I SEMESTER

15AE01 COMPUTATIONAL MATHEMATICS

2 2 0 3

INTRODUCTION TO COMPUTATIONAL METHODS: Solving set of equations - Gauss elimination method, LU - Choleski method, Gauss Jacobi method, Gauss Siedel method, successive over relaxation method, system of non-linear equations – Newton's method. (6+6)

INTERPOLATION: (Revision – Forward, Backward, divided difference interpolation) - Cubic spline interpolation, Bezier curves and B-spline curves, polynomial approximation of surfaces, least square approximations. (4+4)

NUMERICAL INTEGRATION: Numerical integration - Gaussian quadrature, trapezoidal rule and Simpson's one third rule, multiple integrals, multiple integration with variable limits, application of cubic splines. (4+4)

NUMERICAL SOLUTION OF ODE: Taylor series method, Euler and Modified Euler method (Heun's method), Runge Kutta method, Milne's method, Adams - Moulton method. (3+3)

NUMERICAL SOLUTION OF PDE: Classification of partial differential equations of second order, Liebmann's method for Laplace equation and Poisson equation, explicit method and Crank-Nicolson method for parabolic equations, explicit method for hyperbolic equations. (4+4)

FINITE ELEMENT METHOD: The Rayleigh-Ritz method, Collocation and Galerkin method, finite element method – ordinary differential equations, elliptic, parabolic, hyperbolic partial differential equations. (6+6)

SIMULATION MODELLING: Introduction, simulating deterministic behaviour, area under a curve, generating random numbers, simulating probabilistic behaviour, inventory model: gasoline and consumer demand. (3+3)

Note: Exposure to software. Design problems can be given to the students and they have to submit assignments / term papers using programs.

Total L: 30 + T: 30 = 60

REFERENCES:

1. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2011.
2. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers with software and Programming Applications", Tata McGraw Hill, New Delhi, 2006.
3. John H Mathews and Kurtis D Fink, "Numerical Methods using MATLAB", Prentice Hall, New Delhi, 2004.
4. Douglas J Faires and Richard Burden, "Numerical Methods", Cengage Learning, New Delhi, 2005.
5. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning, New Delhi, 2013.

15AE02 AUTOMOTIVE SCIENCES

3 0 0 3

MECHANICAL SCIENCE:

DESIGN CONCEPTS & THERMAL SCIENCES: Types of load, stress and strain –Stress strain curve for materials, fatigue and fatigue life, creep behavior, engineering materials, properties and selection. Power transmission - Belt, gear, and chain drives. First law and second law of thermodynamics & Cycles. Properties of fluids & applications – Bernoulli's theorem, flow though pipes and channels – laminar and turbulent flow. Heat transfer – conduction, convection and radiation. Pumps and compressors, HVAC system. (10)

MANUFACTURING METHODS: Principles of casting, green sand moulds, Advantages and applications of casting; joining methods – welding, soldering and brazing, Metal forming – Cold and hot working. Machining–Shaping, turning, milling, drilling; Finishing - grinding, honing, lapping. Heat treatment and surface treatment. (5)

ELECTRICAL & ELECTRONICS SCEINCES

CIRCUIT THEORY: Current, voltage, passive elements (resistance, inductance, capacitance)- Ohm law, Kirchhoff's laws - dc circuits and ac circuits- star-delta conversion- Concept power, power factor and power triangle- three phase circuits. (5)

ELECTRIC MACHINES: DC machines-construction, types, principle and their operation characteristics, AC machines -construction, types, principle and their operation characteristics. (10)

ANALOG ELECTRONICS: PN junction diode: construction- operating characteristics- circuits using diodes: rectifiers, zener diode. BJT: construction, types and operating characteristics, Field Effect Transistor: construction, types and operating characteristics, Operational amplifiers: Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp circuits. (7)

DIGITAL ELECTRONICS, MICROPROCESSOR AND MICROCONTROLLER: Number systems, logic gates, flip-flops, counters, shift registers, architecture of Intel 8085 microprocessor and 8051 microcontroller -programming and interfacing, interrupts-applications (8)

Total L: 45

REFERENCES:

