Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

New Scheme Based On AICTE Flexible Curricula

Electric Vehicles VII- Semester

EV 701	**Noise, Vibration and Harshness**	**2L-1T-2P**	**4 Credits**

Course Objectives:

1. To introduce the basic concepts and importance of vibration & noise theory in automobile.

2. To help the students to understand the different sources of vibration/noise from automobiles and the effect of vibration/noise measurement.

3. To familiarize the students to understand the instrumentation facilities for measuring noise & vibration .

4. To enable the students to identify the role of NVH engineers in the development stages of a new vehicle and NVH reduction techniques.

Course Outcomes

After studying this course, students will be able to;

1. Characterize the various sources of automotive vibration/noise and their harshness.

2. Aquire knowledge for NVH engineers in modern vehicle development.

3. Identify different sound and vibration measurement techniques for steady-state and transient vehicle responses.

4. Catagorize the transducers, acoustics holography, and other instruments for NVH analysis

5. Compute the sampling, statistical, and frequency analysis of NVH measurements.

6. Acquire the hands-on experience of sound & vibration measurements and their reduction in automobiles.

Syllabus:

Module 1: Noise Pollution from Automobiles :

Introduction to vibration and noise, Noise pollution from automobiles - Vehicle NVH Fundamentals, Effect of NVH in automobiles - Effect of NVH in HEV & EV's - Human comfort level.

Module 2 :Noise Analysis

Different sources of noise from automobiles, Sound quality, Design features - Common problems, Air bone and structural bone noises - Noise ratings and standards, human tolerance levels and weighting factors, Pass-by noise requirements - Target vehicles and objective targets.

Module 3: Vibration Analysis

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 degree of freedom applied to vehicle systems, Modal analysis.

Module 4: Vehicle Noise, Vibration and Harshness

Interior and Exterior noise prediction in automobiles, engine noise, transmission noise, vehicle structural noise, tyre noise, aerodynamics noise, exhaust system noise, inlet manifold noise, combining sound sources - acoustical resonances

Module 5: Test Facilities, Instrumentation and Control Strategies

Laboratory static test setup and instrumentations**,** rolling roads (dynamometers) analysis, four post-test rig analysis, semi-anechoic rooms, wind tunnels, etc. - Transducers, signal conditioning and recording systems - sound intensity technique.

Noise Control, noise ratings and standards related to NVH, Vibration absorbers and Helmholtz resonators, Active control techniques - Noise reduction in Automobiles - Vehicular noise and control – Noise control through barriers and enclosures and absorbent linings

Text Books

1. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989
2. M. L. Munjal, 2014, Noise and Vibration Control, World Scientific Press: Singapore

3. István L. Vér, Leo L. Beranek, Noise and Vibration Control Engineering: Principles and Applications, John Wiley,2006.
4. Anton FuchsEugenius NijmanHans-Herwig Priebsch, Automotive NVH Technology, springer, 2016.

Reference Books

1. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987
2. Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984

Suggested List of Experiments :

1 Mathematical modeling of single degrees of freedom analysis using Matlab/Simulink.
2 Simple system NVH simulations
3 Electic vehicle noise measurement.
4 Enigne vibration response analysis at different locations.
5 Interior noise measurement in an automotive cabin.
6 Radiated noise measurement of different vehicle systems Sound level meter.
7 Electric vehicle structural vibration measurement using Vibro Meter.
8 Simple composite structural vibration measurement at different end condition.
9 Demonstration of acceleration sensor instrumentations and preparation for real time vibration testing.
10 Demonstration of noise sensor instrumentations and preparation for real time noise testing.

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Electric Vehicles VII- Semester

EV-702 (a)	Automotive Vehicles	3L-1T	4 Credits

Course Objectives:

1. To impart the knowledge on vehicle structure
2. To provide an insight on steering, suspension, braking and transmission systems
3. To familiarize the ergonomic, comfort and safety systems

Course Outcomes

Upon successful completion of the course, the students will be able to;

1. Recommend a suitable chassis layout and body construction for different vehicles
2. Demonstrate the working of transmission and steering systems
3. Evaluate the functionality of suspension and braking systems
4. Assess the significance of comfort and safety systems in a vehicle

Module 1 Vehicle Structure and Transmission System

Vehicle Structure; Automotive components, subsystems and their positions - chassis, frame and body - front, rear and four-wheel drives - operation and performance- forces on vehicles, traction force and tractive resistance-power required for automobile - rolling, air and gradient resistance.

