DEPARTMENT OF AERONAUTICAL & AUTOMOBILE ENGINEERING, MIT Manipal

M.Tech. AUTOMOBILE ENGINEERING

Program Structure (Applicable to 2019 admission onwards)

Year	FIRST SEMESTER						SECOND SEMESTER					
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
I	MAT 5155	Applied Numerical Methods	3	1	0	4	AAE 5271	Autotronics and Navigation	3	1	0	4
	HUM 5151	Research Methodology and Technical Communication	1	0	3	2	AAE 5272	Vehicle Dynamics	3	1	0	4
	AAE 5171	Automotive Engines and Subsystems	3	1	0	4	AAE ****	Elective I	3	1	0	4
	AAE 5172	Automotive Materials and Structures	3	1	0	4	AAE ****	Elective II	3	1	0	4
	AAE 5173	Combustion and Emission	3	1	0	4	AAE ****	Elective III	3	1	0	4
	AAE 5174	Vibration and Acoustics	3	1	0	4	*** ****	Open Elective	3	0	0	3
	AAE 5163	Materials Testing Lab	0	0	3	1	AAE 5263	Automotive Design and Simulation Lab	0	0	3	1
	AAE 5164	Vehicle Parts Modeling Lab	0	0	6	2	AAE 5264	Vibration and Acoustics Lab	0	0	3	1
		Total	**16**	**5**	**12**	**25**		**Total**	**18**	**5**	**6**	**25**
II	THIRD AND FOURTH SEMESTER											
	AAE 6098	Project Work							0	0	0	25
								Total	0	0	0	**25**

PROGRAM ELECTIVES			
AAE 5035	Advanced Powertrains	AAE 5041	Design for Manufacturing and Serviceability
AAE 5036	Automotive Control Systems	AAE 5042	Engineering Optimization and Reliability
AAE 5037	Battery and Fuel Cell Technology	AAE 5043	Finite Element Methods
AAE 5038	Computational Fluid Dynamics	AAE 5044	Manufacturing and Testing of Automotive Components
AAE 5039	Crashworthiness and Occupant Safety	AAE 5045	Tribology and Bearing Design
AAE 5040	Design and Analysis of Thermal Systems	AAE 5046	Vehicle Aerodynamics

OPEN ELECTIVES			
AAE 5054	Hybrid And Electrical Vehicles		

SEMESTER I

MAT 5155 APPLIED NUMERICAL METHODS [3 1 0 4]

Mathematical modeling and engineering problem solving: simple mathematical model, conservation laws and engineering. Approximations and round of errors: Accuracy and precision, error definitions, round off errors, truncation errors and Taylor's series. Roots of equations: Bracketing methods, open methods, roots of polynomials applied to engineering problems. Linear algebraic equations: LU decomposition and matrix inversion, special matrices and Gauss Seidel applied to engineering problems. Numerical Differentiation and Integration: Newton Cotes Integration formulas, integration of equations, numerical differentiation applied to engineering problems. Ordinary Differential Equations: RK methods, Boundary value and Eigen value problems. Partial Differential Equations: Finite difference method for elliptic and parabolic equation applied to engineering problems.

References:

1. Steven. C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, (2e) Tata McGraw Hill Edition, 2016.
2. Sastry S.S., Numerical Analysis for Engineers, (1e) Tata McGraw Hill Edition, 2002.

HUM 5151 RESEARCH METHODOLOGY AND TECHNICAL COMMUNICATION [1 0 3 2]

Mechanics of Research Methodology: Basic concepts: Types of research, Significance of research, Research framework, Case study method, Experimental method, Sources of data, Data collection using questionnaire, Interviewing, and experimentation. Research formulation: Components, selection and formulation of a research problem, Objectives of formulation, and Criteria of a good research problem. Research hypothesis: Criterion for hypothesis construction, Nature of hypothesis, need for having a working hypothesis, Characteristics and Types of hypothesis, Procedure for hypothesis testing, Sampling methods- Introduction to various sampling methods and their applications. Data Analysis: Sources of data, Collection of data, Measurement and scaling technique, and Different techniques of Data analysis. Thesis Writing and Journal Publication: thesis writing, journal and conference papers writing, IEEE and Harvard styles of referencing, Effective Presentation, Copyrights, and avoiding plagiarism.

