessment (Theory)	25%	2 periods
2.		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.

Table 3e : Assessment of Project work

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%

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 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. Sponsored candidates from Research and 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:

(i) 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.

Table 4: Grading system

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	B	06	ABOVE AVERAGE
55-59	C	05	AVERAGE
50-54	P	04	PASS
< 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 MTech. 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. 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.

Table 5: Multiple Exit

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.

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,

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

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 ≤ CGPA < 8.0: First Class

5.0 ≤ 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 Clause 9.0 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.

HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

VISION AND MISSION OF THE INSTITUTE

MOTTO

"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 Objectives (PEOs)	Programme Outcomes (POs)					Programme Specific Outcomes (POs)	
	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

		Sl. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
YEAR 1	SEMESTER 1	1	GMA52001	Applied Engineering Mathematics	1.8	2	1.6	1.8	1.4	1.2	1.4
		2	EAT52001	Vehicle Electrification and Hybridization	2	1.6	1.4	2.2	1.8	1.8	1.6
		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
		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
	SEMESTER 2	1	EAT52003	Crashworthiness and Automotive Safety	2.6	2.6	1.8	1.8	0.2	2	1.8
		2	EAT52004	AI for Automotive Applications	1.8	2	1.4	1.6	1.4	1.4	1.6
		3	EAT52005	AI for Autonomous and Connected Vehicles	1.8	2	1.2	2.2	1.2	1.4	1.6
		4	EAT525**	Department Elective– 3							
		5	EAT525**	Department Elective– 4							
		6	GGE52001	Research and Publication Ethics	1.8	2	1.4	2.2	1.4	1.4	1.6

		Sl. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
YEAR 2	SEMESTER 3	1	EAT52800	Internship	2	2	3	3	3	1.33	1.67
		2	EAT52801	Project Work-Phase - I	3	2.33	2	2.33	2.33	2	2.33
	SEMESTER 4	1	EAT52802	Project Work-Phase - II*	3	3	2	2	2.4	2.6	2.4

DEPARTMENT ELECTIVES

		Sl. No	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2
YEAR 1	SEMESTER 1	1	EAT52500	Electronic Engine Management System	2.4	2.2	1.4	1.4	0.8	1.6	1.4
			OR								
			EAT52501	AI for Vehicle Control System	2	1.8	1.4	1.4	1.4	1.6	1.4
		2	EAT52502	Hydrogen Energy for Smart Mobility	1.6	1.8	1.4	1.4	1.4	1.8	1.4
			OR								
			EAT52503	Automotive Emission Control and E waste Management	1.6	2	1.4	1.2	1.4	1.4	1.4
	SEMESTER 2	1	EAT52504	Off-Highway Mobility	2.6	1.2	2.2	1.2	1.6	2.4	1.8
			OR								
			EAT52505	Noise, Vibration and Harshness	1.6	1.8	1.4	1.4	1.4	1.8	1.4
		2	EAT52506	Vehicle Ergonomics and Styling	1.6	1.8	1.6	1.4	1.4	1.8	1.4

			OR								
			EAT52507	Computer Aided Engineering	1.6	1.8	1.6	1.4	1.4	1.8	1.4

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%
	Limited Content	Covered in assessments and other class room activities 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																	
6	EEC	GLS52001	Leadership Skills for 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	AI for Autonomous and Connected Vehicles																	
4	DE	EAT525**	Department Elective– 3																	
5	DE	EAT525**	Department Elective– 4																	
6	EEC	GGE52001	Research and Publication 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 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	EEC	EAT52800	Internship																	
2	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 Partnership 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 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	DE	EAT52500	Electronic Engine Management System																	
2	DE	EAT52501	AI for Vehicle Control System																	
3	DE	EAT52502	Hydrogen Energy for Smart Mobility																	
4	DE	EAT52503	Automotive Emission Control and E waste Management																	
5	DE	EAT52504	Off-Highway Mobility																	
6	DE	EAT52505	Noise, Vibration and Harshness																	
7	DE	EAT52506	Vehicle Ergonomics and Styling																	

8	DE	EAT52507	Computer Aided Engineering																	

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	12
4	EEC	Employment Enhancement Courses	44
		TOTAL	**80**

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				20	**20**
4				20	**20**
Total Credits	**4**	**20**	**12**	**44**	**80**

CURRICULUM COURSE DISTRIBUTION (BASED ON COURSE COUNT)

Semester	BS	PC	DE	EEC	Total Courses per semester
1	1	2	2	1	**6**
2		3	2	1	**6**
3				2	**2**
4				1	**1**
Total Courses	**1**	**5**	**4**	**5**	**15**

CREDIT COUNT

Semester	Credits
1	**19**
2	**21**
3	**20**
4	**20**
Total Credits	**80**

CURRICULUM STRUCTURE

M.TECH. AUTOMOBILE ENGINEERING (AUTOMOTIVE TECHNOLOGY) CURRICULUM - 2024-2025 (NEP R 2024)											
SL. NO	**SEM**	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	I	BS	TH	GMA52001	Applied Engineering Mathematics	4	0	0	4	0	4
2	I	PC	TP	EAT52001	Vehicle Electrification and Hybridization	2	1	2	4	2	5
3	I	PC	TP	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	TP	GLS52001	Leadership Skills for Engineers	1	0	1	1	0	2
					Total	**13**	**2**	**9**	**19**	**8**	**24**
L – Lecture T – Tutorial P – Practical C – Credit S – Self Study TCH – Total Contact Hours											

Semester-II											
SL. NO	**SEM**	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	II	PC	TP	EAT52003	Crashworthiness and Automotive Safety	2	1	2	4	2	5
2	II	PC	TP	EAT52004	AI for Automotive Applications	2	1	2	4	2	5
3	II	PC	TP	EAT52005	AI for Autonomous and Connected Vehicles	3	0	2	4	2	5
4	II	DE	TP	EAT525**	Department Elective– 3	2	0	2	3	2	4
5	II	DE	TP	EAT525**	Department Elective– 4	2	0	2	3	2	4
6	II	EEC	TH	GGE52001	Research and Publication Ethics	3	0	0	3	0	3
					Total	**14**	**2**	**10**	**21**	**10**	**26**
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**	**T**	**P**	**C**	**S**	**TCH**
1	III	EEC	IN	EAT52800	Internship	#			2	0	#
2	III	EEC	PJ	EAT52801	Project Work-Phase - I	0	0	36	18	0	36
					Total	**0**	**0**	**36**	**20**	**0**	**36**
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

Semester-IV											
SL. NO	**SEM**	**COURSE CATEGORY**	**COURSE TYPE**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	IV	EEC	PJ	EAT52802	Project Work-Phase - II*	0	0	40	20	8	40
					Total	**0**	**0**	**40**	**20**	**8**	**40**
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**	**T**	**P**	**C**	**S**	**TCH**
1	I	DE 1	TP	EAT52500	Electronic Engine Management System	2	0	2	3	2	4
				OR							
				EAT52501	AI for Vehicle Control System						
2	I	DE 2	TP	EAT52502	Hydrogen Energy for Smart Mobility	2	0	2	3	2	4
				OR							
				EAT52503	Automotive Emission Control and E waste Management						
3	II	DE 3	TP	EAT52504	Off-Highway Mobility	2	0	2	3	2	4
				OR							
				EAT52505	Noise, Vibration and Harshness						
4	II	DE 4	TP	EAT52506	Vehicle Ergonomics and Styling	2	0	2	3	2	4
				OR							
				EAT52507	Computer Aided Engineering						
L – Lecture T – Tutorial P – Practical C – Credit S – Self Study TCH – Total Contact Hours											

Syllabus

Semester I

COURSE TITLE	APPLIED ENGINEERING MATHEMATICS (Common for ALL except MCA, CSE and IT)			CREDITS	4
COURSE CODE	GMA52001	COURSE CATEGORY	BS	L-T-P-S	4-0-0-0
Version	2.0	Approval Details		LEARNING LEVEL	BTL - 4

ASSESSMENT SCHEME					
CIA					ESE
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	Theory
15%	15%	10%	5%	5%	50%

Course Description	To impart fundamental knowledge in various fields of Advanced Engineering Mathematics and its applications.
Course Objective	1. To apply the concept of calculus of variation. 2. To recognize Laplace Transform Techniques. 3. To recognize Fourier Transform Techniques. 4. To solve partial differential equation problems. 5. To analyse the concept of Probability and Random Variables.
Course Outcome	Upon completion of this course, the students will be able to 1. Analyse the Functional dependent on functions of independent variables. 2. Solve the partial differential equations using Laplace Transform. 3. Solve the partial differential equations using Fourier Transform. 4. Compute numerical solutions using explicit and implicit methods. 5. Implement the concepts of Probability and Random Variables.

