

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)
MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)



Curriculum
(Scheme of Instruction & Evaluation and Course contents)

For
Graduate Programme Leading to
Honours / Minor Degree
in
Automotive Engineering

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Scheme Rules
Honours / Minor Degree Program Structure

Title of Program	Honours / Minor Degree
Eligibility & Progression	<ol style="list-style-type: none"> 1. Third year undergraduate engineering students with minimum CPI of 7.0 and no course backlog at the end of semester 4. 2. It is optional for students to take Honours / Minor degree program. 3. An eligible student can opt for either Honours or Minors program. 4. Failure in the courses of honours / minor program head shall not be counted for candidate's progression for next academic year.
No. of years/Semesters:	4 Semesters (5th, 6th, 7th and 8th)
Credits:	18 Credits earned shall be over and above the minimum credits required for earning a B. Tech. degree. These credits shall not be included in the SPI / CPI scores of the student.
To be implemented from Academic Year:	AY 2022-23 (Applicable for third year, semester V, B. Tech. students)

B. Tech Honours Degree

Honours is an additional credential a student earns if the student opts for the extra 18 credits needed for this in her / his own discipline. The concerned department specifies the course requirements for earning the Honours. An Honours is similar to a specialisation in the student's own discipline.

Honour courses are either advanced level courses in the student's discipline or are courses designed to give a student more exposure to specific area(s) of the student's discipline. On successful accumulation of credits at the end of the B. Tech. programme, a separate grade sheet will be issued by the Examination Section after completion of the B. Tech. program. The Degree Certificate of the student also will indicate "Bachelor of Technology in XXX*", with honours in Automotive Engineering. No SPI or CPI will be calculated for honours degree courses. Any backlog courses with respect to Honours Degree should be successfully completed by the BTech semester VIII re-examination. If the student fails to earn 18 credits even after B. Tech semester VIII re-examination, no certificate for completion of Honours Degree will be given, instead the student will get a certificate stating completion of extra courses.

B. Tech. with a Minor Degree

A Minor is an additional credential, a student earns if the student opts for earning 18 credits worth of additional learning in a discipline other than student's major discipline. The concerned department specifies the course requirements for earning a Minor Degree in a particular area.

The Department offering a Minor degree prescribes a specific set of courses and/ or other activities like projects for earning a minor in that discipline. On successful accumulation of credits at the end of the B. Tech. programme, a separate grade sheet will be issued by the Examination Section after completion of the B. Tech program. The Degree Certificate of the student also will indicate "Bachelor of Technology in YYY@ , with Minor in Automotive engineering." No SPI or CPI will be calculated for Minor degree courses. Any backlog courses with respect to Minor Degree should be successfully completed by the B. Tech. semester VIII re-examination. If the student fails to earn 18 credits even after B. Tech semester VIII re-examination, no certificate for completion of Minor Degree will be given, instead the student will get a certificate stating completion of extra courses.

Content delivery, curriculum and exams will remain same for both Honours and Minor degree. Short listing of students for honours and minor degrees will be done on basis of CPI of semester 4.

Additional Degree: Internet of Things will be honours and minor degree for Major Degree students as follows:

Honours Degree *	Minor Degree®
BTech Civil Engineering	BTech Electronics Engineering
BTech Mechanical Engineering	BTech Electronics & Telecommunication Engineering
BTech Textile Technology	BTech Electrical Engineering
	BTech Computer Engineering
	BTech Information Technology

Scheme of Instruction and Evaluation

Minor Automotive Engineering									
Scheme of Instruction					Scheme of Evaluation				
S. No.	Course Code	Course Title	L-T-P (Hours/week)	Credits	Semester	TA	MST	ESE	ESE hours
1.	AE3001T	Automobile Engineering	3-0-0=3	3	V	20	20	60	3
2.	AE3001P	Automobile Engineering Laboratory	0-0-2=1	1	V	60	-	40	-
3.	AE3002T	Chassis and Body Engineering	3-1-0=4	4	VI	20	20	60	3
4.	AE4001T	Vehicle Performance	3-0-0=3	3	VII	20	20	60	3
5.	AE4001P	Vehicle Performance laboratory	0-0-2=1	1	VII	60	-	40	-
6.	AE4901D	Mini-project	0-0-4=4	2	VIII	60	-	40	-
7..	AE4002T	Hybrid and Electric vehicles	3-1-0=4	4	VIII	20	20	60	3

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER - V
Course Code	AE3001T
Course Title	Automobile Engineering

COURSE OUTCOMES

After completion of course, students would be able:

- 1 To outline the structure of the automobile
- 2 To analyze the various forces and torque reaction on front and rear axles.
- 3 To formulate steering, braking and suspension systems.
- 4 To identify the usage of Electrical vehicles/Hybrid electric vehicle and power plants.