References:

1. Dr Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, SAGE, 2005.
2. Geoffrey R. Marczyk, David DeMatteo & David Festinger, Essentials of Research Design and Methodology, John Wiley & Sons, 2004.
3. John W. Creswel, Research Design: Qualitative, Quantitative & Mixed Methods Approaches, SAGE, 2004.
4. Suresh C. Sinha and Anil K. Dhiman, Research Methodology (2 Vols-Set), Vedam Books, 2006.
5. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International Publisher, 2008.

AAE 5171 AUTOMOTIVE ENGINES AND SUBSYSTEMS [3 1 0 4]

Basics of engine, operation, classification, types of engine, characteristics of engine, theory of carburetion and carbonator, electronics controlled carburetor system for Petrol engines, ignition system in SI engines, fuel supply in Diesel engine, injection system types, swirl and turbulence generation in combustion chamber, flame travel, combustion chamber design, engine testing and standard, methods to improve engine performance, performance map.

References:

1. Richard Stone, Introduction to Internal Combustion Engines, McMillan, London.
2. John B. Heyhood. Internal Combustion Engines Fundamentals, McGraw Hill.,2012.
3. Fayette Taylor & Edward S. Taylor, I. C. Engines, International text book com.
4. Heldt.P.M., High Speed Combustion Engines, Oxford IBH Publishing Co.,1965.
5. Obert.E.F., Internal Combustion Engine analysis and Practice, International Text Book Co, Scranton, Pennsylvania,1988.
6. Wiliam.H.Crouse., Automotive Engines, McGraw Hill Publishers, 1985.

AAE 5172 AUTOMOTIVE MATERIALS AND STRUCTURES [3 1 0 4]

Mechanical behavior of materials, structure of crystalline solids, plastic deformation, failure modes, creep mechanism, selection of materials for different components, manufacturing feasibility, modern materials and alloys, heat treatment process, advanced forming and joining , smart materials, composites, emerging trends of composites in automotive industry, mechanics of composite materials, body load, toughness characteristics and energy absorption characteristics of vehicle structure, optimization of vehicle structure.

References:

1. Raghavan V, Material science and engineering, Prantice Hall India, 2015.
2. Avner Sidney, Introduction to physical metallurgy, Mc Graw Hill International, 1995.
3. Johnson, W., and Mamalis, A.G., Crashworthiness of Vehicles, MEP, London, 1998.
4. Matthew Huang, Vehicle Crash Mechanics. CRC Press, 2002.
5. Powloski, J., Vehicle Body Engineering, Business Books Ltd., 1989.

AAE 5173 COMBUSTION AND EMISSION [3 1 0 4]

Introduction to combustion, principles and applications of combustion, characterization of fuels, laws of thermodynamics, fundamental laws of transport, basic reaction kinetics, global kinetics, regulatory test procedures, analysis of pollutants, pollution diagnosis, and instrumentation, NDIR analyzers, thermal conductivity and flame ionization detectors, EGR, catalytic converter, thermal reactors, fuel modifications

References:

1. Colin R. Ferguson, Allan T. Kirkpatrick, Internal Combustion Engines-Applied Thermosciences, John Wiley and Sons Inc., U.K., 2015.
2. Willard W. Pulkrabek, Engineering Fundamentals of Internal Combustion Engine, Pearson Education Inc., U.S.A, (1e) 2004.
3. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill Pvt. Ltd., India, 2012.
4. J.B. Heywood, Internal Combustion Engine, Tata McGraw Hill Pvt. Ltd., India, 1989.
5. M.L. Mathur, R.P. Sharma, Internal Combustion Engine, Dhanpat Rai Publications, India, (2e) 1994.