Prerequisites: Basics in Differential Equation ,Partial Differential Equations and Statistics

CO, PO AND PSO MAPPING

CO	PO-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
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 (12L)

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.	**CO-1** **BTL-2**
MODULE 2: LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS (12L)	
Laplace transform: Definitions, properties -Transform of error function, Bessel's function, Dirac Delta function, Unit Step functions – Convolution theorem – Inverse Laplace Transform: Complex inversion formula – Solutions to partial differential equations: Heat equation, Wave equation **Suggested Reading**: Partial Differential Equations, Half range sine series.	**CO-2** **BTL-3**
MODULE 3: FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS (12L)	
Fourier transform: Definitions, properties – Transform of elementary functions, Dirac Delta function – Convolution theorem – Parseval's identity– Solutions to partial differential equations: Heat equation, Wave equation, Laplace and Poison's equations. **Suggested Reading**: Basic integration .	**CO-3** **BTL-3**
MODULE 4: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12L)	
Solution of Laplace and Poisson equation on a rectangular region by Liebmann's method – Diffusion equation by the explicit and Crank Nicolson – Implicit methods – Solution of wave equations by explicit scheme Cubic spline interpolation. **Suggested Reading**: Partial Differential Equations	**CO-4** **BTL-4**
MODULE 5: PROBABILITY AND RANDOM VARIABLES (12L)	
Discrete and Continuous random variables - Standard distributions - Binomial, Poisson, Geometric, Normal, Transformation of one dimensional random variables- Two dimensional random variables - Joint, Marginal and Conditional distributions. Correlation and Regression. **Suggested Readings:** Basic knowledge on probability, Introduction to probabi**lity.**	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Gupta. A.S(2006),Calculus of Variations with Applications, Prentice Hall of India(P) Ltd., 6th print, New Delhi.
2.	Sankar Rao. K(2004) , Introduction to Partial Differential Equations, Prentice Hall of India(P) Ltd.,5th print, New Delhi.
3.	Keith M. Walker(2013),Applied Mechanics for Engineering Technology,Pearson New International Edition.
REFERENCE BOOKS	
1.	Grewal, B.S , Numerical Methods in Science and Engineering, Kanna Publications, New Delhi.
2.	Nawazish Ali Shah(2020),Vector And Tensor Analysis, University of Houston.
3.	Viswanadham. N and Narahari. Y(1992), Performance Modelling of Automated Manufacturing Systems, Prentice-Hall, Inc. Upper Saddle River, NJ,USA.
E BOOKS	

1.	https://www.google.co.in/books/edition/Introduction_To_The_Calculus_of_Variatio/EmlQDwAAQBAJ?hl=en&gbpv=0
2.	https://www.maplesoft.com/products/ebooks/advanced_engineering_mathematics/toc.aspx
3.	https://www.e-booksdirectory.com/listing.php?category=679
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_ma34/preview
2.	https://archive.nptel.ac.in/courses/111/101/111101153/

COURSE TITLE	**VEHICLE ELECTRIFICATION AND HYBRIDIZATION**			**CREDITS**	**4**	
COURSE CODE	**EAT52001**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-1-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
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	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	1. To compare the concepts of Hybrid and Electric Vehicles. 2. To categorize the Electric machines and Power Electronics 3. To analyse Battery Technology of Electric Vehicles 4. To appraise the Charging Technology of Electric Vehicles 5. To discuss the future trends in Electric Vehicles					
Course Outcome	Upon completion of this course, the students will be 1. Interpret the concepts of hybrid and Electric Vehicles. 2. Categorize the Electric machines and Power Electronics 3. Analyse Battery Technology of Electric Vehicles 4. Assess the Charging Technology of Electric Vehicles 5. Discuss on the future trends in Electric Vehicles					
Prerequisites: Knowledge on basics of Electrical, Electronics, Mechanical, Mechatronics, Automobile Systems						
CO, PO AND PSO MAPPING						

CO	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: Introduction to Electric and Hybrid Vehicles	**(6L+3T+ 6P)**
Historical Journey of Electric and Hybrid vehicles - Economic and Environmental Impact of Electric Hybrid Vehicle - Well-to-Wheel Emissions of EVs. **Lab Component** 1. To build Full Electric Vehicle Model 2. To evaluate Power and Energy of Electric Vehicle **Software/Equipment Required** MATLAB with Simulink	**CO-1** **BTL-2**
Module 2: Electric Machines and Power Electronics	**(6L+3T+ 6P)**
EV Power Electronics - Electric Machines - Inverter/VFD - Speed Control - Losses in Power Electronics, Battery and Electric Machines. **Lab Component** 1. To model traction motors 2. To develop Motor Control Units **Software/Equipment Required** MATLAB with Simscape tool	**CO-2** **BTL-3**
Module 3: Battery Technology for EVs	**(6L+3T+ 6P)**
Battery -working principles & Battery losses - Lithium-ion Batteries - Battery pack and Battery Management system - Battery Production and Reuse. **Lab Component** **1.** To model batteries and develop battery management systems (BMS) **Software/Equipment Required** MATLAB with Simscape tool	**CO-3** **BTL-3**
Module 4: Charging Technology of EVs	**(6L+3T+ 6P)**
AC charging - Type 1,2,3 - DC charging - CHAdeMO, Tesla, CCS, GB/T - Fast charging and its limitations - Smart charging and Applications - Vehicle to Grid (V2G) Technology **Lab Component** 1. Case study of ABB Charging Technology	**CO-4** **BTL-3**
Module 5: Future Trends in Electric Vehicles	**(6L+3T+ 6P)**
Wireless and on-road Charging of EV - Battery Swap Technology - Autonomous Driving Charging EVs from Renewable Resources **Lab Component** 1. Case Study : Vattenfall solar car team	**CO-5** **BTL-3**

TEXT BOOKS	
1.	James Halderman and Curt Ward, “Electric and Hybrid Electric Vehicles”, 1st edition, Published by Pearson (2022)
2.	A. K. Babu., “Electric and Hybrid Vehicles”, Second Edition, Khanna Publishing., January 2022.
REFERENCE BOOKS	
1.	Robert Bosch Automotive Handbook, 10th Edition (2018)., BOSCH 10, ISBN of 978-0-7680-9567-8.
2.	Tom Denton., “Electric and Hybrid Vehicles”2020.
E BOOKS	

1.	https://autocrypt.io/wp-content/uploads/2021/08/electric-vehicle-ebook.pdf
2.	https://www.routledge.com/rsc/downloads/CRC_Hybrid_Vehicles_Freebook.pdf
MOOC	
1.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/
2.	https://nptel.ac.in/courses/108106170

COURSE TITLE	**MODELLING AND SIMULATION OF VEHICLE SYSTEMS WITH A CASE STUDY**			**CREDITS**	**4**	
COURSE CODE	**EAT52002**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-1-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
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	This course gives in-depth knowledge on modelling of vehicle performance parameters, modelling battery electric vehicles, drivetrain characteristics, energy management system and vehicle dynamic control systems.					
Course Objectives	1. To understand the modelling of vehicle performance parameters. 2. To model battery electric vehicles. 3. To describe the drivetrain characteristics. 4. To know the concepts of energy management system. 5. To know the vehicle dynamic control systems.					
Course Outcomes	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: Basic Knowledge on electric and electronics						

CO, PO AND PSO MAPPING

CO	**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	2	3	2	2	2	1	1
CO-5	2	2	1	1	1	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

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. **Lab Component**	**CO-1** **BTL-3**

Vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill) **Software/Equipment Required** MATLAB/SIMULINK	
Module 2: Modelling of Battery Electric Vehicles	**(6L+3T+ 6P)**
Electric Vehicle Modelling - Tractive Effort, rolling resistance force, Aerodynamic drag, Hill climbing force, Acceleration force, Total tractive effort, Modelling Electric Vehicle Range - Driving cycles, Range modelling of battery electric vehicles, Constant velocity range modelling, Range modelling of fuel cell vehicles, Range modelling of hybrid electric vehicles. **Lab Component** 1. Develop a simulation model to analyse the effect of Rolling Resistance on vehicle range and Performance 2. Efficiency evaluation of a series HEV in city and high-way cycles: study and analyse two strategies for ICE/Battery power split. **Software/Equipment Required** MATLAB/SIMULINK	**CO-2** **BTL-3**
Module 3: Drive Train Characteristics	**(6L+3T+ 6P)**
Modelling and Characteristics of EV/HEV Powertrains Components- ICE Performance Characteristics, Electric Motor Performance Characteristics - Battery Performance Characteristics-Transmission and Drivetrain Characteristics-Regenerative Braking Characteristics-Driving Cycles Modelling and Analysis of Electric and Hybrid Electric Vehicles Propulsion and Braking - Longitudinal Dynamics Equation of Motion - Vehicle Propulsion Modelling and Analysis - Vehicle Braking Modelling and Analysis. **Lab Component** Series HE powertrain mathematical model **Software/Equipment Required** MATLAB/SIMULINK	**CO-3** **BTL-3**
Module 4: Energy Management	**(6L+3T+ 6P)**
Handling Analysis of Electric and Hybrid Electric Vehicles - Simplified Handling Models Energy/Power Allocation and Management - Power/Energy Management Controllers - Rule-Based Control Strategies - Optimization-Based Control Strategies. **Lab Component** Computer model of the HEV **Software/Equipment Required** MATLAB/SIMULINK	**CO-4** **BTL-3**
Module 5: Vehicle Dynamic Control	**(6L+3T+ 6P)**
Control of Electric and Hybrid Electric Vehicle Dynamics - Fundamentals of Vehicle Dynamic Control (VDC) Systems, VDC Implementation on Electric and Hybrid Vehicles – Case Studies, Rechargeable Battery vehicles, Hybrid Vehicles, Fuel Cell Powered Bus. **Lab Component** Various strategies for improving vehicle energy/fuel efficiency **Software/Equipment Required** MATLAB/SIMULINK	**CO-5** BTL-3

BOOKS	
1.	James Larminie, John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2019.
2.	Amir Khajepour, Saber Fallah and Avesta Goodarzi, “Electric and Hybrid Vehicles-Technologies, Modelling and Control: A Mechatronic Approach”, John Wiley & Sons Ltd, 2018
3.	Antoni Szumanowski, “Hybrid Electric Power Train Engineering and Technology: Modeling, 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 Cell Vehicles_ Fundamentals, Theory, and Design, Second Edition", CRC Press, 2019.
E Resources for Reference	
1.	http://ebooks.asmedigitalcollection.asme.org/book.aspx?bookid=277
2.	http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection
MOOC	
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 SCHEME