Transmission System; Clutch: Types- diaphragm type clutch, single and multi-plate clutches – Gearbox: Types constant mesh, sliding mesh and synchromesh gearbox, layout of gearbox, gear selector and shifting mechanism, overdrive, hydraulic coupling, automatic transmission, propeller shaft, universal joint, slip joint, differential and rear axle arrangement.

Module 2 Steering System and Suspension System

Steering System; Front axle – types and construction, steering system types, Ackermann principle, Davis steering gear, steering gearboxes, steering linkages, power steering, wheel geometry - caster, camber, toe-in, toe-out, wheel alignment and balancing.

Suspension System; Types - front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems, active suspension systems, wheels and tyres.

Module 3 Braking System,

Braking System ; Load transfer, brake force distribution, stopping distance, types of brakes - disc & drum brakes, actuation - mechanical, hydraulic, air, engine brakes, anti-lock braking system (ABS), electronic brake force distribution (EBD), traction control system (TCS), electronic stability program (ESP).

Module 4 Ergonomics, Comfort and Safety

Ergonomics: Regulations and requirements, passenger and driver's cabin, dashboard equipment arrangement, positioning of operational controls, human factors, pedal positioning. Comfort: Regulations and requirements - ride and vehicle handling, HVAC, seating and upholstery.

Safety: active and passive safety, concept of crumple zone, safety sandwich construction, passenger and occupant safety – testing

Module 5 Vehicle Testing and Standards

Vehicle performance & emission testing: Energy consumption and emission tests under part load and full load condition of vehicles, grade ability test, road and track testing methods – testing on chassis dynamometers, driving cycles.

Text Books

1. Jack Erjavec, Martin Restoule, Stephen Leroux, Rob D. Thompson, Automotive Technology - A Systems Approach, Nelson Education Limited, Canada, 2015
2. James D. Halderman, Automotive Chassis Systems, 7th Edition, Pearson Publishers, US, 2016
3. K.V. Fadadu, B.H.Kadiya, Vehicle Testing And Homologation, First Edition, Books India Publications, 2016.

Reference Books

1. Bosch Automotive Handbook, 10th Edition, Wiley publications, 2018.
2. Dr. Kirpal Singh, Automobile Engineering, 13th Edition, Vol 1 & 2, Standard Publishers, New Delhi, 2020
3. N. K. Giri, Automobile Mechanics, 5th Edition, Khanna Publishers, 2014.
4. James E Duffy, Modern Automotive Technology, 8th Edition, Goodheart - Willcox, US, 2013

Mode of Evaluation: CAT, Written assignment, Quiz, FAT

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Electric Vehicles VII- Semester

EV-702 (b)	**Electric Vehicle Testing and Certification**	**3L-1T-0P**	**4 Credits**

Course Objectives:

1. To familiarize various safety standards for EVs
2. To understand various testing standards of batteries
3. To gain the knowledge of characterization and testing procedures of motors
4. To familiarize the testing standards of power electronics components in EVs
5. To gain the knowledge of testing and certification standards of EV chargers
6. To learn performance assessment of EVs on chasis dynamometer

Course Outcomes:

Upon successful completion of the course, the students will be able to;

1. Identity safety standards for EVs
2. Apply testing standards of batteries and motors
3. Aware the testing standards of electronics components and chargers for EVs
4. Choose the appropriate testing standards for NVH in EVs
5. Implement performance assessment of EVs

Syllabus

Module 1 Electric Vehicle Safety and Standards

Homologation & its types, EV Testing-Global and Indian perspective- Regulations (EEC, ECE, FMVSS, AIS, CMVR)- ARAI Standards for India- Conformity of production, Test tracks- Vehicle Instrumentation- Export Homologation- Active and Passive Safety-Light/Light Signaling Devices.

Module 2 Battery Testing and Standards

Battery performance safety test- Evaluation and testing of Battery as per AIS 048, ECE R100, USABC, etc., performance testing, life-cycle testing and safety/abusive testing, BMS and TMS testing, Explosion Proof test, Constant temperature chamber test, High Low-temperature chamber test. Testing standards- UL1642, ICE 62133, IEEE 1625, IEEE 1725, ISO 17025. Safety Test Standard of Li-Ion Cell and Battery.

Module 3 Electric Vehicle Motor Characterization and Testing

Types of electric motors in EV, characteristics; Necessity of motor testing, types of testing and its standards, Indian standards, global standards; efficiency calculations and loss calculations; testing of parameters, testing for copper loss, testing for core losses, EMI/EMC, testing for mechanical losses, testing for performance.