COURSE CONTENTS

Module I	Vehicle classifications and specifications
	Introduction: Current Scenario of the global automobile industry and future challenges in vehicle manufacturing. Vehicle classifications and specifications: Frames, Chassis Layout and constructional details. power plant locations and drive.
Module II	Axles, Steering System, Wheels and Tyres
	Axles: Types of front axles and their constructions, Purpose and materials. Steering System: Steering geometry, Steering requirements, Steering linkages and steering gears, over steer and under steer, Cornering power, Reversibility of steering gears. Wheels and Tyres: Wheels construction, alloy wheel, wheel balancing, types of tyres, construction, materials, factors affecting tyre life.
Module III	Brakes
	Requirement of brakes, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes, Disc brakes, Weight transfer during braking and braking efficiency, braking of vehicle front wheel, Rear wheel and four wheel brakes, Introduction to antilock braking system and EBD (Electronic Brake force Distribution).
Module IV	Suspension
	Objectives of suspension, Basic requirements, Springs-Leaf and Coil springs, Air suspension and its features, Independent suspension, Sprung and un-sprung mass, Pitching, Rolling and bouncing, Shock absorbers.
Module V	Transmission and drive line
	Requirements of clutches, Types of clutches and clutch materials, Fluid coupling- Gear box-types, Automatic Transmission, Continuously Variable Transmission (CVT), Propeller Shafts, Overdrive, final drive and differential.

	TEXT BOOKS:
1	Kirpal Singh, Automobile Engineering, Vol. 1&2 Standard Publications.
2	N.K. Giri, Mechanics, Khanna Publishers, New Delhi, 8 th Edition

3.	C. P. Nakra, Basic Automobile Engineering, Dhanpat Rai Publishing Company.
4.	P. S. Kohali, Automobile Electrical Equipment, Tata McGraw Hill Publication.

	ADDITIONAL READING
1	William H. Crouse, Automotive Mechanics, Tata McGraw-Hill., 10 th edition
2	J. Reimpell H. Stoll, J.W. Betzler, The Automotive Chassis, SAE International Publication.
3	Newton, Steed and Garrot, Motor Vehicles, Butterworth London, 13 th Edition
4	SAE Manuals and Standards.
5	Joseph Heitner, Automotive Mechanics, C. B. S. Publishers and Distributers.
6	R. B.Gupta, Automobile Engineering, Satya Publication.

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER - V
Course Code	AE3001P
Course Title	Automobile Engineering Laboratory

COURSE OUTCOMES

The student should be able to –

1. Understand the structure of the automobile.
2. Analyze the transmission systems, wheels and tyres.
3. Study of different automotive systems

COURSE CONTENTS

Module I	Study of the following automotive systems
	<ol style="list-style-type: none"> a. Chassis Layout, b. Steering systems. c. Drum and disc brakes. d. Suspension systems. e. Different types of clutches. f. Gear Boxes. g. Transmission systems. h. Wiring layout.
Module II	Experimental study of the following systems
	<ol style="list-style-type: none"> a. Spark ignition systems. b. Differential gear boxes. c. Clutch systems. d. Gear boxes. e. Power steering. f. Pneumatic Braking System.

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER -VI
Course Code	AE3002T
Course Title	Chassis and Body Engineering

COURSE OUTCOMES

The students should be able to

1. Evaluate various analytical techniques for vehicle body engineering.
2. Design different frames types, to minimize the deformation in the body.
3. Analyze the effects of vibration, noise and ergonomics of the vehicle.
4. Evaluate various methods in vehicle body manufacturing.

COURSE CONTENTS

Module I	Power Required for Propulsion Introduction to vehicle body engineering and various systems mounted on frames:
	Vehicle body type and layouts, load distribution, dynamic loading, Aerodynamic drag on cars and commercial vehicle, drag reduction chassis frames for commercial vehicles, analysis of frame structure and application to chassis frames.
Module II	Body Types and constructions:
	Integral construction for cars, structural analysis integral chassis, application of theory of plates, shell to body components, principles of thin walled beams. Shear centres.
Module III	Noise control:
	Noise and vibration sources, Effects of vibration on various components of vehicle and comfort of passengers. Engine.
Module IV	Body vibrations and damping
	Vehicle Body Panels, tyres and vibration damping and absorption.
Module V	Safety consideration
	Impact protecting desirable crash characteristics. CMVR (Central Govt. Motor Vehicle acts) Rules and regulations.
Module VI	Vehicle Ergonomics
	Driver visibility and passenger seating and controlling arrangements for more safety.

	TEXT BOOKS:
1	Reimpell J.,“The automotive chassis: Engineering principle”, 2ndEdition, 1983.
2	“Automotive Chassis”, Heldt P. M. – Chilton Co., New York -1990.

	ADDITIONAL READING
1	“Automotive chassis and body”, Crouse W. H. McGraw – Hill, New York – 1971.
2	“Vehicle Body Engineering”, Powloski, J., Business Books Ltd., 1998.