CIA					**ESE**
First Periodical Assessment	**Second Periodical Assessment**	**Weekly assignment/ Observation / lab records and viva as approved by the DEC**	**Surprise Test/ Quiz etc., as approved by the DEC**	**Attendance**	
15%	**15%**	**10%**	**5%**	**5%**	**50%**

Course Description	This course focuses on developing leadership skills for engineers through hands-on activities, simulations and real-world case studies. Students will engage in practical exercises to build effective communication, team management, strategic decision-making and ethical leadership capabilities.
Course Objectives	1. To apply leadership theories and models in practical scenarios. 2. To enhance communication and interpersonal skills through interactive exercises. 3. To develop team management and conflict resolution strategies via simulations. 4. To practice strategic thinking and decision-making in engineering contexts. 5. To address ethical issues and professional responsibilities through case studies.
Course Outcomes	Upon completion of this course, the students will be able to 1. Demonstrate the ability to apply various leadership theories and models effectively in engineering-related practical scenarios through simulations and role-playing exercises. 2. 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. 3. Implement effective team management and conflict resolution strategies, showcasing their capability to lead diverse teams and mediate conflicts in engineering contexts through practical simulations. 4. Develop strategic thinking and decision-making skills by developing strategic plans, conducting risk assessments, and making informed decisions in simulated engineering projects. 5. Analyze and respond to ethical issues and professional responsibilities in engineering, applying ethical frameworks and principles to real-world case studies and role-playing scenarios.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	**PO-1**	**PO-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 related, 2: Moderately related and 3: Strongly related							
Module 1: Practical Leadership Foundations							**(6T+6P)**
Self-assessment using tools (like Myers-Briggs, DISC)- Different leadership styles- Personal leadership style identification- mindful Leadership-Setting personal leadership development goals- Leadership challenges in engineering contexts- employers wish list in leadership skills. **Lab Exercises:** • Leadership style self-assessment and reflection, Role-play scenarios to practice different leadership styles.							**CO-1** **BTL-2**
Module 2: Communication and Interpersonal Skills							**(6T+6P)**
Simulations for effective verbal and non-verbal communication- Building rapport and active listening drills -Group communication exercises- Networking and building professional relationships- Influencing and persuading skills- The ability to lead the people effectively- Conflict avoidance and stress management techniques. **Lab Exercises:** • Exercises on influencing and persuading in team settings, Leadership skills in Group discussion							**CO-2** **BTL-2**
Module 3: Team Dynamics and Conflict Management							**(6T+6P)**
Forming and leading diverse engineering Teams-Team-based problem-solving Exercises- Leadership roles in team settings- role of feedback and negotiation skills- Conflict scenarios in engineering Projects-Role-playing conflict resolution strategies- Mediation and negotiation simulations. **Lab Exercises:** • Team-based engineering challenge, Conflict resolution role-plays.							**CO-3** **BTL-3**
Module 4: Strategic Thinking and Decision Making							**(6T+6P)**
Developing strategic plans for hypothetical project- Scenario planning and risk management exercises -Delegation of tasks -SWOT analysis workshops -Real-time decision-making simulations -Ethical decision-making in engineering cases -Group discussions on decision-making processes. **Lab Exercises:** • Strategic planning exercise- Real-time decision-making simulation.							**CO-4** **BTL-3**
Module 5: Ethical Leadership and Professional Development							**(6T+6P)**
Analysis of ethical dilemmas in engineering- Role-playing responses to ethical challenges -Group discussions on professional responsibility -Building a leadership brand -Networking and mentorship activities- emotional intelligence -Continuous professional development planning. **Lab Exercises:** • Ethical dilemma role-plays-Developing a personal professional development plan							**CO-5** **BTL-3**
TEXT BOOKS							
1.	Arnold, E. E., & Bowman, J. S. (2022). *Engineering leadership: Key competencies and principles for effective leadership* (2nd ed.). Wiley						
REFERENCES							
1.	Tate, M. J., & Springer, J. S. (2021). *Leadership for engineers: The magic of mindset* (1st ed.). Routledge.						
E- RESOURCES							
1	Important Leadership Skills for Workplace Success (thebalancemoney.com)						
MOOC COURSES							
1.	https://www.mooc-list.com/tags/english						

Semester II

COURSE TITLE	CRASHWORTHINESS AND AUTOMOTIVE SAFETY			CREDITS	4
COURSE CODE	EAT52003	COURSE CATEGORY	PC	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 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 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	1. To know about the basics about the fundamentals and design of crashworthiness 2. To understand the safety aspects in the vehicle advanced crashworthiness and frontal impact analysis 3. To Know and understand the safety aspects 4. To know about the various safety equipment in a vehicle 5. To know about the collision systems comfort and convenience system
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on the fundamentals and design principles of crashworthiness. 2. Analyse safety aspects in advanced vehicle crashworthiness and frontal impact scenarios. 3. Comprehend and evaluate various vehicle safety aspects. 4. Identify and understand the different safety equipment used in vehicles. 5. Explore and understand collision systems, comfort, and convenience features in vehicles.

Pre requisite: Knowledge on Vehicle Dynamics, Vehicle Body Structures, 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	3	4	3	3	-	1	3
CO-3	3	2	1	1	-	3	1
CO-4	2	4	3	3	-	1	1
CO-5	2	2	1	1	-	3	3

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Crashworthiness – Fundamentals and Design	**(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** AUTO CAD software.	**CO-1** **BTL-2**
Module 2: Frontal Impact Analysis	**(6L+3T+ 6P)**
Mechanics of frontal collisions - Frontal impact analysis – acceleration-time characteristics modelling-force vs. crush characteristics and using LS DYNA for crash modelling. **Lab Component** 1. Setting up of crash simulation in LS DYNA 2. Input parameters and boundary conditions for accurate modeling 3. Running simulations and interpreting results **Software/Equipment Used** LS DYNA software.	**CO-2** **BTL-4**
Module 3: Introduction and Safety Concepts	**(6L+3T+ 6P)**
Design of the body for safety – active safety and passive safety. **Lab Component** 1. Quarter Car modeling including suspension types, spring damper systems **Software/Equipment Used** MATLAB.	**CO-3** **BTL-4**
Module 4: Safety Equipment	**(6L+3T+ 6P)**
Seat belt, Regulations, Automatic seat belt tightener system, Collapsible steering column, Tiltable steering wheel, Air bags, Electronic system for activating air bags, Bumper design for safety, Antiskid braking system, Regenerative Braking System, Cruise Control, Adaptive Cruise Control Devices. **Lab Components** 1. Testing seat belt and air bag 2. Examining braking system **Software/Equipment Used** ABS, Launchpad DS201	**CO-4** **BTL-3**
Module 5: Collision Systems, Comfort and Convenience	**(6L+3T+ 6P)**
Causes of rear end collision, Frontal and rear object detection, Object detection with braking system interactions, Driver Behaviour Detection. Steering and mirror adjustment, Central locking and garage door opening, Tyre pressure control, Rain sensor, Environment information, Manual and Automated Wiper, GPS. **Lab Component** 1. Central Locking 2. Tyre Pressure Control 3. Rain Sensors and GPS Navigation **Software/Equipment Used** Matlab, Hyundai Creta	**CO-5** **BTL- 4**

TEXT BOOKS

1.	J. Kisilowski, J. Zalewski Modeling of Road Traffic Events, Springer, 2022
2.	C. Lakshmana Rao, V. Narayanamurthy, K. R. Y. Simha, Applied Impact Mechanics, Wiley, 2016

REFERENCES

1.	D. C. Fleming and K. E. 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 and Principles, 2 nd edition, CRC Press, 2020
4.	Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 2015
E Resources for Reference	
1.	https://www.researchgate.net/publication/320520945_Improving_automotive_
2.	https://www.iqytechnicalcollege.com/Auto%20Vehicle%20Safety.pdf
MOOC	
1.	https://www.mooc-list.com/course/safety-first-ev-maintenance-best-practices-coursera
2.	https://www.mooc-list.com/course/vehicle-dynamics-i-accelerating-and-braking-iversity

COURSE TITLE	**AI FOR AUTOMOTIVE APPLICATIONS**			**CREDITS**	**4**	
COURSE CODE	**EAT52004**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-1-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
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 provides knowledge on Artificial Intelligence in Automotive Applications and Intelligent Transportation					
Course Objectives	1. To discuss on AI Automotive industry and Applications 2. To demonstrate the AI in Autonomous Driving Technology 3. To discuss on AI in Automotive Manufacturing and Supply Chain 4. To describe the Machine Learning Algorithms used in AI 5. To describe the AI in Safety Regulations, and Customer Experience					
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on AI Automotive industry and Applications 2. Demonstrate the AI in Autonomous Driving Technology 3. discuss on AI in Automotive Manufacturing and Supply Chain 4. Describe the Machine Learning Algorithms used in AI 5. describe the AI in Safety Regulations, and Customer Experience					
Prerequisites: Nil						

CO, PO AND PSO MAPPING

CO	**PO -1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**
CO-1	2	2	1	2	1	1	2
CO-2	2	3	2	2	2	2	1
CO-3	1	2	1	1	1	1	2
CO-4	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:Introduction to AI in Automotive Industry	**(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**	**CO-1** **BTL-2**