Module 4 Testing of Power Electronics components

Power Electronics Components (PEC) testing, Reliability requirements and challenges of PEC in EV/ Hybrid EV, PEC failures and causes, Testing standads-ISO 21780:2020, Development testing, Validation testing, Environmental testing, Reliability testing and robustness validation, Qualitative test methods (Highly Accelerated Life Testing - HALT, Highly Accelerated Stress Screening - HASS), Quantitative test methods (Accelerated Life Testing - ALT, Calibrated Accelerated Life Testing - CALT), Qualification testing - qualification testing standards ICE 60747, 60749, 60068, 60384, JESD 22).

Module 5 Charger testing and certification

EV charging infrastructure - EV and Grid effective integration - EV conductive AC charging modes and characteristics - Interface requirements - Automotive DC charging characteristics - EV charging and safety standards- AIS138-Part1 and Part 2.-IEC Global Standards-SFS safety standards.

Text Book

- Standards as per ARAI, Pune. https://www.araiindia.com/downloads

Reference Books

1. Bosch Automotive Handbook, Robert Bosch, 10th Edition, 2018
2. “Vehicle Inspection Handbook”, American Association of Motor Vehicle Administrators
3. Michael Plint& Anthony Martyr, “Engine Testing & Practice”, Butterworth Heinmenn, 3rd ed, 2007
4. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUN

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Electric Vehicles VII- Semester

EV-702 (c)	Materials for Electric and Hybrid Vehicle Technology	3L-1T-0P	4 Credits

Course Objectives:

1. To familiarize with the fundamentals of materials and properties in EVs and HEVs
2. To understand the materials for Battery and other energy storage devices
3. To study the materials for power train and its manufacturing
4. To gain the knowledge of materials for vehicle structure.
5. To understand the light weighting technologies.
6. To analyse the materials cost, failure and sustainability of materials.

Course Outcomes:

1. Identify the materials used and their properties in EVs and HEVs
2. Familiarize the materials for battery and energy storage devices
3. Gain the knowledge of materials for power train and vehicle structure
4. Familiarize the light weighting technologies in EVs and HEVs
5. Analyse the materials cost, failure and sustainability of materials.

Module:1 Advanced Engineering Materials and Properties

Materials for EV- Ferrous materials- carbon steel, maraging steel and stainless steel-Non-Ferrous materials- Aluminium, magnesium, titanium and other alloys, Polimers-Thermosetting and Thermoplastics- Rubber- Ceramics-Glass, Nano Ceramics- Composites- Nanomaterials Smart materials-Mechanical, Thermal, Electrical and Magnetic properties.

Module:2 Materials for Energy Storage

Lead acid and Nickel metal-hydride batteries-Electrochemical double layer capcitors- Fuel cells - Lithium battery materials: negative and positive electrode materials, electrolytes and separators.

Module: 3 Materials for Power train

Materials for all type of EV and HEV Motors and engine components– Materials for Power electronic components – Low friction alloys- manufacturing techniques.

Module:4 Materials for Automotobile bodies

Materials for consideration and use in automotive body structures - component manufacturing & assembly- corrosion and protection of automotive structure- Future trends in automotive body materials.

Module:5 Light weighting Materials and processes

Advanced Steels-Aluminum Alloys-Magnesium Alloys-Thermoplastics and Thermoplastic-Matrix Composites-Thermoset-Matrix Composites- Metal 3D-Printing and its materials-Composite material development and processes

Text Books

1. William D. Callister and David G. Rethwisch, “Materials Science and Engineering”, 10th Edition, John Wiley & Sons, 2020.
2. Helena Berg, “Batteries for Electric Vehicles: Materials and Electrochemistry”, 1 st edition Cambridge University Press, 2015.
3. Geoffrey Davies, “ Materials for Automobile Bodies”, 2 nd edition, Butterworth-Heinemann, 2012.
4. P.K. Mallick, “Materials, Design and Manufacturing for Lightweight Vehicles”, 2 nd Edition, Woodhead Publishing, 2020

Reference Books

1. Beadle, John D, “ Product treatment and finishes”, Macmillan, London 1971.
2. Ashby, Michael; Johnson, Kara, “Materials and Design: The Art and Science of Material Selection in Product Design”, Butterworth-Heinemann; 2002