1. Cengel Y A and Boles M A, "Thermodynamics – An Engineering Approach", Tata McGraw Hill, New Delhi, 2003.
2. Nisbett J K and Budynas R G, "Shigley's Mechanical Engineering Design", Tata McGraw Hill, New Delhi, 2011.
3. Kalpakjian S, Schmid S R, "Manufacturing Engineering and Technology", Pearson Education, USA, 2002.
4. Murugesh Kumar K, "Basic Electrical Science and Technology", Vikas Publishing Ltd, 2011.
5. Nagrath I J, Kothari D P, "Electric Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
6. Leach D P, Malvino A P and GoutamSaha, "Digital Principles and Applications", Tata McGraw – Hill, 2012.

15AE03 VEHICLE DEVELOPMENT PROCESS

3 0 0 3

VEHICLE DEVELOPMENT PROJECTS: An Overview, Categories of vehicle development projects, Platforms and model lines, The product evolution process (PEP), Vehicle project management, Aspects of international development projects. Cars that topped and cars that flopped, Factors of success in the automotive industry. Phases of the product evolution process: Initial phase, Concept phase, Series development phase, Series support and further development. (9)

VIRTUAL CAR PROCESS: Building virtual cars, Geometric integration, further functional geometry evaluation, Virtual build groups. E/E system development**:** From machinery to E/E systems, Systems engineering processes. (9)

MANAGEMENT PROCESSES FOR COMPLETE VEHICLE DEVELOPMENT: Target management, Design problem management, Release and change management, Quality management. (9)

CUSTOMER RELEVANT COMPLETE VEHICLE CHARACTERISTICS: Registrability, Total vehicle costs, Design appeal, Cabin comfort, Infotainment, Agility, Passive safety, Theft deterrence, Reliability, Sustainability. (10)

SECONDARY COMPLETE VEHICLE CHARACTERISTICS: Production Integration, Service Integration. (8)

Total L: 45

REFERENCES:

1. Weber Julian, "Automotive Development Processes**"**, Springer, 2009.
2. Daniel Sörensen, "The Automotive Development Process", Springer, 2006.
3. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007.
4. Tony Lewin, Ryan Borroff, "How to Design Cars Like a Pro", Motor Books International, 2010.
5. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray, "H-Point: The Fundamentals of Car Design & Packaging", Design Studio Press, 2009.

15AE04 AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS

3 2 0 4

BATTERIES: Lead acid and alkaline batteries, battery rating, battery charging characteristics, battery testing and maintenance, gel battery. (5+3)

IGNITION SYSTEM: Battery, magneto coil ignition system, spark plug types, electronic ignition system-transistor ignition system, capacitor discharge ignition system, distributorless ignition system and solid state ignition system. (7+3)

STARTING AND CHARGING SYSTEM:: Principle and construction of starter motor, working of different starter drive units. DC and AC Generators – principle, construction and working, regulation. (8+6)

SENSORS AND ACTUATORS: Classification of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay. (9+6)

ELECTRONIC ENGINE CONTROLS: Concept of an electronic engine control system, electronic fuel injection - throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics – engine control module and power train control module. (10+6)

LIGHTING SYSTEM: Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Horn, wiper system and trafficator fuses, cables, connectors and selection. Multiplexing and de-multiplexing, Immurements cluster and tell-tales. (6+6)

Total L: 45 + T: 30 = 75

REFERENCES:

1. Robert Bosch, "Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive" Springer Vieweg , Plochingen, Germany, 2014.
2. William B Ribbens, "Understnading Automotive Electronics- An Engineering Persepective", The Boulevard, Langford Lane, Kidlington, Oxford, 2014.
3. Barry Holembeak, "Automotive Electricity and Electronics" Delmar Publishers, Clifton Park, USA, 2010.
4. James D Halderman, "Automotive Electricity and Electronics" Prentice Hall, USA, 2013.
5. Al Santini, "Automotive Electricity and Electronics" Delmar Learning, 2011.