• Demonstration of AI tools and its capabilities **Software/ Equipment Required** • TensorFlow and OpenCV	
Module 2: AI in Autonomous Driving and Design	**(6L+3T+ 6P)**
Technologies involved in Autonomous Driving Systems – Sensor Technology - Actuators - Control Systems and Onboard Computing -NVIDIA AI tools -AI Techniques for Vehicular Perception -AI techniques for Decision Making and Control Tasks -AI for Capturing and Processing Real-Time Data **Laboratory Component** • Demonstration of NVIDIA AI tools and AI techniques for vehicular perception **Software/ Equipment Required** • NVIDIA AI tools, TensorFlow and OpenCV	**CO-2** **BTL-2**
Module 3: AI in Automotive Manufacturing and Supply Chain	**(6L+3T+ 6P)**
Smart Manufacturing -Integrating AI, IoT and Data analytics -AI in supply chain management Robotics and Automation in Assembly Lines -Automated Guided Vehicles (AGVs) -Collaborative Robots -AI for Quality Control Inspection -AI for Monitoring and Maintenance -AI for Detecting Anomalies and Fail Safes **Laboratory Component** • Case Study: General Motors – Dream Catchers • Case Study: Continental - AI driven Virtual Simulation Tool **Software/ Equipment Required** • Dream Catchers and Virtual Simulation Tool	**CO-3** **BTL-3**
Module 4:Machine Learning Algorithms	**(6L+3T+ 6P)**
Linear Regression - Logistic Regression -Decision tree - SVM algorithm Naive Bayes Algorithm - KNN Algorithm - K-means -Random Forest Algorithm Dimensionality Reduction Algorithms - Gradient Boosting Algorithm and AdaBoosting Algorithm **Laboratory Component** • Demonstration of SVM algorithm and Random Forest Algorithm **Software/ Equipment Required** • TensorFlow and OpenCV	**CO-4** **BTL-2**
Module 5: AI in Safety, Regulations and Customer Experience	**(6L+3T+ 6P)**
AI Autonomy and Human Control - Rules and Regulations by Society of Automotive Engineers (SAE) -Industry Guidelines by National Highway Traffic Safety Administration (NHTSA) - European Union Agency for Cybersecurity (ENISA) -Advanced Driver Assistance Systems (ADAS) -Cybersecurity measures for protecting AI-driven Automotive Systems **Laboratory Component** • Demonstration of Cyber Security Measures for protecting AI-driven automotive systems **Software/ Equipment Required** • TensorFlow and OpenCV	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach Third Edition ISBN-13: 978-0-13-604259-4, 2010
2.	S. Meenakshi Ammal, M. Kathiresh, R. Neelaveni, Artificial Intelligence and Sensor Technology in the Automotive Industry: An Overview, Springer International Publishing , 2021
REFERENCES	
1.	Aparna Kumari, Sudeep Tanwar ,Artificial Intelligence-Empowered Modern Electric Vehicles in Smart Grid Systems Fundamentals, Technologies, and Solutions, 2024, eBook ISBN: 9780443238154
2.	Intel Corporation “Artificial Intelligence in the Automotive Industry 2021
MOOC	
1.	https://www.edureka.co/artificial-intelligence-ai-automotive-course

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 LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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	This course provides knowledge on Automated, Connected, Intelligent Vehicles and Wireless Technology used in Automated and Connected vehicle.
Course Objectives	1. To discuss the concept of Automated, Connected, and Intelligent Vehicles 2. To demonstrate the Sensor Technology for Automated, Connected, and Intelligent Vehicles 3. To describe the Wireless Technology used in Automated, Connected vehicle 4. To describe the Wireless Networking and Applications to Vehicle Autonomy 5. To describe the Connected Car Technology and Display Technology
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss the concept of Automated, Connected, and Intelligent Vehicles 2. Interpret the Sensor Technology for Automated, Connected, and Intelligent Vehicles 3. Design the Wireless Technology used in Automated, Connected vehicle 4. Develop the Wireless Networking and Applications to Vehicle Autonomy 5. Develop the Connected Car Technology and Display Technology

Prerequisites: Basic Knowledge on sensors, electronics

CO, PO AND PSO MAPPING

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	2	1	1	2
CO-4	2	2	1	2	1	2	1
CO-5	2	1	1	2	1	1	2

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Connected and Autonomous Vehicle Technology	**(9L+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 **Laboratory Components** • Demonstration of Automotive Electronics Network • Demonstration of ECU Architecture **Software/ Equipment Required** • ECU and Automotive Electronics Network layout	**CO-1** **BTL-2**
Module 2: Sensor Technology for Automated, Connected, and Intelligent Vehicles	**(9L+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** • Demonstration of working of Radar and Lidar Sensor • Demonstration of working of Camera sensor **Software/ Equipment Required** Radar, Lidar Sensor and Camera sensor	**CO-2** **BTL-2**

Module 3: Overview of Wireless Technology	(9L+6P)
Wireless Data Networks and Autonomy -Block Diagram and its Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Signal Propagation Physics, Basic Transmission Line and Antenna Theory. **Laboratory Components** • Demonstration of working of wireless technology (Bluetooth and Wi-Fi) • Demonstration of working of Modulation/Encoding, Receiver System Concepts **Software/ Equipment Required** • Bluetooth and Wi-Fi Transceiver	**CO-3** **BTL-3**
Module 4: Wireless Networking and Applications to Vehicle Autonomy	**(9L+6P)**
Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks. **Laboratory Components** • Demonstration of working of Internet of Things **Software/ Equipment Required** • Thingspeak IOT	**CO-4** **BTL-2**
MODULE 5: Vehicle-to-Vehicle Technology	**(9L+6P)**
Connectivity Fundamentals, Navigation, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications **Case Study on Advanced Driver Assistance System Technology** •Toyota, Nissan, Honda, Hyundai, Volkswagen, BMW, Daimler, Fiat Chrysler Automobiles, Ford, General Motors	**CO-5** **BTL-2**

TEXT BOOKS	
1.	G. Mullett, Wireless Telecommunications Systems and Networks, Thomson – Delmar Learning, ISNB#1-4018-8659-0, 2018
2.	G. Mullett, Basic Telecommunications: The Physical Layer, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2017
REFERENCE	
1.	Steven Van Uytsel, Autonomous Vehicles , 1st Edition, 2021
MOOC	
1	https://www.edx.org/learn/automation/rwth-aachen-university-automated-and-connected-driving-challenges

COURSE TITLE	**RESEARCH AND PUBLICATION ETHICS**			**CREDITS**	**3**
COURSE CODE	**GGE52001**	**COURSE CATEGORY**	**EEC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**41st ACM**	**LEARNING LEVEL**	**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%**	**25%**	**25%**

Course Description	This 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.
Course Objective	1. To understand and apply various research methodologies, including qualitative and quantitative approaches. 2. To enhance skills in data collection, analysis, and interpretation. 3. To foster an understanding of ethical principles in research, including plagiarism prevention and responsible authorship. 4. To ensure adherence to ethical guidelines in academic and professional publications. 5. To prepare students for effective communication and dissemination of research findings through scholarly publications.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply fundamental research methods and techniques to design, conduct, and analyze research projects. 2. Develop advanced academic writing skills, understand philosophical foundations of research, and adhere to ethical standards. 3. Apply intellectual property rights principles and follow ethical practices 4. Recognize ethical standards in publishing, avoid misconduct, and ensure proper authorship and peer review 5. Learn about ethical publishing, open access models, and effectively use research databases and metrics to evaluate and disseminate research

CO, PO AND PSO MAPPING

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	2	1	1	2
CO-4	2	2	1	2	1	2	1
CO-5	2	1	1	2	1	1	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: Elementary Research Methodology	**(9L)**
Research 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	**CO-1 BTL-2**
MODULE 2: Academic Writing, Philosophy and Ethics	**(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.	**CO-2 BTL-2**
MODULE 3: IPR and Scientific Conduct	**(9L)**

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 PCT 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.	**CO-3 BTL-3**
MODULE 4: Publication Ethics	**(9L)**
Publication ethics: definition, introduction and importance - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals.	**CO-4 BTL-2**
MODULE 5: Open Access, Publication Misconduct and Research Metrics	**(9L)**
Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc., Use of plagiarism software like Turnitin, Urkund and other open-source software tools. Indexing databases, Citation databases: Web of Science, Scopus, etc., Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics.	**CO-5 BTL-3**

REFERENCE BOOKS

1	Herman Aguinis (2023), Research Methodology Best Practices for Rigorous, Credible, and Impactful Research. SAGE Publications
2	Carol Ellison (2010) McGraw-Hill's Concise Guide to Writing Research Papers, McGraw-Hill
3	Kothari CR (2016) Research Methodology: Methods and Techniques, New Age Pvt Ltd
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 Press, 2003
7	Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7
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, Pearson, 2007.

E BOOKS

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 TITLE	INTERNSHIP (To be carried out in summer vacation after 2nd semester and evaluated in 3rd semester)			CREDITS	2
COURSE CODE	EAT52800	COURSE CATEGORY	EEC	L-T-P-S	0-0-0-0
Version	1.0	Approval Details	41 ACM	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME

Visit Report, Feedback of the employer, Presentation & Viva Voce, MCQ Assessment

100%

Course Description	This course aims to inculcate the application of knowledge & skill learned through classroom practices. It demands the academic component consisting of research, reflection, written and oral skills of the learner.
Course Objective	The course will enable the students to 1. Explore career alternatives prior to graduation. 2. Integrate theory and practice. 3. Assess interests and abilities in their field of study. 4. Build a record of work experience.
Course Outcome	Upon completion of this course, the students will be able to 1. Choose appropriate modern tools used in the field of Automobile engineering to manage the resources effectively by applying innovative ideas 2. Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society. 3. Communicate effectively and to write the scientific report of the learnings

Prerequisites: Basic knowledge in Measurements, Data Analysis, Interpretation.