AAE 5174 VIBRATION AND ACOUSTICS [3 1 0 4]

Vibration fundamentals, vibration measuring parameter and their values, single degree of freedom, torsional vibration, forced vibration, design of isolators, multidegree freedom system, finite element method, Eigen

value problem, Cholesky factorization, concept of iteration, random vibration, random variable and processes, Gaussian random process, Fourier analysis, vibration measuring instruments, vibration transducers, vibration excitation techniques, fundamentals of signal analysis, data acquisition and processing, frequency domain analysis, dealing with random signals, fundamentals of acoustics, acoustic transducers and measurement, acoustic exciters, automotive vibration and noise.

References:

1. Sujatha C., Vibration and Acoustics, Tata McGraw Hill publication, 2010.
2. Matthew Harrison, Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Mathew Harrison Publication, 2004.
3. Malcolm J. Crocker, Handbook of Acoustics, John Wiley & sons Publication 1993.
4. Malcolm J. Crocker, Handbook of Noise and Vibration Control, John Wiley & sons Publication, 2007.
5. Singiresu S Rao, Mechanical Vibrations, Pearson education publication, 2004.

AAE 5163 MATERIALS TESTING LAB [0 0 3 1]

Deflection of simply supported beam, Verification of Maxwell's reciprocal theorem, Determination of young's modulus using strain gauge, Non-destructive testing using ultrasonic flaw detector, Non-destructive testing using C-Scan, Examination of flaw using magnetic flaw detector, Hardness test of given specimen, Determination of young's modulus of leaf spring, Determination of Modulus of rigidity of coil spring, Impact test, Torsion test, Tension test, Fatigue test, Flexural test.

References:

1. Egor P. Popov, Engineering Mechanics of Solids 2e, Prentice Hall 1998.
2. Beer, F.P., Johnston, E.S. & DeWolf, J.T., Mechanics of Materials 3e, Tata McGraw-Hill, 2004.
3. Gere, J.M., Mechanics of Materials 5e, Brooks/Cole, 2001.
4. Srinath L.S. Advanced Mechanics of Solids 3e, Tata McGraw-Hill, 2009
5. Bhavikatti S.S., Mechanics of Solids New Age International 2010.

AAE 5164 VEHICLE PARTS MODELING LAB [0 0 6 2]

Basics of CATIA and Creo PRO-E, two dimensional modeling of modeling techniques, three dimensional modeling techniques, Modeling of automotive systems and its subsystems; engine, piston, crank shaft, disc, drum brake, tire, hub, surfacing, modeling of car using views. Assembly of components.

References:

1. Michael Michaud, CATIA Core Tools: computer aided three dimensional interactive applications, McGraw Hill Professional Publication, 2012.
2. Prof Sham Tickoo, CATIA V5R17 for engineers & Designers, Dreamtech Press Publication, 2008.
3. Nadar G Zamani, Jnonathan M Weaver, Catia V5 tutorials mechanisms, Design & Animation relase 21, SDC Publication, 2012.
4. Sean Harris, Adithya Chopra, Creo Elements Pro E - Comprehensive Guide to CAD/CAM, Createspace Independent Pub, 2014.
5. Kuang-Hua Chang, Mechanism Design with Creo Elements/Pro 5.0: (Pro/ENGINEER Wildfire 5.0), SDC Publication, 2011.

SEMESTER II

AAE 5271 AUTOTRONICS AND NAVIGATION [3 1 0 4]

Microprocessor and micro computer application, engine management systems, chassis management system, sensor and actuators, auxiliary systems, new developments, automotive navigation system, application of navigation system, traffic control, mobile mapping, pedestrian navigation, GPS, navigation massage generation, inertial navigation system(INS), mobile land vehicle INS, strap-down INS, automatic navigation system with multiple sensors, geographical information system (GIS), GIS data base and laser scanning, location and navigation systems based on LEDs.