15AE05 AUTOMOTIVE CHASSIS

3 0 0 3

FRAME AND BODY: Introduction, Vehicle classification, frame types-conventional, integral construction – ladder chassis, sub frames, functions and requirements, chassis lay out types, Loads acting on chassis, chassis members selection, frame materials, types of bodies, features of body, body structural requirements ,body structural elements ,design for body bending, design for body torsion, design for crashworthiness, design for vibration, design for vehicle and styling integration, material selection and mass estimation in preliminary design (10)

SUSPENSION SYSTEM: Introduction, Functions, characteristics of good suspension system, suspension spring types-, types of suspension system, dampers, types, telescopic shock absorbers, air suspension,hydroelastic suspension, hydro-pneumatic suspension system, active suspension system. (8)

STEERING SYSTEM: Introduction, Functions and requirements, steering mechanisms, arrangement of steering system, over steer and under steer, steering ratio calculation, steering gear box types, turning radius, centre point steering, stub axle types, Wheel alignment, hydraulic power steering. (8)

BRAKE SYSTEM: Introduction, principle, classifications, requirements, drum brake,disc brake, stopping distance calculations, weight transfer calculations, braking efficiency calculations, mechanical brake ,hydraulic brakes, vacuum servo brakes, air brakes, air assisted hydraulic brakes, introduction to Anti-lock braking system. (8)

ELECTRICAL SYSTEM: Automotive Battery-principle, types, characteristics. Ignition system-battery coil, magneto coil and electronic ignition system. Starting system-starter motor and drive types, Alternator charging system. Lighting system, horn and wiper system. (11)

Total L: 45

REFERENCES:

1. Heinz Heister, "Vehicle and Engine Technology", SAE International, 1999.
2. Robert Bosch, "Automotive Electrics Automotive Electronics", Professional Engineering Publication, 2004.
3. Robert Bosch "Automotive Hand book", 2004.
4. Kenneth Garret T,Kenneth Newton and William Steeds," The Motor Vehicle", Butterworth-Heinemann Limited, 2001.
5. Anthony E S, "Motor Automotive Technology",Delmar Publishers,1998.
6. Donald E M," Fundamentals of Automobile Body Structure Design" SAE International,2011.
7. James E D, "Body Repair Technology for 4-Wheelers", Cengage Learning Yes Dee Publishing Pvt.Ltd,2009.
8. Jack Ejavec "Automotive Engineering Suspension & Steering Systems- Classroom Manual)", Cengage Learning Yes Dee Publishing Pvt. Ltd., 2009.

15AE51 OBJECT COMPUTING AND DATA STRUCTURES LABORATORY

0 0 4 2

LABORATORY COMPONENT:

Object Computing (Using C++):

Implementation of the following problems:

1. Creation of class and objects.
2. Implementation of array of objects and dynamic objects.
3. Simple Arithmetic operations.
4. Implementation of Static members.

5. Implementation of different types of functions.
6. Creation of derived class and implementation of different visibilities and access specifiers.
7. Implementation of virtual classes and virtual functions
8. Overloading operators.
9. Overloading stream operators and creation of user manipulators.
10. Usage of file stream.

Data Structures (Using C or C++):

1. Program using arrays.
2. Representation of Sparse & dense Matrix using arrays.
3. Implementation of Stacks using array.
4. Application of Stack: Conversion of infix to postfix expression
5. Implementation of queue using array.
6. Implementation of Linked Lists: Singly linked, doubly linked and Circular lists and applications.
7. Implementation of various sorting algorithms.

Total P: 60

REFERENCES:

1. Harvey M Deitel,and Paul J Deitel, “C++ How to Program”, Prentice Hall, New Delhi, 2010.
2. Herbert Schildt, “C++ - The Complete Reference", Tata McGraw Hill, New Delhi, 2012.
3. Sahni Sartaj, "Data Structures, Algorithms and Applications in C++", Universities Press, Hyderabad, 2005.
4. Aaron M Tanenbaum, Moshe J Augenstein and Yedidyah Langsam, "Data structures using C and C++", Pearson Education, New Delhi, 2009.
5. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, New Delhi, 2007.
6. Robert L Kruse, Bruce P Leung and Clovin L Tondo, “Data Structures and Program Design in C”, Pearson Education, New Delhi, 2009.