CO, PO AND PSO MAPPING

CO	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 Indicators	Excellent(5)	Good(4)	Fair(3)	Poor(2)
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	PROJECT WORK PHASE-1			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 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 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. 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 PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	3	2	2	3	2	2	3
CO-2	3	2	2	2	3	2	2
CO-3	3	3	2	2	2	2	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 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	PROJECT WORK PHASE-2			CREDITS	20
COURSE CODE	EAT52802	COURSE CATEGORY	EEC	L-T-P-S	0-0-40-8
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 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 their academic supervisor.
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 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**

EVALUATION PARAMETERS FOR ASSESSMENT

To be followed same as approved for Project Phase I

DEPARTMENT ELECTIVES for AUTOMOTIVE TECHNOLOGY

Semester-I

DEPARTMENT ELECTIVE-1

COURSE TITLE	ELECTRONIC ENGINE MANAGEMENT SYSTEM			CREDITS	3
COURSE CODE	EAT52500	COURSE CATEGORY	DE	L-T-P-S	2-0-2-2
Version	1.0	Approval Details	41 ACM	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
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	This course gives in-depth knowledge on fundamentals of Automotive electrical and engine, service and repair of electronic controlled fuel injection system, interpreting engine electrical circuit diagram, troubleshooting techniques of engine sensors, actuators, and PCM circuit problems.
Course Objective	1. To Know about the fundamentals of Automotive electrical and engine. 2. To covers the knowledge, skills and attitude required to service and repair of electronic controlled fuel injection system 3. To familiarise with the components of both diesel and gasoline engine. 4. To gain knowledge on reading and interpreting engine electrical circuit diagram 5. To apply the troubleshooting techniques of engine sensors, actuators, and PCM circuit problems.
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize with automotive instruments and sensors 2. Gain knowledge about the measurement of engine parameters by using sensors to design chassis frame and suspension components 3. Attain knowledge on the working of Electronic Ignition System 4. Design the Digital Control systems and its applications 5. Familiarize with the concept of Engine mapping

Pre requisite: Knowledge on Basic Automotive Electrical & Electronics and Components.

CO, PO AND PSO MAPPING

CO	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	-	1	2
CO-3	3	2	1	1	1	2	1
CO-4	2	3	2	2	-	1	1
CO-5	2	2	1	1	2	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Introduction to System-on-Chip	**(6L+ 6P)**
Microprocessor and Microcontroller architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. A/D and D/A controllers. **Lab Component** 1. Open/Closed loop control using Raspberry PI 2. Softcore ECU using FPGA **Software/Equipment Required** Matlab, Raspberry PI & Labview	**CO-1** **BTL-3**
Module 2: Sensors	**(6L+ 6P)**
Types – Mass Air flow, Manifold Absolute Pressure, Temperature, Speed, EGO, Knock, and Crankshaft Position-Hall Effect-Principle of operation, construction, material, and characteristics. **Lab Component** 1. Data acquisition using Pressure Sensor 2. Data acquisition of Hall Effect sensor using Labview **Software/Equipment Required** Labview, Matlab	**CO-2** **BTL-3**
Module 3: SI Engine Management	**(6L+ 6P)**
Mono point, Multi point and Direct injection systems - Principles and Features, Bosch injection systems- L-Jetronic and LH –Jetronic- Layout and working, Open loop control and Lambda loop control in injection.	**CO-3** **BTL-3**

Lab Component 1. GDI injection control – 1D Simulation 2. Injection mapping using Open ECU **Software/Equipment Required** GDI System, Open Engine ECU	
Module 4: CI Engine Management	**(6L+ 6P)**
Fuel injection system parameters affecting combustion, noise, and emissions in CI engines. Inline injection pump, Rotary pump, and injector - Construction and principle of operation, electronically controlled Unit Injection system. Layout of the common rail fuel injection system. **Lab Component** 1. CRDI Injection control – 1D simulation 2. Labview user interface development for Injection mapping **Software/Equipment Required** Labview, CRDI System	**CO-4** **BTL-3**
Module 5: Ignition Systems and Engine Mapping	**(6L+ 6P)**
Ignition fundamentals, Types of solid state ignition systems, High energy ignition distributors, Electronic spark timing and control. Combined ignition and fuel management systems. Digital control techniques - Dwell angle, Ignition timing and Injection duration calculation. **Lab Component** 1. ECU mapping and Tuning for performance 2. Time based ignition circuit development **Software/Equipment Required** Open ECU, Arduino	**CO-5** BTL-3

TEXT BOOKS	
1	Tom Denton, Automotive Electrical and Electronic Systems, Edward Publications, 2012
2	William B Ribbens “Understanding Automotive Electronics”, SAE Publications, 2018
3	Eric Chowanietz “Automobile Electronics” SAE Publications, 2016
REFERENCE BOOKS	
1	Robert Bosch “Diesel Engine Management” SAE Publications, 2012
2	Robert Bosch, “Gasoline Engine Management” SAE Publications, 2013
3	Robert N.Brady, “Automotive Computers and Digital Instrumentation”, Prentice Hall, 2015
4	Eric Chowanietz “Automobile Electronics” SAE Publications, 2016
E Resources for Reference	
1.	https://www.slideshare.net/slideshow/engine-management-system-39094863/39094863
2.	https://eworkshop.tatamotors.com/pdf/Engine_Management_System_EMS.pdf
MOOC	
1.	https://www.mooc-list.com/course/model-based-automotive-systems-engineering-edx

COURSE TITLE	**AI FOR VEHICLE CONTROL SYSTEM**			**CREDITS**	**3**	
COURSE CODE	**EAT52501**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
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	This course gives in-depth knowledge on Vehicle Control System, Modelling of Control System and Controller Design Techniques
Course Objectives	1. To describe the Vehicle Control System 2. To discuss the Modeling Control System 3. To discuss the Controller Design Techniques 4. To describe Control Schemes, Cruise and Headway Control 5. To discuss Modeling and Digital Control System Design
Course Outcomes	Upon completion of this course, the students will be able to 1. Gain knowledge on Vehicle Control System 2. Acquire concept on Modeling Control System 3. Discuss on the Controller Design Techniques 4. Design Control Schemes, Cruise and Headway Control 5. Develop Modeling and Digital Control System Design

Pre requisite: Basic knowledge on vehicle dynamics and control system

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-4	PSO-1	PSO-2
CO-1	2	1	1	1	1	2	1
CO-2	3	1	2	2	2	1	2
CO-3	1	2	1	1	1	2	1
CO-4	2	3	2	2	2	1	1
CO-5	2	2	1	1	1	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Introduction to Vehicle Control System	**(6L+ 6P)**
Vehicle control system- Sensors, actuators and controller Modules-Vehicle Communication Network-System Engineering V-diagram- Algorithm Development – Steps in vehicle control system design- Degree of freedom for vehicle control- types of vehicle controller configurations **Lab Component** • Introduction to Matlab/Simulink **Software/Equipment Required** • Matlab/Simulink	**CO-1** **BTL-3**
Module 2: Modelling and Control Systems	**(6L+ 6P)**
Engine modelling - Vehicle dynamics – longitudinal control - lateral Control - vertical and ride - Driving simulators- percentage of road departure- Driver modelling- Transfer Function Models- Preview/ Predictive models- longitudinal driver models Control oriented engine modelling **Lab Component** • Longitudinal and lateral control Modeling using Matlab/Simulink **Software/Equipment Required** • Matlab/Simulink	**CO-2** **BTL-3**
Module 3: Controller Design	**(6L+ 6P)**
Proportional, Integrative and Derivative Controller, P, PI, and PID Control Actions and Mathematical Model – P, PI, and PID Controller Design using Simulink **Lab Component** • P, PI, and PID Controller Design using Simulink **Software/Equipment Required** • Matlab/Simulink	**CO-3** **BTL-3**
Module 4: Control Schemes, Cruise and Headway Control	**(6L+ 6P)**
Feed - Forward control - Cascade control- Design considerations for cascade control, Time delay compensation, Inferential control- Nonlinear control- Adaptive control etc. Cruise control design- Autonomous cruise control- Anti locking brakes- Traction control system- Vehicle stability control linear and non-linear vehicle model. **Lab Component** • Development of 4WS Algorithms and linear and non-linear vehicle Control model **Software/Equipment Required** • Matlab/Simulink	**CO-4** **BTL-3**
Module 5: Modelling and Digital Control System Design	**(6L+ 6P)**

System Modeling suing Z transformation - Discrete Time System – Sampling and Aliasing Consideration –System Time Response Characteristics- Jury Stability Test - Mapping to S to Z plane – Digital Controller Design – Digital to Analog Control **Lab Component** • System Modeling suing Z transformation • Digital Controller Design – Digital to Analog Control **Software/Equipment Required** • Matlab/Simulink	**CO-5** BTL-3
TEXT BOOKS	
1.	Galip Ulsoy , Automotive Control System, Cambridge University Press, 2012
2.	Richard C.Dorf and Robert H.Bishop, Modern Control Systems, Pearson Prentice Hall,2018
REFERENCE BOOKS	
1	Benjamin C.Kuo and Farid Golnaraghi, Automatic Control System, John Wiley and Sons, Eight edition, 2013.
2	Bosch Automotive Handbook, Sixth Edition,2014
E Resources	
1.	Uwe Kiencke , Lars Nielsen , Automotive Control Systems For Engine, Driveline, and Vehicle, 2014
2	
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_de04/preview
2.	https://training.uplatz.com/online-it-course.php?id=automotive-control-systems-490