3. Thompson R, “Manufacturing processes for design professionals”, Thames & Hudson, London 2007
4. Conway B.E. “Electrochemical Supercapacitors –Scientific Fundamentals and TechnologicalApplications”, Springer 1999.
5. David Linden and Thomas B. Reddy, “Handbook of Batteries”, Third Edition , McGrawHill, 2002
6. Ron Hodkinson and John Fenton, “Lightweight Electric/Hybrid Vehicle Design”, 1st Edition, Butterworth-Heinemann, 2001
7. James Edmondson and Alex Holland, “Materials for Electric Vehicles: Electric Motors, Battery Cells & Packs, HV Cabling 2020-2030” , www.IDTechEx.com, Research Consultance.
8. R.M. Jones, “Mechanics of Composite Materials”, 2nd Edition, Taylor & Francis, 2015.

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Electric Vehicles VII- Semester

EV-703 (a)	**Computational Fluid Mechanics**	**3L-0T-0P**	**3 Credits**

Course Objectives

1. To familiarize students with the mathematical representation of governing equations for fluid flow and heat transfer problems.

2. To equip the students to address complex fluid flow and heat transfer problems by approximating the governing equations through Finite difference and finite volume discretization methods.

3. To enable students to understand different types of grids and their suitability for different engineering applications.

Course Outcomes

At the end of the course, the student will be able to;

1. Apply mathematical and engineering fundamentals to recognize the type of flow and arrive at equations governing the flow

2. Apply the numerical techniques to find the solution for the system of algebraic equations

3. Generate appropriate type of grids required for solving engineering problems

4. Solve governing equations using finite difference and finite volume approaches

5. Solve fluid flow and heat transfer problems using commercial CFD tools

Module:1 Fundamental of Fluid Dynamics and Governing Equations

Introduction and fundamentals of CFD, Classification of flows, Overview and Importance of CFD, Physical verses Numerical Techniques, Applications of CFD Conservation and Non-conservation form – Continuity, Momentum, Energy and Species Transport Equations, Simplified Mathematical models – Incompressible – Inviscid – Potential – Creeping flow, Characteristics of PDE: Elliptic, Parabolic and Hyperbolic.

Module:2 Solution of Linear Algebraic Equations

Direct Methods - Elimination methods, Tri-diagonal Algorithm, LU Decomposition method, Error Analysis. Iteration Methods - Point iterative/block iterative methods, Gauss-Seidel iteration (concept of central coefficient and residue, Success over Relaxation) and other techniques

Module:3 Grid Generation

Overview of mesh generation, Structured and Unstructured meshes, Guideline on mesh quality and design, Mesh refinement and adaptation, Grid Transformation.

Module:4 Finite Difference Method and Discretization

Comparison of finite difference and finite volume techniques. Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation. Finite Difference Method: Taylor series - Forward, Backward and Central difference schemes, One Dimension and Two Dimension FDM Problems – Explicit, Implicit and Semi-Implicit schemes.

Module:5 Finite Volume Method

Integral form of Discretization – Steady and Transient One and Two-dimensional diffusion. Properties of discretization schemes – Conservativeness, boundedness and transportiveness Convection and Diffusion: Central difference, upwind and QUICK schemes.

Text Book

1.Joel H. Ferziger, Milovan Peric, Robert L. Street, Computational Methods for Fluid Dynamics, 2020, 4 th Edition, Springer Publisher.

Reference Books

1. Versteeg H.K, Malalasekara W, An Introduction to Computational Fluid Dynamics – The Finite Volume Method, 2011, 3 rd Edition, Pearson.

2. John D Anderson, Computational Fluid Dynamics – The Basics with Applications, 1st Edition, McGraw Hill 2012.

3. Muralidhar K, Sundararajan T, Computational Fluid Flow and Heat Transfer, 2014, Narosa Publications, New Delhi.

4. Chung T.J, 2014, Computational Fluid Dynamics, Cambridge University Press. Mode of Evaluation: CAT, written assignment, Quiz, FAT

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Electric Vehicles VII- Semester

EV-703 (b)	Artificial Intelligence	3L-0T-0P	3 Credits

Course Objectives

1. To provide basic understanding on Artificial Intelligence with its sub-sets.

2. To impart knowledge of search algorithm, logics, reasoning and uncertainty.

3. To introduce the basic concepts of machine learning and its application in mechanical engineering.

Course Outcome

At the end of the course, the student will be able to;

1. Translate the characteristics of artificial intelligence and its sub-sets.
2. Implement appropriate algorithm for problem solving by searching.
3. Construct the logical agents and familiar in the application of fuzzy in AI.
4. Design the decision making algorithm with the reasoning of uncertainties.
5. Develop machine learning programs based on supervised, unsupervised and reinforcement learning.
6. Experiment the benefit of neural network in deep learning.
7. Apply machine learning approach to solve problems related to mechanical engineering.