15AE61 INDUSTRIAL VISIT & TECHNICAL SEMINAR

0 0 2 1

The student will make at least four one or half day Industry visits and technical presentations. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

Total P: 30

II SEMESTER

15AE06 AUTOMOTIVE POWERTRAIN

3 0 0 3

ENGINE: Classification, SI and CI engine operation - two stroke and four stroke engines, construction, working principle. Theoretical and actual indicator diagrams, calculation of power, efficiency. Valve and port timing diagram, stages of combustion in SI and CI engine, abnormal combustion, combustion chamber. (12)

FUELS, LUBRICATION AND COOLING SYSTEM: Properties of I.C. engine fuels, fuel injection system- CRDI, MPFI, lubrication system- principle, lubricating system for petrol and diesel engines, oil pump. Cooling system - water cooled engine, air cooled engine. (10)

CLUTCH AND GEAR BOX: Clutches - types, construction, working principle, torque calculation. Gear box - Types, construction, function and design characteristics, gear ratio calculations. Speed and torque characteristics of power transmission system. Gear shifting mechanisms. (10)

PROPELLER SHAFT AND FINAL DRIVE: Propeller shaft - functional and design characteristics, universal joints, slip joint. Rear end torque and driving force. Rear axle types. Differential and final drive - purpose, principle, construction. (10)

WHEELS AND TYRES: Types of wheels and tyres, specification, materials. (3)

Total L: 45

REFERENCES:

1. Giri N K, “Automobile Mechanics”, Khanna Publishers, New Delhi, 2006.
2. William H Crouse & Anglin D L, “Automotive Mechanics”, Tata McGraw Hill Publishing Company, Delhi, 2006.
3. Robert Bosch “Automotive Hand book”, 2011.

4. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Standard Publishers Distributors, Delhi, 2011.
5. Ganesan V, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 2003.

15AE07 DYNAMICS OF ROAD VEHICLES

3 0 0 3

INTRODUCTION: Earth and vehicle coordinate system. Longitudinal, lateral and vertical vehicle dynamics. Dynamic axle loads. Road loads - Aerodynamic forces and moments, viscosity effects, separation and its control; aerodynamic lift and its control, ground effect, styling for minimum drag. Rolling resistance, grade loads. (10)

PERFORMANCE MODE: Acceleration - Free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance, maximum braking force. Vehicle performance. (10)

RIDE MODE: Degrees of freedom-single, two and multi degrees of freedom system, free, forced and damped vibration, model of an automobile, magnification factor, transmissibility, vibration absorbers, pitch and bounce motion, oscillation centers, active and semi active suspension, orthogonality of mode shapes, modal analysis. (7)

SPRING SYSTEM: Requirements, sprung mass and un-sprung mass, wheel hop, shimmy, wheel wobble, choice of suspension spring rate, calculation of effective spring rate. Tyres - mechanics, stability of vehicle on slope, on curve and bankedroad. (6)

HANDLING MODE: Vehicle control-low speed cornering and static steering-Ackerman steering geometry, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer) , roll steer, compliance steer, ride steer, slip angle steer, steady state handling-lateral acceleration gain, characteristic speed, yaw velocity gain, critical speed, effect of brakingon vehicle handling. (12)

Total L: 45

REFERENCES:

1. Thomas D G, “Fundamentals of Vehicle Dynamics”, SAE USA 1992.
2. Rao S S, “Mechanical Vibrations”, Pearson Education Publication, 2009
3. Giri N K, “Automobile Mechanics”, Khanna Publishers, New Delhi, 2006.
4. Cole D E, “Elementary Vehicle Dynamics”, Ann Arbor, Michigan, USA, 1972.
5. Wong J Y, “Theory of Ground Vehicles”, John Wiley & Sons, New York, 1978.

15AE08 AUTOMOTIVE INSTRUMENTATION AND TESTING

3 0 0 3

INSTRUMENTATION: Introduction, characteristics and calibration. (3)

WIND TUNNEL TEST: Test requirements –ground boundary simulation-wind tunnel selection and Reynolds number capability, model requirements, model details, model mounting, test procedure. (2)

RIDE VIBRATION AND BODY TEST: Vibration measurement instrument – accelerometer and signal conditioning, graphical presentation. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage, instrumentation. Vehicle roof strength test – test procedure and test measurements. Door system crush test –procedure and measurements. (7)