DEPARTMENT ELECTIVE-2

COURSE TITLE	**HYDROGEN ENERGY FOR SMART MOBILITY**			**CREDITS**	**3**	
COURSE CODE	**EAT52502**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-2**	
VERSION	**1.0**	**APPROVAL DETAILS**	**41 ACM**	**LEARNING LEVEL**	**BTL-4**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Practical Report**	**Attendance**	**Theory**	**Practical**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	This course provides a comprehensive overview of hydrogen production, storage techniques, fuel cell and associated challenges. Students will also delve into the mechanics of fuel cell vehicles, exploring their architecture and gain hands-on experience in analysis and modelling, fostering a deeper understanding of hydrogen's role in future transportation systems.					
Course Objectives	1. To learn the basics of hydrogen energy, its production and storage 2. To study the hydrogen mobility systems available 3. To learn the working concept of fuel cell vehicle and its components 4. To examine the fuel cell vehicle architecture and analyze its performance 5. To study the global scenario of hydrogen energy market in transportation					
Course Outcomes	Upon the completion of this course, the students will be able to 1. Discuss the basics of hydrogen energy, its production and storage along with the available policy framework 2. Familiarize with the hydrogen mobility systems available and build a PEM single stack fuel cell					

	3. Interpret the types of fuel cell vehicles available in market and provide analytical design solutions 4. Examine the fuel cell vehicle architecture and assess its performance 5. Analyze the global scenario of hydrogen transportation
Prerequisites: Engineering Chemistry	

CO, PO AND PSO MAPPING

CO	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
CO-5	2	2	1	1	1	2	1

1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated

Module 1 – Introduction to Hydrogen Energy	**(6L+6P)**
Hydrogen as Green fuel, Hydrogen Production-Different methods, Hydrogen storage - challenges and solution, Policy framework - National Hydrogen Mission, Green ammonia policy, etc., Fuelling stations, Infrastructure requirement – Global & Local Scenario. **Lab Component:** 1. To construct a small-scale hydrogen generator using the electrochemical method 2. Techno-Economic Analysis of a Solar-Powered Green Hydrogen Production system using Matlab Simulink **Software/Tools Required:** Matlab Simulink, Electrolyzer model	**CO-1** **BTL-3**
Module 2 – Hydrogen Mobility Systems	**(6L+6P)**
ICE vs EV, Fuel cell -Introduction, Fuel cell thermodynamics, Reaction kinetics, Proton exchange membrane FC (PEM), Solid oxide fuel cell (SOFC), Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – road map to market. **Lab Component:** 1. To build a model car using a single stack PEM fuel cell - Hydrocar 2. Comparative study of two FCEV vehicles on market – Well to Wheel Analysis **Software/Tools Required:** Hydrocar, Power BI	**CO-2** **BTL-3**
Module 3 – Fuel Cell Electric Vehicle (FCEV)	**(6L+6P)**
Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, kinetic performance, mass transfer effects – MEA components, fuel cell stack, fuel cell control system, fuel cycle analysis, cooling system, FCEV energy flow analysis. **Lab Component:** 1. To model a fuel cell powertrain using Matlab Simscape 2. Analytical solution of a PEM cell cooling using CFD model – Ansys Fluent **Software/Tools Required:** Matlab Simscape, Ansys Fluent	**CO-3** **BTL-4**
Module 4 – Fuel Cell Electric Vehicle Architecture	**(6L+6P)**
Drive cycles and operation scenarios Electric motor, DC-DC converter, battery system, and drivetrain, Supervisory and feedback control algorithms, Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation, fuel cells in parallel and serial connection, over-potential and polarizations. **Lab Component:** 1. To assess the performance of a PEM fuel cell operated under different humidity levels.	**CO-4** **BTL-4**

2. To model a PEM cell 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 power generation, economic and environmental analysis on usage of fuel cell, future trends of fuel cells, safety and environmental impacts, economics of transition to hydrogen systems. **Lab Component:** 1. Hydrogen fuelling infrastructure – Case Study 2. Socio-Economical challenges in FCEV implementation – Case Study **Software/Tool Required:** Power BI	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Prodip K. Das, Kui Jiao, Yun Wang, Barbir Frano, Xianguo Li, Fuel Cells for Transportation: Fundamental Principles and Applications", Woodhead Publishers, Elsevier, 2023.
2.	Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri; 'Hydrogen Fuel Cells for Road Vehicles", Springer London, 2020.
REFERENCE BOOKS	
1.	I Dincer, C Zamfirescu, "Sustainable 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",1st edition, CRC Press 2015.
E BOOKS	
1.	https://link.springer.com/book/10.1007/978-981-10-7626-8
2.	https://onlinelibrary.wiley.com/toc/16156854/2023/23/1
MOOC	
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

COURSE TITLE	**AUTOMOTIVE EMISSION CONTROL AND E-WASTE MANAGEMENT**			**CREDITS**	**3**
COURSE CODE	**EAT52503**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-4**

ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Observation / lab records as approved by the Department**	**Attendance**	**Theory**	**Practical**

			Examination Committee "DEC"			
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**

Course Description	This course provides comprehensive knowledge on the principles and technologies involved in controlling automotive emissions and managing electronic waste (E-waste).
Course Objectives	1. To understand the effect of various types of emissions. 2. To know about the formation of various types of pollutants from SI and CI engines. 3. To understand the significance of emission control techniques. 4. To familiar with regulatory frameworks and best practices for E-waste management 5. To analyze and develop strategies for effective E-waste management
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize the effect of various automotive emissions. 2. Gain Knowledge about the formation of various types of pollutants from SI and CI engines. 3. Acquire the significance of emission control techniques. 4. Discuss on the sources, components, and environmental impacts of automotive E-waste. 5. Gain knowledge of recycling technologies and sustainable practices.

Pre requisite: Knowledge on IC Engines, combustion characteristics, Electronic waste

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	1	1	1	1	-	2	1
CO-2	2	3	2	2	2	1	2
CO-3	2	3	1	2	2	2	1
CO-4	2	2	2	-	2	1	1
CO-5	1	1	1	1	1	1	2

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Introduction	**(6L+ 6p)**
Pollutant - Sources and types - Effects of Automotive Pollutants – Greenhouse effect – Global warming - Effect of emissions on Environment and human beings **Lab Component** 1. Case study on growth of road transport sector in India 2. Case study on pollution concentration in various cities **Software/Equipment Required** Emission Analyzer	**CO-1** **BTL-4**
Module 2: Emission Formation and Control in SI Engine	**(6L+ 6P)**
Hydrocarbon Emission Mechanism, Carbon Monoxide Formation; Effects of operating variables on emission formation; Zeldovich Mechanism - Formation of NOx emissions, Controlling Techniques -Thermal reactors -Catalytic Converters - Exhaust gas recirculation **Lab Components** 1. Study on Performance characteristics of SI engine 2. Study on Emission characteristics of SI engine **Software/Equipment Required** SI engine, Fuel Measuring Unit, Emission Analyzer	**CO-2** **BTL-4**
Module 3: Emission Formation and Control in CI Engine	**(6L+ 6P)**
CO and HC Formation in CI engine - NOx formation in CI Engines- Smoke - Types of smoke, Diesel engine Particulates - Selective Catalytic Reduction(SCR) - Air injection -Diesel Oxidation Catalyst(DOC)-Diesel Particulate Filter(DPF)-Water injection. **Lab Components** 1. Study on Performance characteristics of CI engine 2. Study on Emission characteristics of CI engine **Software/Equipment Required** CI engine, Fuel Measuring Unit, Emission Analyzer	**CO-3** **BTL-4**
Module 4: Automobile E-Waste	**(6L+ 6P)**

Sources of E-waste in the Automotive Industry-Components of Automotive E-Waste, sensors, control units, batteries, infotainment systems - Environmental and Health Impacts-Regulatory Frameworks and Standards - E-Waste Collection and Transportation. **Lab Components** 2. Identifying Automotive Electronic Components 3. Lifecycle Analysis of Automotive Electronics **Software/Equipment Required** End Life EV Vehicle for component analysis, Open life cycle assessment (LCA)	**CO-4** **BTL-4**
Module 5: Recycling and Disposal Technologies	**(6L+ 6P)**
Introduction to Recycling Technologies-Battery Recycling and Reuse, challenges, technologies and Methods-Dismantling and Segregation Techniques-Treatment and Disposal of Hazardous Materials- Best Practices and Industry Standards. **Lab Components** 2. Recycling Technology Demonstration 3. Battery Recycling Experiment **Software/Equipment Required** Li-ion battery pack	**CO-5** **BTL-4**

BOOKS	
1.	John Heywood – "Internal Combustion Engine"- McGraw-Hill-2018
2.	Patterson D.J. and Henein N.A,"Emissions from combustion engines and their control," Ann Arbor Science publishers Inc, USA, 2018
REFERENCE BOOKS	
1.	V. Ganesan, "Internal Combustion Engine",4th Edition McGraw Hill Education, 2017
2.	R. Edward White "End-of-Life Vehicle (ELV) Recycling: State of the Art of Resource Recovery from Shredder Residue"-2019
E Resources for Reference	
1.	Catalysis and Automotive Pollution Control IV (ISSN Book 116) 1st Edition, Kindle Edition
2.	Rakesh Johri "E-waste: Implications, Regulations, and Management in India and Current Global Best Practices", ISBN: 978-3319902387
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2.	https://archive.nptel.ac.in/courses/105/105/105105169/