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Module:1 Foundation of AI

Introduction – Foundations of AI – Evolution of AI – Intelligent Agents: Agents and environments, Concept of rationality, structure of agents – Structure of Knowledge based system - Risks and Benefits of AI.

Module:2 Problem-solving by searching

Uninformed search: Breath first search, Depth first search, iterative deepening – Heuristic search: Greedy search, A*search – Adversarial search: Minimax search, alpha-beta-pruning.

Module:3 Logic (Knowledge, reasoning and planning)

Propositional Logic – First Order Logic – Inference in First Order Logic – Knowledge representations – automated planning. Fuzzy: Fuzzy sets, operation and properties, Feature of membership functions, fuzzification and defuzzification, Fuzzy logic rules based system.

Module:4 Reasoning with uncertainty

Quantifying uncertainty – Probabilistic reasoning – Making Simple Decisions – Making Complex Decisions – Multiagent decision making.

Module:5 Machine Learning

Supervised learning: Decision trees, linear regressing and classification, and support vector machine – Unsupervised: Clustering, dimensionality reduction, Principal component analysis – Reinforcement: Passive and active reinforcement learning.

Module:6 Deep Learning

Simple feedforward networks – Computation graph for deep learning – Convolution neural networks – Learning algorithms – generalization – Recurrent Neural Networks - Deep reinforcement learning.

Module:7 Use cases

AI in manufacturing process: Materials characterization and machine process – AI in logistics and supply chain management – Prediction of mechanical system failure – diagnostic system – Human-in-loop for Machine human collaborative task.

Text Books

1.Russell S, Norvig P, Artificial Intelligence - A Modern Approach, 2021, 4th edition, Prentice Hall.

2. Ivan Vasilev, Advanced Deep Learning with Python: Design and implement advanced next-generation AI solutions using TensorFlow and PyTorch, 2019, 1st edition, Packt Publishing Ltd.

Reference Books

1. Bishop C. M, Pattern Recognition and Machine Learning, 2011, 2nd edition, Springer.

2. Nilsson N.J, Artificial Intelligence: A New Synthesis, 1998, 1st edition, Morgan Kaufmann.

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Electric Vehicles VII- Semester

EV-703 (c)	Reliability Engineering	3L-0T-0P	3 Credits

Course Objectives:

1. To introduce the basic concepts of reliability, various models of reliability.
2. To analyze reliability of various systems.
3. To introduce techniques of frequency and duration for reliability evaluation of repairable systems

Unit 1 Reliability : Definition, Importance, History, Reliability Vs. Quality, Failure pattern of complex product, Factor of safety and reliability, Reliability analysis procedure, Reliability management , Some examples of system failures., Reliability function-MTTF, Hazard rate function, Bathtub curve

Unit 2. Basic probability theory: Set theory, Laws of probability, Probability theorem Random variables and probability distributions, Bay's Theorem, Central limit theorem,

Unit 3. Functions of Random Variables: Single , two and several random variables, Probability distribution functions, density functions for different types of discrete and continuous variables, mean, mode and median, Numerical solutions, Extremal distributions, derivation of the reliability function-constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution.

Unit 4. Modeling of geometry, strength and loads: Fatigue strength, Time dependent reliability of components, Failure rate versus time, reliability and hazard functions and different distributions, Estimation of failure rate, Expected residual life, Series, parallel and mixed systems, complex systems, Reliability enhancement,

Unit 5. Reliability based design: Optimization problems, Failure modes and effect analysis, Event tree and fault tree analysis, Reliability testing, Reliability data and analysis, measurement of reliability, Monte Carlo Simulation, Computation of reliability, Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability-redundancy allocation by dynamic programming – reliability optimization by non linear programming.

REFERENCES

1. Singiresu S. Rao, Reliability Engineering, Pearson
2. Grant E. L. & Leave Worth, Statistical Q. C., T.M.H.
3. Balagurusamy, Reliability Engg., T.M.H.
4. Mahajan , Statistical Q.C.
5. Juran and Grayan, Quality Planning Analysis, T.M.H
6. Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw-Hill, 2000
7. Atrick D T o'connor, "Practical Reliability Engineringt", John-Wiley and Sons inc, 2002
8. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002.
9. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.