References:

1. William B Ribbens, Understanding Automotive Electronics, (6e), Newnes, 2003.
2. Tom Denton, Automobile Electrical and Electronics systems, (4e), Routledge Taylor & Francis group, 2012.
3. Zhao, Y., Vehicle Location and Navigation Systems, Artech House, Inc. Boston, London, 1997.
4. I.Skog, Development of a low cost GPS aided INS for vehicles, Technical Report, Dept. of Signals, Sensors and Systems, Royal Institute of Technology, Sweden, 2005.
5. Richardson, B., Green, P. and Ann Arbor, Trends in North American Intelligent Transportation Systems: A Year 2000 Appraisal (Technical Report UMTRI-2000-9), MI: The University of Michigan transportation Research Institute, 2000.
6. Gilliéron P Y, A mobile mapping system for automating road data capture in real time, Optical 3D, Vienna, Oct 2001.

AAE 5272 VEHICLE DYNAMICS [3 1 0 4]

Vehicle dynamics and control, basics of vehicle dynamics, kinematics equation of motion, multi body dynamics, A car model; virtual four wheel vehicle modal, force and torque, tire mechanics, tire force and torque, tire characteristics, contact geometry, tire cornering characteristics, Fiala's theory, mathematical model for braking and cornering, fundamentals of vehicle dynamics and characteristics, nonlinear effect of tire, vehicle motion disturbance, traction control system, ABS, hydraulic unit for ABS and EPS, active steering system.

References:

1. Georg Rill, Road Vehicle Dynamics; Fundamentals and Modeling, CRC press publication, 2012.
2. Martin Meywerk, Vehicle Dynamics, Wiley publication, 2015.
3. Masato Abe, Vehicle Handling Dynamics; Theory and Application, Butterworth-Heinemann publication, 2015.
4. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics, Technology & Engineering publication, 1992.
5. Pacejka H. B., Tire and Vehicle Dynamics, Butterworth-Heinemann publication, 2012.

AAE 5263 AUTOMOTIVE DESIGN AND SIMULATION LAB [0 0 3 1]

Basic introduction to ANSYS and MATLAB, deformation of different chassis structure, engine block, disc brake, Thermal analysis; engine block, piston, Modal analysis; connecting road Math Lab: Design of dump truck, analysis of automobile shock absorber. Engine model simulation, Vehicle dynamics, rigid body dynamics, and cruise control simulation.

References:

1. Choudary R B, Introduction to ANSYS10.0, IK International, 2009.
2. Esam M A, Finite element simulation using ANSYS, Taylor & Francis Publication, 2010.
3. MATLAB 6 for Engineers: Hands-on Tutorial, Joe King, Library of Congress publication, 2001.
4. Rao V Dukkipati, MATLAB for Mechanical Engineers, New age Science Publication, 2009.
5. Misza Kalechman, Practical MATLAB basics for engineers, CRC Press Publication, 2010.

AAE 5264 VIBRATION AND ACOUSTICS LAB [0 0 3 1]

Viscous damping, forced vibration setup, whirling of shaft, condition monitoring unit, modal analysis, balancing of disc.

References:

1. Sujatha C., Vibration and Acoustics, Tata McGraw Hill publication, 2010.
2. Matthew Harrison, Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Mathew Harrison Publication, 2004.
3. Malcolm J. Crocker, Handbook of Acoustics, John Wiley & sons Publication, 1993.
4. Malcolm J. Crocker, Handbook of Noise and Vibration Control, John Wiley & sons Publication, 2007.
5. Singiresu S Rao, Mechanical Vibrations, Pearson education publication, 2004.

SEMESTER III and IV

AAE 6098 PROJECT WORK [0 0 0 25]

Students are required to undertake innovative and research oriented projects, which not only reflect their knowledge gained in the previous two semesters but also reflects additional knowledge gained from their own effort. The project work can be carried out in the institution/ industry/ research laboratory or any other competent institutions. The duration of project work should be a minimum of 36 weeks. There will be a mid-term evaluation of the project work done after about 18 weeks. An interim project report is to be submitted to the department during the mid-term evaluation. Each student has to submit to the department a project report in prescribed format after completing the work. The final evaluation and viva-voice will be after submission of the report. Each student has to make a presentation on the work carried out, before the departmental committee for project evaluation. The mid-term & end semester evaluation will be done by the departmental committee including the guides.