DEPARTMENT ELECTIVE-3

COURSE TITLE	**OFF-HIGHWAY MOBILITY**			**CREDITS**	**3**	
COURSE CODE	**EAT52504**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-3**	
ASSESSMENT SCHEME						
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	This course gives knowledge on off road vehicles and its applications
Course Objectives	1. To familiarize with the construction and working of various Earth moving equipment 2. To acquire the knowledge on construction and working of various constructional equipment 3. To gain knowledge on the construction and working of Farm equipment 4. To familiarize with the working of Industrial equipment 5. To develop the knowledge on working of Military equipment
Course Outcomes	Upon completion of this course, the students will be able to 1. Familiarize with the construction and working of various Earth moving equipment 2. Acquire the knowledge on construction and working of various constructional equipment 3. Gain knowledge on the construction and working of Farm equipment 4. Familiarize with the working of Industrial equipment 5. Discuss on working of Military equipment

Prerequisites: Basic Knowledge on Engines and Chassis

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2
CO-1	3	1	3	1	1	3	1
CO-2	2	1	2	1	2	2	2
CO-3	3	2	1	2	2	3	2
CO-4	2	1	2	1	2	2	1
CO-5	3	1	3	1	1	2	3

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1 - Earth Moving and Mining Equipment	**(6L+6P)**
Layout of earth moving equipment, capacity and applications of earthmovers like dumpers, front-end loaders, bulldozers, backhoe loaders etc. Rock drilling machines and Excavators. **Lab Component:** Demonstration of operation of backhoe loader, bulldozers **Software/Equipment Required** Backhoe loader, bulldozers (Industrial visit to Company)	**CO-1** **BTL-2**
Module 2 - Constructional and Road Equipment	**(6L+6P)**
Layout of Constructional and Road equipment: Tower cranes, hoist, motor graders, Soil Compactors, Road paving machines, concrete ready mixers for construction of bridges and their working principles. **Lab Component:** Demonstration of operation of concrete ready mixers, Road paving machines **Software/Equipment Required** Concrete ready mixers, Road paving machines (Industrial visit to Company)	**CO-2** **BTL-2**
Module 3 - Farm and Forestry Equipment	**(6L+6P)**
Classification of tractors – Main components of tractor. Working of tractors – Auxiliary equipment – Trailers and body tipping mechanism - plowing - paddy plantation machine, harvesting machines, Tree cutting machine. **Lab Component:** Demonstration of operation of tractors and implements. **Software/Equipment Required** Tractors and implements (Industrial visit to Company)	**CO-3** **BTL-3**
Module 4 - Industrial Equipment	**(6L+6P)**
Constructional features, capacity and stability of Overhead cranes, Mobile cranes, jib cranes, Forklifts, Towing vehicles. **Lab Component:** Demonstration of operation of mobile cranes, Forklifts, Towing vehicles. **Software/Equipment Required** Mobile cranes, Forklifts, Towing vehicles (Industrial visit to Company)	**CO-4** **BTL-2**
Module 5 – Heavy Vehicles and Military Vehicles	**(6L+6P)**

Special features and constructional details of heavy commercial vehicles; tankers, Main Battle Tank(MBT), gun carriers and Military transport vehicles. **Lab Component:** Demonstration of operation of Heavy trucks, Military transport vehicles. **Software/Equipment Required** Heavy trucks, Military transport vehicles (Industrial visit to Company)	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Wong.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York.
2.	Construction planning, Equipment and Methods - Robert L. Peurifoy, William B. Ledbrtter, Clifford J. Schexnayder - McGrawHill, Fifth Edition.
REFERENCE BOOKS	
1.	Construction Equipment Management by John Schaufelberger
2.	Abrosimov. K. Bran berg.A. andKatayer.K., " Road making Machinery ", MIR Publishers, Moscow
E BOOKS	
1.	https://www.studynama.com/.../construction-techniques-equipment-practices-ebook-n...
2.	https://www.kopykitab.com/Construction-Equipment-and-Job-Planning-eBook
MOOC	
1.	https://www.iti.com/heavy-equipment-training
2.	www.news.mit.edu/2015/mitx-mooc-helps-farmer-develop-autonomous-tractor-app

COURSE TITLE	**NOISE, VIBRATION AND HARSHNESS**			**CREDITS**	**3**	
COURSE CODE	**EAT52505**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-2**	
VERSION	**1.0**	**APPROVAL DETAILS**	**41 ACM**	**LEARNING LEVEL**	**BTL-4**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Practical Report**	**Attendance**	**Theory**	**Practical**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	This course delves into the intricate dynamics of noise, vibration, and harshness (NVH) in vehicles where students explore the principles behind NVH phenomena, studying methods to minimize noise, vibration, and harshness through advanced measurement and control techniques.					
Course Objectives	1. To introduce the basic concepts of noise and vibration 2. To study and compare the NVH concept of vehicle interior and exterior noise 3. To compare different noise measurement techniques 4. To learn the basic aspects of vehicle vibration 5. To study and analyse different vibration measurement and control techniques					
Course Outcomes	Upon the completion of this course, the students will be able to 1. Interpret the basics of vehicle noise and vibration along with Human comfort level 2. Distinguish and examine vehicle interior and exterior noise 3. Apply different noise measurement techniques and evaluate the noise level 4. Demonstrate fundamental vehicle vibrations and evaluate vehicle harshness 5. Evaluate vibration control techniques and implement the same					

Prerequisites: Basic Physics and Automotive Chassis

CO, PO AND PSO MAPPING

CO	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
CO-5	2	2	1	1	1	2	1

1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated

MODULE 1 – Introduction to Noise and Vibration	**(6L+6P)**
Definition, basic attributes of sound, Sources - distance from source, atmospheric absorption, ground absorption, reflections, humidity - Introduction to vibration and noise, Basic Concepts of Vibrations, Noise pollution from automobiles - Vehicle NVH Fundamentals, Effect of NVH in automobiles - Effect of NVH in HEV & EV's - Human comfort level. **Lab Component:** 1. To study the human perception of NVH and its impact on comfort and overall driving experience. **Software/Tool Required:** None	**CO-1** **BTL-3**
MODULE 2 – Vehicle Interior and Exterior Noise	**(6L+6P)**
Internal noise sources in vehicles - engine noise; road noise; aerodynamic (wind) noise; brake noise; squeak, rattle and tizz noises; sound package solution to reduce the interior noise: acoustic isolation, acoustic absorption and damping material solutions; Exterior noise sources - air intake systems and exhaust systems; Tyre noise. **Lab Component:** 1. To study and compare the NVH levels of an IC engine, Hybrid and EV vehicle. **Software/Tool Required:** Matlab, Power BI	**CO-2** **BTL-3**
MODULE 3 – Noise Measurement and Analysis	**(6L+6P)**
Different sources of noise, Sound quality, Design features – Common problems, Air bone and structural bone noises - Noise ratings and standards, human tolerance levels, Weighting factors, Pass-by noise requirements - Measuring microphones, Sound level meter, Time and Frequency weighting, Acoustic testing chambers, Sound power measurement. **Lab Component:** 1. Transient analysis of the time structure of motor rattle in EV vehicle **Software/Tool Required:** Matlab Simulink	**CO-3** **BTL-4**
MODULE 4 – Fundamentals of Vehicle Vibration	**(6L+6P)**
Power train and Engine vibrations; Driveline vibrations; Chassis and suspension vibrations; Control strategies; Concept of harshness; Harshness - sources, its effects, Measurement and Control, Acceptable degree of Harshness, Perception of Ride comfort, Human response to vehicle vibrations, Subjective and Objective evaluation of vehicle harshness. **Lab Component:**	**CO-4** **BTL-3**

1. To perform vibration analysis of BMW engine using Matlab Simulink. **Software/Tool Required:** Matlab Simulink	
MODULE 5 – Vibration Measurement and Control	**(6L+6P)**
Different sources of vibration from automobiles, Vibration basics - common problems, vibration measurement techniques, human sensitivity - One DOF vehicle model, Two and multi DOF vehicle model - Transient and steady-state response of one DOF applied to vehicle systems, Modal analysis, Types of Dampers, Vibrations absorber / isolator, Introduction to Active Vibration Control. **Lab Component:** 1. Modal Analysis of Transient vibration of a quarter car model using deep learning classification. **Software/Tool Required:** TensorFlow, Matlab	**CO-5** **BTL-4**

TEXT BOOKS	
1.	M. Harrison, "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier Butterworth-Heinemann, 2022.
2.	Mathew Harrison, Vehicle Refinement- Controlling Noise & Road, Elsevier Publication, IstEdition, 2019.
REFERENCE BOOKS	
1.	S. S. Rao, Mechanical Vibrations, Pearson Education Inc., 5th Edition, 2010
2.	Malcom J. croker, "Noise and Vibration Control", Wiley, 2007
3.	S. Graham Kelly, Mechanical Vibrations, Schaum's Outline Series, Tata McGraw Hill Publishing Co.Ltd. SI Edition, 2000
E BOOKS	
1.	https://link.springer.com/chapter/10.1007/978-3-031-57526-6_6
2.	https://ieeexplore.ieee.org/book/9386454
MOOC	
1.	https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-me15/
2.	https://www.youtube.com/watch?v=qHvlqbjJ3uM
3.	https://www.youtube.com/watch?v=GUvoVvXwoOQ&list=PLUl4u3cNGP62esZEwffjMAsEMW_YArxYC