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Electric Vehicles VII- Semester

EV-704	Vehicle Dynamics Lab	0L-0T-6P	3 Credits

The purpose of the lab is to study and research to understand the longitudinal, lateral and vertical dynamics of road vehicles by applying both theoretical and experimental approaches. Longitudinal dynamics concern with vehicle performance, Lateral dynamics includes modelling of vehicle in a virtual environment to analyse vehicle steering control and stability on different roads and operating conditions whereas, Vertical dynamics focus on prediction of tire and suspension characteristics and force transfer characteristics of other subsystems of a vehicle to quantify ride comfort.

Suggested Major Equipments/ Software

Vibration Test Rig
16 Channel LMS Scadas mobile data acquisition system
Instrumented hammer
Electro Magnetic Shaker
Mid and High frequency volume Q source
Modal analysis test rig.
Sensors like tri-axial accelerometers, seat pad accelerometers, microphones etc.
Simcenter 3D
CAR sim software

Suggested List of Experiments

1.Determine natural frequency of torsional vibration in single rotor system
2. Find the displacement, velocity and acceleration with the use of mathematical software using various sensors
3. Determination of whirling speed of shafts
4. Critical speed of shaft
5. Camber angle measurement
6. Study of introduction to Matlab
7. Simulation using CARSim Software

Evaluation: Evaluation will be continuous and integral part of the class as well as through external assessment (Viva/voce)

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Electric Vehicles VII- Semester

EV-705	MATLAB	0L-0T-6P	3 Credits

The purpose of this laboratory is to provide the knowledge of latest research tools/techniques such as MATLAB which is being used in finding out the solution of most of the engineering problems. MATLAB is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Suggested List of Experiments: (Atleast 10 Experiments)

Following are the suggested list of experiments related to MATLAB (Pl expand)
1. Introduction to MATLAB
2. Working with matrices
3. Rational and logical operation of MATLAB
4. Creating a plot using Plot function
5. Complex and statistical functions (e,g.: Produce ten elements vector of random complex numbers and find the summation of this vector)
6. Numbers and strings (1.Write a program in M-File to read 3 x 3 Matrix, then display the diagonal of matrix as shown below: The Diagonal of This Matrix = [ ]
2. Write a program to read a string, then replace each character in the string with its following character in ASCII code*.)

7.Write a function that will receive as an input argument a temperature in degrees Fahrenheit, and will return the temperature in both degrees Celsius and Kelvin. The conversion factors areC = (F –32) * 5/9 and K = C + 273.15. Write a script to use the developed function

8.Write a script that will:a. Call a function to prompt the user for an angle in degrees.b. Call a function to calculate and return the angle in radians.c. Call a function to print the result.Write all of the functions as well. Note that the solution to this problem involves four M-files:one which acts as a main program (the script shown below), and three for the functions.

9.Write a program to print a length conversion chart. It will print lengths in feet, from 1 to an integer specified by the user, in one column and the corresponding length in meters (1 foot = 0.3048 m)in a second column. The main script will call one function that prompts the user for the maximum length in feet; this function must error-check to make sure that the user enters a valid positive integer. The script then calls a function to write the lengths to the screen.

Evaluation: Evaluation will be continuous and integral part of the class as well as through external assessment (Viva/voce)

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Electric Vehicles VII- Semester

EV-706	Major Project -I	0L-0T-8P	4 Credits

Objectives of the course Major Project I:

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do something creative and to assimilate real life work situation in institution.
- To adapt students for latest development and to handle independently new situations.
- To develop good expressions power and presentation abilities in students.

The focus of the Major Project I is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule:

The faculty and students should work according to following schedule: Each student undertakes substantial and individual project in an approved area of the subject and supervised by a faculty of the department. In special case, if project is huge, then maximum 03 students may be permitted to work together as a team to do the same. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty and Head of department.

Project guide should motivate students to develop some Innovative working models in the field of Electric and Hybrid Vehicles Technology which can contribute to the society.

Evaluation: There will be both external and internal evaluation of project carried out by each student.

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EV-707	**Internship- III**	**0L-0T-6P**	**3 Credits**

Evaluation:

Internal Evaluation will be done on the basis of Internship/industrial training (real time) carried out in industry/research center. Preference should be given to Public sectors, Govt and reputed Limited companies/research organizations. A detailed report may be submitted in the department after successful completion of internship.