PROGRAM ELECTIVES

AAE 5035 ADVANCED POWERTRAINS [3 1 0 4]

Requirement of transmission system, Layouts of transmission systems with different engine locations, automotive clutches, principle, construction, design aspects of friction clutches, Determination of gear ratios for vehicles, Different types of gearboxes, Design of propeller shafts, Hydrodynamic Drive, Automatic Transmission, Electronically controlled automatic transmission systems, Hydrostatic Drive systems, Various types of hydrostatic drive systems, Principles of hydrostatic drive system, Construction and working of typical Janny hydrostatic drive, electric drive, Principles of early and modified Ward Leonard Control system, Toyota ECT-I automatic transmission with intelligent electronic control system.

References:

1. Lukin P, Gasparyarts G, Rodionov V, Automotive Chassis – Design and Calculation, MIR Publishing, Moskow.
2. Heldt P. M, Automotive Chassis, Chilton Co.
3. Steed W, Mechanics for Road Vehicles, Illiffe Books Ltd., London.
4. Heinz Heisler, Advanced Vehicle Technology, (2e), Butterworth – Heinemann, New York, 2002.
5. Giri N. K, Automobile Mechanics, Seventh reprint, Khanna Publishers, Delhi, 2005.
6. Heldt P. M, Torque Converters, Chilton Book Co., 1992.
7. Garret T. K, Newton K.Steeds W. , The Motor Vehicle, (13e), Butterworth Heinemann, India, 2004.

AAE 5036 AUTOMOTIVE CONTROL SYSTEMS [3 1 0 4]

Automatic control system, feedback control systems, stability, performance and characteristic analysis, vehicle body dynamics, dynamics model and simulation, engine control system, engine management system, engine control module, control system development tools, driveline control, vehicle system control, ABS control, road and driver model, stability control, cruise control system, intelligent cruise control, adaptive and autonomous cruise control.

References:

1. Richard C. Dorf and Robert H. Bishop, Modern Control System, (8e), PEARSON Education, 1998.
2. Uwe Kiencke and Lars Nielsen, Automotive Control Systems for Engine, Driveline and Vehicle, (2e), Springer, 2005.
3. Allan W. M. Bonnick, Automotive Computer Controlled Systems, Diagnostic tools and techniques, 1st published, Butterworth-Heinemann OXFORD Auckland Boston Johannesburg Melbourne New Delhi, 2001.
4. Dave Walker, Engine Management, Haynes High performance series, 2008.
5. Newton K and Steeds W, Motor Vehicle, Butter Worths & Co., Publishers Ltd, 1997.

AAE 5037 BATTERY AND FUEL CELL TECHNOLOGY [3 1 0 4]

Introduction and Description of Automotive Battery System Architecture, Classification and Application of Safety Measures for Automotive Battery Systems, Application of Measures at Battery System Units, Specific Hazards of Electric Vehicles, Applicable Design Approach for Batteries, Batteries in Crash Tests and Crash Simulation, Finite Elements Model of the Battery, Thermal Runaway Experiment and modelling. Thermal Behaviour, Electrical Behaviour, Distributed-Micro-Structure Modelling, Mobility Demands and Primary Energy Resources, Basic Concepts of Electrochemistry, Proton Exchange Membrane Fuel Cells, Sensitivity of Durability of PEM Fuel Cells, Design of Hydrogen Fuel Cell Hydrogen Fuel Cell Systems. Integrated Fuel Cell System.

References:

1. Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri, Hydrogen Fuel Cells for Road Vehicles, Springer London Dordrecht Heidelberg New York, ISBN 978-0-85729-135-6, 2011.
2. Michael H. Westbrook, The Electric Car Development and future of battery, hybrid and fuel-cell cars, Co-published by The Institution of Engineering and Technology, London, United Kingdom, and Society of Automotive Engineers, Warrendale, PA 15096-0001, USA, ISBN (13 digit) 978-0-85296-013-4, 2007.
3. Alexander Thaler, Daniel Watzenig, Automotive Battery Technology, Springer Cham Heidelberg New York Dordrecht London, ISBN 978-3-319-02522-3, 2009.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Press, ISBN-I O: 1420053981, ISBN-13; 978-1420053982, 2009.