FUEL CONSUMPTION TEST: Type I & II, test route selection, vehicle test speeds, cargo weights, driver selection, test data form, calculations. Test on rough terrain, pot holes with laden and unladen conditions. (6)

SUSPENSION AND STABILITY FOR DIRECTIONAL CONTROL: Measurement of dimensional and geometric characteristics, measurement of centre of gravity position, measurement of moments and products of inertia, measurement of suspension kinematic characteristics, measurement of suspension elastic and coulomb friction characteristics, measurement of shock absorber characteristics. (9)

STEERING CONTROL SYSTEM DIRECTIONAL CONTROL TEST: Analysis of constant radius test, constant steer angle test, constant speed variable radius test, constant speed variable steer angle test, response gain test. (5)

WHEELS AND BRAKING PERFORMANCE TEST: Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria**.** Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test. (9)

ENERGY CONSUMPTION TEST: Engine cooling fan, air conditioning and brake compressors, hydraulic pumps power consumption. Antilock brake systems energy consumption. (4)

Total L: 45

REFERENCES:

1. Crouse W H and Anglin D L., "Automotive Mechanics"' Tata McGraw Hill Publishing Company, 2004.
2. Rangan, Mani and Sharma, "Instrumentation", Tata McGraw Hill Publishers, New Delhi, 2004.
3. SAE Hand book, Vol. 3, SAE Publications, 2000.
4. Stockel M W, "Auto Mechanics Fundamentals", Good Heart-Wilcox Co., Inc., 2000.
5. Jain R K "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
6. Tim Gilles, "Automotive Service"' Delmar Publishers, 1998.
7. Beckwith TG and Buck N L, "Mechanical Measurements", Addition Wesley Publishing Company Limited, 1995.

15AE09 ELECTRONIC ENGINE MANAGEMENT SYSTEM

3 0 0 3

INTRODUCTION: Combustion flame and pressure sensing, Ignition timing, variable valve timing, variable lift control, fuel quantity, action of governor control systems, on-board diagnostics, exhaust gas recirculation, variable displacement engine. (9)

SENSORS AND ACTUATORS: Mass air flow (MAF), exhaust gas oxygen, throttle plate angular position, crankshaft angular position/rpm, coolant temperature, intake air temperature, manifold absolute pressure (MAP), differential exhaust gas pressure, vehicle speed, pickups sensors, exhaust gas recirculation sensors, electric fuel pump motor characteristics, piezoelectric stack injectors and solenoids for injection systems. (9)

ELECTRONIC DIESEL CONTROL: Comparison indirect and direct injection- mechanical and hydraulic actuated EDC - In-line fuel-injection pumps, helix and port controlled axial piston distributor, solenoid valve control, unit injectors, common rail systems, data processing, lambda closed loop control, torque controlled EDC systems, control and triggering of actuators. (9)

ELECTRONIC GASOLINE CONTROL: Battery ignition system-open loop and closed loop systems, mono point, multi point, gasoline direct injection systems, air assisted systems, principles and features of Bosch jetronic systems, idle speed, knock and spark timing control, magnetostrictive ignition, capacitor discharge ignition, solid state and transistor ignition , distributor less ignition. (9)

DIGITAL ENGINE CONTROL SYSTEM: Control modes for fuel control, engine crank, engine warm-up, look-up table volumetric efficiency, intake density and EGR volume flow rate, acceleration enrichment, deceleration leaning, Idle speed control, closed-Loop ignition timing, spark advance correction scheme, integrated engine control system, system diagnosis, fuel injection timing, speed density and fuel calculations, dwell calculation, injection duration calculation, diagnosing engine management system faults. (9)

Total L: 45

REFERENCES:

1. Ronald K J, "Automotive Electronics Handbook", McGraw Hill Book Co, 1999.
2. William B R, "Understanding Automotive Electronics", SAE Publications 2004.
3. Robert Bosch, "Diesel Engine management" Bentley Publishers, Cambridge, 2004.
4. Robert Bosch, "Gasoline Engine management" Bentley Publishers, Cambridge, 2004.
5. Tom Denton, "Automotive Electrical and Electronic Systems", Edward Arnold, 2009.
6. Robert N B, "Automotive Computers and Digital Instrumentation", Prentice Hall, 2004.
7. Alan W M B, "Vehicle Electronic Systems and Fault Diagnostics", STS Press.