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER - VII
Course Code	AE4001T
Course Title	Vehicle Performance

COURSE OUTCOMES

Students should be able to -

- 1 Compute different performance parameters associated with vehicle systems.
- 2 Apply the knowledge of vehicle dynamics for solving the problems.
- 3 Analyze and interpret the results of various vehicle systems.
- 4 Use modern tools and techniques to solve vehicle performance problems.

COURSE CONTENTS

1.	Introduction to vehicle system: Morphology of vehicles, General layout of passenger cars and commercial vehicle, Type of power units, Arrangement of power train, Vehicle controls
2.	Friction and rolling resistance of pneumatic tyres: Aerodynamics forces and moments, Relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, Equation of motion and maximum tractive effort.
3.	Vehicle performance estimation and prediction: power plant characteristic and transmission related requirements, Vehicle acceleration, and max. Speed, Gradability Drive systems comparison.
4.	Vehicle transmissions: characteristics and features friction clutches, mechanical geared transmission lay shaft and epicyclic gearbox, Synchronizers, Fluid coupling and torque converters.
5.	Drive lines, two wheel drive, four wheel drive, braking arrangement, safety in braking, weight transfer steering, and cornering power of tyres.
6.	Handling characteristics of vehicles. Steering geometry, steady state handling characteristics, steady state response to steering input. Directional stability of vehicle. Effect of shock and vibration on human being, comfort criteria.

	TEXT BOOKS:
1	Rao J.S. and Gupta. K., "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2 nd Edition, 2002.
2	J.Y. Wong, "Theory of ground vehicle", John Wiley and Sons Inc., New York, 1 st Edition, 1978.
3	Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 3 rd Edition, 2005

	ADDITIONAL READING
1	W.Steeds, "Mechanics of road vehicle", Illiffe Books Ltd, London 3 rd Edition, 1992.
2	J.G.Giles, "Steering, Suspension tyres", Illife Books Lid London 1 st Edition, 1975.
3	P.M .Heldt, "Automotive chassis", Chilton Co, New York, 1 st Edition, 1982.
4	J. R. Ellis, "Vehicle Dynamics", Business Books, London, 2 nd Edition, 1969.

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER - VII
Course Code	AE4001P
Course Title	Vehicle Performance Laboratory

COURSE OUTCOMES

Students should be able to -

1. Interpret various forces in static and dynamic conditions.
2. Select analytical modelling for various vehicle dynamics systems.
3. Study vehicle dynamics, their properties, applications & selection of design parameters.
4. Compute effect of various parameters on performance of vehicle systems.

Study and modeling of the following automotive systems

Module I	Aerodynamics forces and moments, cornering properties of tyres, Vehicle acceleration, Speed, Gradability Drive systems.
Module II	Mechanical geared transmission lay - shaft and epi-cyclic gearbox, Synchronizers, Fluid coupling and torque converters. Drive lines, two wheel drive, four wheel drive, weight transfer, steering, and cornering power of tyres.
Module III	Handling characteristics of vehicles. Steering geometry, steady state handling characteristics, steady state response to steering input. Directional stability of vehicle. Effect of shock and vibration on human being, comfort criteria.

Programme Name	Honours / Minor in Automotive Engineering, SEMESTER - VIII
Course Code	AE4002T
Course Title	Hybrid and Electric Vehicles

COURSE OUTCOMES

After completion of course, students would be able to:

- 1 Understand the concept of electric vehicles.
- 2 Understand the motors & drives for electric vehicles,
- 3 Understand the concept of hybrid vehicles
- 4 Understand the fuel cell for electric vehicles.

COURSE CONTENTS

Module I	Introduction to Hybrid Electric Vehicles:
	History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.
Module II	Conventional Vehicles:
	Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.
Module III	Hybrid Electric Drive trains:
	Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.
Module IV	Electric Drive trains:
	Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing. Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.
Module V	Electric Propulsion unit:
	Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.
Module VI	Energy Storage:
	Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.
Module VII	Sizing the drive system:

	Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.
Module VIII	Energy Management Strategies:
	Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

	TEXT BOOKS:
1	Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2	James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
3.	Seth Leitman, “Build Your Own Electric Vehicle” MC Graw Hill, 1st Edition, 2013.
4.	Gopal K D, “Fundamentals of Electric Drives”, Narosa Publishing House Pvt. Ltd., 2011.
5.	Pillai S K, “A first course on Electrical Drives”, Wiley Eastern Ltd, Bombay 2011.

	ADDITIONAL READING
1	B D Mc Nicol, D A J Rand, “Power Sources for Electric Vehicles”, Elsevier publications, 1 st Edition, 1998.
2	James Larminie, John Lowry, “Electric Vehicle Technology”, Wiley publications, 1 st Edition, 2003.
3	Ali Elamadi, “Handbook Automotive Power Electronics and Drives”, CRC publishers, 2012
4	Bimal K Bose, “Modern Power Electronics and Drives”, Elsevier publishers, Butter worth Hinnemann, 2012.