5. Amir Khajepourj M. Saber Fallahi Avesta Goodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, Wiley, ISBN: 978-1-118-86340-4, 2010.

AAE 5038 COMPUTATIONAL FLUID DYNAMICS [3 1 0 4]

Governing equation of fluid mechanics, continuity equation, momentum and energy equation, Initial and boundary conditions, Equilibrium and Marching behavior, format of differential equation, explicit Taylor series expansion, steady state conduction heat transfer, 2D heat conduction, unsteady conduction heat transfer, implicit and Crank Nicholson method, space and time marching problems, comtrol volume techniques, diffusion convection flow, SIMPLE algorithms, boundry conditions in CFD, introduction to turbulence.

References:

1. John D Anderson Jr., Computational Fluid Dynamics- The Basics with Applications, International Edition. McGraw Hill. New York, 1995.
2. Suhas V Patankar, Numerical Heat Transfer and Fluid Flow-Hemisphere, McGraw Hill. New York, 1980.
3. H.K. Versteeg and W. Malalasekera,An Introduction to Computational Fluid Dynamics- The Finite Volume Method, Longman Scientific & Technical England, 1995.
4. K.Muralidhar and T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 2003.
5. Anderson D.A, Tannehill J.C, and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Taylor and Francis Group. New York, 1997.
6. T.J. Chung., Computational Fluid Dynamics, Cambridge University Press, South Asia Edition, 2003.

AAE 5039 CRASHWORTHINESS AND OCCUPANT SAFETY [3 1 0 4]

Introduction to automotive structure, crashworthiness, occupant safety, design of vehicle structure for crash energy management, design practice for crash, crash/crash design techniques, stiff cage structure concept, vehicle front structure design, vehicle frontal collision, finite element analytical techniques and application of structure design, explicit formulation, fundamental principle for vehicle/ occupant system analysis, barrier collision, laws of motion, energy and work, restrain performance and design, human body modeling, dynamic joint modeling, dummy modeling, modeling of real human body, injury biomechanics, head injury mechanism, thoracic injury mechanism, chest injury, abdominal injury, lower extremity injury mechanism.

References:

1. Paul Du Bois Clifford C. Chou Bahig B. Fileta Tawfik B. Khalil Albert I. King Hikmat F. Mahmood Harold J. Mertz Jac Wismans, Vehicle Crashworthiness and Occupant Protection, Automotive Applications Committee American Iron and Steel Institute Southfield, Michigan, 2004.
2. Narayan Yoganandan, Alan M. Nahum, John W. Melvin, Accidental Injury: Biomechanics and Prevention, The Medical College of Wisconsin Inc, 2015.
3. CAE Methods for Vehicle Crashworthiness and Occupant Safety, and Safety-critical Systems, SAE special publication: Society of Automotive Engineers, 2004.
4. Jorge A.C. Ambrosio, Crashworthiness: Energy Management and Occupant Protection, Springer-Verlag Wein publication Newyork, 2001.

AAE 5040 DESIGN AND ANALYSIS OF THERMAL SYSTEMS [3 1 0 4]

Introduction, basics of themodynamics, modes of heat transfer, engineering design, modeling of thermal systems, mathematical and physical modeling, basic heat exchanger design, materials for thermal application, super conductive materials, nanomaterials, optimization in design, programing, economic factors in design.

References:

1. Adrian Bejan, George Tsatsaronis, Michael Moran, Thermal Design and Optimization, John Wiley & Sons, 1996.
2. Robert F. Boehm, Developments in Design of Thermal Systems, Cambridge University Press, 1997.
3. W.F. Stoecker, Design of thermal systems, Tata Mcgraw-hill, 2011.
4. R.F. Boehm, Design analysis of thermal systems, Wiley, 1987.
5. Yogesh Jaluria, Design and Optimization of thermal systems, CRC Press, Taylor & Francis, 2007.