15AE10 DESIGN OF AUTOMOTIVE SYSTEMS

3 0 0 3

INTRODUCTION: Fundamentals of designing automobiles, general layout of the automobile, types of chassis layout, various types of frames, constructional details, materials, unitized frame body construction. (9)

ENGINE COMPONENTS: Choice of material for various engine components, design of cylinder, design of piston assembly, design of connecting rod, design of crankshaft under bending and twisting, balancing weight calculations, design of valves, valve springs and design of flywheel. (9)

CLUTCHES and BRAKES: Introduction-design diagrams of clutch, calculation of critical parameters of clutches, design calculation of standard elements of friction clutches. Pressure distribution along shoe length, determining braking torque, design of drum brakes-internally expanding brakes, design of disc brakes. (9)

TRANSMISSION SYSTEMS: Determining main parameters of transmission, differential, axle shafts, gear box, design of universal joint and propeller shaft, location determination of universal joint and propeller shaft. (9)

SUSPENSION, STEERING SYSTEM AND ELECTRONICS: Oscillation and smoothness of ride, fundamentals of designing and

calculating steering control linkage, steering gears, hydraulic booster. Sensors in automobiles, engine management system. (9)

Total L: 45

REFERENCES:

1. Lukin P G G and Rodionov V, “Automobile Chassis Design and Calculations”, Mir Publishers, Moscow, 1989.
2. Heinz Heisler, “Vehicle and Engine Technology”, SAE, New York, 1999.
3. Gillespie T D, “Fundamentals of Vehicle Dynamics”, SAE, New York, 1992.
4. Schwaller A E, “Motor Automotive Technology”, Delman Publishers, New York.
5. Steed W, “Mechanics of Road Vehicles” Illiffe Books Ltd., London,1960.
6. Giles J G, “Steering, Suspension and Tyres”, Iiiffe Book Co., London- 1988.

15AE52 AUTOMOTIVE COMPUTER AIDED ENGINEERING LABORATORY

0 0 4 2

1. Modeling of Automotive Component and Assemblies
2. Analysis of Automotive Component and Assemblies
3. Simulation of Automotive Component and Assemblies

Automotive Component and Assemblies
1. Engine Components
2. Cooling System
3. Power train
4. Steering System
5. Brake System
6. Suspension System
7. Chassis Frame
8. Aerodynamic forces
9. Structural analysis
10. Safety Analysis

Total P: 60

REFERENCE:

1. Manual prepared by Department the of Automobile Engineering, 2015.

III SEMESTER

15AE71 PROJECT WORK I

0 0 6 3

- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalisation of system requirements and specification
- Proposing different solutions for the problems based on literature survey
- Future trends in providing alternate solutions
- Consolidated report preparation of the above

Total P: 90

IV SEMESTER

15AE72 PROJECT WORK II

0 0 28 14

The project work involves the following:
- Preparing a project brief proposal including
  - Problem identification
  - A statement of system / process specification proposed to be developed (Block diagram / concept tree)
  - List of possible solutions including alternative and constraints
  - Cost benefit analysis
  - Time Line of activities
- A report highlighting the design finalization (based on functional requirements & standards (if any))
- A presentation including the following:
  - Implementation Phase (Hardware / Software / both)

- Testing & Validation of the developed system
- Learning in the Project

▪ Consolidated project report preparation

Total P: 420

ELECTIVE THEORY COURSES

15AE21 AUTOMOTIVE ELECTRONICS

3 2 0 4

INTRODUCTION: Embedded Systems Definition - Components of embedded systems - Hardware Module - Microprocessor, microcontrollers, on-chip peripherals - Program memory(PM), Data memory (DM), parallel port structures, timer, input capture & output compare units, ADC, PWM. (8+3)

EMBEDDED RTOS: Comparison of conventional OS with RTOS. Tasks & task states (Pre-emptive & Non-pre-emptive, scheduler, interrupt – Interrupt latency and context switch latency) – Task, multi-tasking, task synchronization, inter-task communication, shared data problem and its prevention - Features of a typical embedded RTOS (µC/OS-II). (8+3)