DEPARTMENT ELECTIVE-4

COURSE TITLE	**VEHICLE ERGONOMICS 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	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical Assessments**	**Practical Report**	**Attendance**	**Theory**	**Practical**
15%	**15%**	**10%**	**5%**	**5%**	**25%**	**25%**
Course Description	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 experience.					
Course Objectives	1. To familiarize with the concept of automotive ergonomics 2. To learn the art of sketching, sculpting, clay modelling in vehicle design 3. To compare and study different factors influencing seating and visibility ergonomics 4. To design vehicle interior and ensure compactness for urban transportation 5. To study different virtual ergonomics evaluation techniques					
Course Outcomes	Upon the completion of this course, the students will be able to 1. Demonstrate basic driver information acquisition using anthropometry 2. Sketch and experiment different form of vehicle exterior and interior designs 3. Apply anthropometric data and evaluate comfort for seating and visibility 4. Design and construct new vehicle models with functionality, packaging and comfort 5. Apply virtual ergonomic techniques and evaluate vehicle designs					
Prerequisites: Engineering Graphics						

CO, PO AND PSO MAPPING

CO	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
CO-5	2	2	1	1	1	2	1

1 - Weakly Correlated, 2 - Moderately Correlated and 3 - Strongly Correlated

MODULE 1 – Introduction to Automotive Ergonomics	**(6L+6P)**
Driver information acquisition, Anthropometry – Need, Data collection methodology, Different postural considerations, Biomechanical data, Psychological factors – stress, attention, Interior features and conveniences—Use of modern technology, Safety issues, Spaciousness, Ventilation, Temperature control, Dust and fume prevention, Ergonomic research methods. **Lab Component:** 1. Anthropometric Measurement for Driver's Seat comfort 2. Comparative Evaluation of Men & Women drivers on comfort **Software/Tool Required:** Matlab	**CO-1** **BTL-3**
MODULE 2 – Automotive Styling and Form Studies	**(6L+6P)**

Vehicle Design - Fundamentals of perspective drawing, Automotive Sketching, Styling process, Car proportions, Form studies, Speed Forms, Clay Modelling, 2D systems, 3D systems, Measuring Procedures, Subject and Sampling size selection, Introduction to human body, Measurement of Hands/Feet/Full, posture, Applying Anthropometry data. **Lab Component:** 1. 3D Perspective sketching of a vehicle model from different angles 2. Sculpt a small-scale model of the vehicle exterior with focus on form and contours **Software/Tool Required:** Autodesk Alias, Clay Sculpting Tools	**CO-2** **BTL-4**
MODULE 3 – Ergonomics for Seating and Visibility	**(6L+6P)**
Seating dimensions- interior ergonomics- seat comfort- suspension seats- split frame seating-back, Regulations- driver's visibility- tests for visibility- methods of improving visibility and space- Dash board equipment and arrangement, mirror and cockpit design, visibility, man-machine system, electronic displays, commercial vehicle cabin ergonomics- mechanical package layout- goods vehicle layout. **Lab Component:** 1. Digital rendering of interior parts using Autodesk Alias/CATIA 2. Comparative analysis of 3 vehicles (same segment) for seating ergonomics **Software/Tool Required:** Autodesk Alias	**CO-3** **BTL-4**
MODULE 4 – Vehicle Packaging and Interior Design	**(6L+6P)**
Passenger Compartment, Floor Pan, Technical requirements, Dash board equipments arrangement, Positioning of operational controls, Force Analysis, Seating and position – ECE Regulations, Human Factors, Navigation systems, pedal positioning, R-Point, AHP, Mannequin positioning of 2-D pattern, car entry/exit, Boot lid packaging, Loading/Unloading analysis. **Lab Component:** 1. Design a compact electric vehicle for urban commuting **Software/Tool Required:** Autodesk Alias, CATIA	**CO-4** **BTL-4**
MODULE 5 – Virtual Ergonomics Evaluation Technique and its Application	**(6L+6P)**
User 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, Sustainability. **Lab Component:** 1. Virtual Evaluation of the vehicle designed in the previous module. **Software/Tool Required:** Autodesk Alias	**CO-5** **BTL-5**
TEXT BOOKS	

1.	Julian Happian-Smith; Transport Research Laboratory (TRL) Introduction to Modern Vehicle Design, Publisher: Elsevier, 2021
2.	Nikolaos Gkikas, Automotive Ergonomics Driver-Vehicle Interaction, routledge, Taylor & Francis Group, 2016.
REFERENCE BOOKS	
1.	Tony Lewin, "How to Draw Cars like a Pro", Motorbooks International, 2012
2.	Thom Taylor, Lisa Hallett, "How to Draw Cars like a Pro", Motorbooks International; 2Rev Ed edition, 2016
3.	Fenton John, "Handbook of automotive body and system design", Wiley-Blackwell, 2015
4.	J. Brian Peacock, WaldemarKarwowski, "Automotive ergonomics", Taylor & Francis ltd, 2014
E BOOKS	
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&f=false
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc19_de01/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/

COURSE TITLE	**COMPUTER AIDED ENGINEERING**			**CREDITS**	**3**	
COURSE CODE	**EAT52507**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-2**	
Version	**1.0**	**Approval Details**	**41 ACM**	**LEARNING LEVEL**	**BTL-4**	
ASSESSMENT SCHEME						
CIA					**ESE**	
First Periodical Assessment (Theory)	**Second Periodical Assessment (Theory)**	**Practical 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 aims to make the students expert in solving the engineering structural, thermal and fluid flow problems with the help of finite element methods and computational fluid dynamics procedures.					
Course Objectives	The course should enable the students to: 1. To understand the mathematical and physical principles underlying in finite element method 2. To understand the procedure of static structural analysis in 1D approach 3. To understand the procedure of static structural analysis in 2D approach 4. T familiarize on the numerical modeling, governing equations of fluid flow and heat transfer					

	5. To Know the importance of grid generation.
Course Outcomes	Upon completion of this course, the students will be able to 1. Discuss on the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis 2. Solve static structural analysis problems in 1D approach 3. Solve static structural analysis in 2D approach 4. Design the numerical modeling, governing equations of fluid flow and heat transfer 5. Interpret the importance of grid generation.

Pre requisite: Knowledge on Mathematics, Engineering Mechanics, Solid and Fluid Mechanics, Heat Transfer

CO, PO AND PSO MAPPING

CO	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
CO-5	2	2	1	1	1	2	1

1: Weakly related, 2: Moderately related and 3: Strongly related

Module 1: Finite Element Formulation of Boundary Value Problem	**(6L+ 6P)**
Weighted residual methods - Principle of stationary total potential - Rayleigh Ritz method - Galerkin's method - Piecewise continuous trial functions. **Lab Component** 1. Force and stress analysis of trusses 2. Stress and deflection analysis in various beam with different load type **Software/Equipment Required** ANSYS/ABAQUS/MATLAB	**CO-1** **BTL-4**
Module 2: One Dimensional Finite Element Analysis	**(6L+ 6P)**
Generic form of finite element equations - linear bar element - quadratic bar element - truss element - beam element - application problems. **Lab Component** 1. Stress analysis of a rectangular plate with circular hole 2. Stress analysis of the corner angle bracket **Software/Equipment Required** ANSYS/ABAQUS/MATLAB	**CO-2** **BTL-4**
Module 3: Two Dimensional Finite Element Analysis	**(6L+ 6P)**
Approximation of geometry and field variable - 3 nodded triangular elements - 4 nodded rectangular elements - Higher order elements - Natural coordinates and coordinate transformations – Engineering applications. **Lab Component** 1. Stress analysis of an axis-symmetric component 2. Thermal stress analysis within the rectangular plate **Software/Equipment Required** ANSYS/ABAQUS/MATLAB	**CO-3** **BTL-4**
Module 4: Governing Equations and Boundary Condition	**(6L+ 6P)**
Basics and governing equations of computational fluid dynamics - Continuity, Momentum and Energy equations - Time averaged equations for Turbulent flow - Turbulence - Kinetic Energy Equations. **Lab Component** 1. Convective heat transfer analysis of a 2D component 2. Modal analysis of various beam with different load types **Software/Equipment Required** ANSYS/ABAQUS/MATLAB/CONVERGE	**CO-4** **BTL-3**
Module 5: Grid Generation and Types of Grid	**(6L+ 6P)**

Grid- Types of grid- Unstructured mesh- polyhedral mesh- tetrahedral mesh, Structured Mesh- prismatic mesh, Grid Independence study, Advantages of Grid generation. **Lab Component** 1. Harmonic analysis of a 2Dcomponent 2. Simulation of spring-mass system using MAT LAB **Software/Equipment Required** ANSYS/ABAQUS/MATLAB/CONVERGE	**CO-5** **BTL-3**
TEXT BOOKS	
1.	P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2018.
2.	Versteeg, H.K, and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Longman, 2015
REFERENCE BOOKS	
1	J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions (Engineering Mechanics Series), 2013.
2	Muralidhar, K and Sundarajan .T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi,2nd Edition 2016.
E Resources for Reference	
1.	https://soaneemrana.com/onewebmedia/TEXT%20BOOKOF%20FINITE%20ELEMENT%20ANALYSIS%20BY%20P.%20SESHU%20(1).pdf
2.	
MOOC	
1.	https://archive.nptel.ac.in/courses/112/104/112104193/