AAE 5041 DESIGN FOR MANUFACTURING AND SERVICEABILITY [3 1 0 4]

Manufacturing, design for manufacturing, mechanical and physical properties materials, tolerance analysis and allocation, Taguchi's approach, principle of selective assembly, selection of materials for manufacturing process, process selection, DFM guidelines, design for casting, powder metallurgy, sheet metal forming, design for assembly, assembly process design for welding, brazing, bonding, joining, design for serviceability, cost relationship, standardization, mistake proof assembly, improve of DFS.

References:

1. Design for Manufacturing and Assembly: Concepts, Architectures and Implementations, O. Molloy, Steven Tilley, E. A. Warman; Springer Books, 1998.
2. Handbook for Product design and manufacturing, James G Bralla, McGraw Hill, 1986.
3. Tolerance Design-A handbook for developing optimal specifications, C.M. Creveling, Addison-Wesley, 1997.
4. Design for Manufacturing- A structured approach, Volume1, C. Poli; Buttworth-Heinneman, Elsevier publications, 2001.
5. Product Design for Manufacturing and Assembly, Geoffery Boothroyd, CRC Press, (3 e) 2010.

AAE 5042 ENGINEERING OPTIMIZATION AND RELIABILITY [3 1 0 4]

Single variable optimization algorithms, local and global optima, bracketing methods, Fibonacci search method, gradient based method, Newton Raphson method, multivariable unconstrained optimization, direct search method, nonlinear optimization simplex search, Hooks & Jeeves pattern search, multivariable constrained optimization, Lagrange multiplier method, Kuhn-Tucker condition, cutting plane method, integral programing and geometric programming, genetic algorithm, ant colony optimization, particle swarm optimization, Tabu search.

References:

1) Rao S. S., Engineering Optimisation (3e) John Wiley & Sons 2009.
2) Kalyanmoi Deb, Optimisation for engineering Design Prentice Hall India, 1995.
3) Chander Mohan & Kusum Deep, Optimisation Techniques New Age Science Ltd. 2009.
4) Onwubolu G.C., Babu B.V., New Optimisation Techniques in Engineering, Springer 2004.
5) Kalyanmoi Deb, Multi-objective optimization using evolutionary algorithms, John Wiley and sons, 2001.

AAE 5043 FINITE ELEMENT METHODS [3 1 0 4]

Introduction to matrix notations, role of computer, General steps in Finite element methods, Application of Finite element method, Advantages of Finite element methods. Definition of stiffness matrix, Derivation of stiffness matrix for spring elements, Transformation of vectors in 2D, Global stiffness matrix, computation of stresses in bar in x-y plane, Use of symmetric structure, beam stiffness, assemblage of beam stiffness matrices, distributed loading, beam element with nodal hinge, potential energy method, Galerkin method for deriving he beam element equation, Basic concept of plane stress and plane strain, derivation of the constant Strain triangle element stiffness matrix and equations, Derivation of the Liner Strain triangular element stiffness matrix and examples.

References:

1. Zienkiewicz O C and Taylor R L., Finite Element Method for Solid and Structural Mechanics,Elsevier, 2013.
2. RaoSingiresu S., Finite Element Method in Engineering, Butterworth and Heinmann, 2011.
3. Huebner Kenneth H, Finite element method for Engineers, John Wiley and Sons., 2008.
4. Reddy JN., Introduction to the Finite Element Method, McGraw Hill., 2006.
5. Logan D L., First Course in the Finite Element Method, Thomson., 2011.

AAE 5044 MANUFACTURING AND TESTING OF AUTOMOTIVE COMPONENTS [3 1 0 4]

Basic of vehicles, manufacturing of engine parts; piston, piston ring, crank shaft, automotive silencer, automotive chain, cylinder liner, mounting pad, manufacture of valve and valve seat, processes and methodology, alternative process of manufacture, manufacture of cylinder block, presumption, technical aspects, quality control, automotive body manufacture process, manufacture of disc and brake drum, manufacture of leaf spring, measurement and testing, failure preventions.

References:

1. B.P. Bhardwa, The Complete Book on Production of Automobile Components & Allied Products, asia pacific business press Inc, NIIR Project Consultancy Services, 2014.
2. K. J. Marsh, Full-Scale Fatigue Testing of Components and Structures, butterworth & co ltd, 1988.
3. V Ganesan, Internal combustion engines, Tata McGraw Hill Eduaction Private LTD, 2012.
4. A. J. Martyr and M A Plint,Engine Testing: Theory and Practice, Butterworth & Heinemann Publication, 2007.

AAE 5045 TRIBOLOGY AND BEARING DESIGN [3 1 0 4]

Introduction to tribology, laws of friction, theories of friction, wear, lubrication, viscosity, Newtonian fluid, absolute and kinematic viscosity, effect of temperature and pressure on viscosity, viscosity index, introduction to selection and classification of bearings, hydrodynamics and hydrostatic bearing, rolling element bearing, design of sliding contact bearing, journal bearing, journal bearing design and procedure, minimum film thickness, air bearings, design of hydrostatic bearings, selection and design of rolling bearing, contact stresses in bearing, fatigue life calculation, introduction to rotor dynamics.

References:

1. Michael M. Khonsari, E. Richard Booser, Applied Tribology: Bearing Design and Lubrication, Wiley publication, 2008.
2. Rowe W. B, Hydrostatic, Aerostatic, and Hybrid Bearing Design, Butterworth-Heinemann publication, 2012.
3. Majumdar B.C, Introduction to Tribology of Bearings, S. Chand & Company publication, 2008.
4. Bharat Bhushan, Introduction to Tribology, Wiley Publication, 2013.
5. Tadeusz Stolarsk, Tribology in Machine Design, Butterworth-Heinemann publication, 2000.

AAE 5046 VEHICLE AERODYNAMICS [3 1 0 4]

Introduction, Historical development, Fundamentals of fluid mechanics, Properties of incompressible fluid, basic equations of incompressible flow, Friction drag and pressure drag, Aerodynamic drag of passenger cars, Aerodynamics of commercial vehicles, tractive effort and fuel consumption, reducing aerodynamic drag in trucks, Aerodynamics of high performance vehicles, Aerodynamic features of race cars, vehicle dynamics under side wind, influence of vehicle shape on aerodynamic forces and moments, Experimental Procedure and Facilities, Types of wind tunnels, Instrumentation for wind tunnels: pressure measurement, velocity measurement, force and moment measurement devices, Flow visualization.

References:

1. Hucho W.H., Aerodynamic of Road vehicles, Butterworths Co. Ltd, 1997.
2. Wolf-Heinrich Hucho, Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering, 1990.
3. Pope. A., Wind Tunnel Testing, John Wiley & Sons, (2e), New York, 1974
4. Handbook on vehicle body design, SAE Publications,1993.
5. Rose McCallen, Fred Browand, The Aerodynamics of Heavy Vehicles: Trucks, Buses, and Trains, Volume 1, 2004.

OPEN ELECTIVES

AAE 5054 HYBRID & ELECTRICAL VEHICLES [3 0 0 3]

Introduction to alternative vehicles, developments, environmental impact, architecture of hybrid and electrical vehicles, basics of electric and hybrid vehicles, hybrid power trains, series and parallel hybrid systems, electrical propulsion systems, configuration of motors, introduction to energy storage systems, fuel cell, super capacitor, powertrain systems in hybrid vehicles, two mode hybrid transmission, torque coupling mechanism, energy management systems, diagnostics method.

References:

1. Chris Mi, Abdul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical Prespectives, Wiley Publications, 2011.
2. James Larminie Electric Vehicle Technology Explained, Wiley Publications, 2003.
3. Mehrda Ehsani, Yimi Gao Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.