INTEGRATED SYSTEMS: Introduction to an embedded board, Software module - IDE- Getting Started - Creating new project, creating new files, adding files to project, compile, build, debug and simulation of a project. Embedded system programming - Up-loaders, ISP, ROM emulators, in-circuit emulators. Debug Interfaces - BDM and JTAG. (8+3)

COMMUNICATION PROTOCOLS: Introduction to control networking – Communication protocols in embedded systems – SPI, I2C, USB. Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000. (6+2)

AUTOMOTIVE APPLICATIONS: Engine management systems – Gasoline / diesel systems, Various sensors used in system – Electronic transmission control vehicle safety system – Electronic control of braking and traction. (7+2)

ADVANCED APPLICATIONS: Body electronics – Infotainment systems – Navigation systems – System level tests – Software calibration using engine and vehicle dynamometers – Environmental tests for electronic control unit - Application of Control elements and control methodology in automotive System. (8+2)

Total L: 45 + T: 15 = 60

REFERENCES:

1. Denton T , “Automobile Electrical and Electronic Systems”, Elsevier Jordan Hill, Oxford, 2010.
2. BOSCH Automotive Handbook, Bentley Publications, Massachusetts Avenue, London, 2010.
3. Knowles D, “Automotive Electronic and Computer Controlled Lgnition Systems”, Prentice Hall Publications, New Jersey, 2009.
4. Joerg Schaeuffele and Thomas Zurawka, “Automotive Software Engineering – Principles, Processes, Methods and Tools”, SAE. International Publication, 2005.
5. Ronald K J, “Automotive Electronics Handbook”, McGraw Hill Publications, Columbus, 2009.
6. Nicholas Navit, “Automotive Embedded System Handbook”, CRC Press Publications, New Delhi, 2008.

15AE22 MODELING OF DYNAMIC SYSTEMS

3 0 0 3

MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Introduction to control systems, differential equations of physical systems, dynamics of robotic mechanisms, transfer functions, block diagram algebra, signal flow graphs. (7)

FEEDBACK CHARACTERISTICS OF CONTROL SYSTEMS AND COMPONENTS: Feedback and non-feedback systems, reduction of parameter variations, control over system dynamics, control of the effects of disturbance signals, linearizing effect, regenerative feedback ,Linear approximation of non-linear systems, stepper motors, hydraulic systems, pneumatic systems. (9)

TIME RESPONSE ANALYSIS AND STABILITY IN TIME DOMAIN: Standard test signals, time response of first-order systems, time response of second-order systems, steady-state errors and error constants, effect of adding a zero to a system, design specifications of second-order systems, design considerations for higher-order system, performance indices, robotic control systems, state variable analysis, approximation of higher-order systems by lower order systems, concept of stability, necessary conditions, Routh stability criterion, relative stability analysis . (9)

FREQUENCY RESPONSE ANALYSIS AND STABILITY IN FREQUENCY DOMAIN: Correlation between time and frequency response, polar plots, bode plots, all-pass and minimum-phase systems, experimental determination of transfer functions, log-magnitude versus phase plots, Nyquist stability criterion, assessment of relative stability, closed loop frequency response, sensitivity analysis. (9)

INTRODUCTION TO DESIGN: Preliminary considerations, realization of basic compensators, cascade compensation in time domain and frequency domain, feedback compensation, robust control system design. (5)

STATE VARIABLE ANALYSIS AND DESIGN: Concepts of state, state variables and state model, state models for linear-continuous-time systems, state variables and linear discrete-time systems, solutions of state equations, concepts of controllability and observability, pole placement by state feedback. (6)

Total L: 45

REFERENCES:

1. Nagrath I J and Gopal M, “Control Systems Engineering”, New Age International Publishers, 2012.
2. Okata K, “Modern Control Engineering”, Pearson/Prentice Hall of India Pvt. Ltd., New Delhi, 2012.
3. Gopal M, "Control Systems – Principles and Design", Tata McGraw Hill Co. Ltd., 2011.
4. Norman S Nise, “Control System Engineering”, John Wiley and Sons Inc., 2013.
5. Stanislaw H Zak, “Systems and Control”, Oxford University Press Inc., 2010.

15AE23 AUTOMOTIVE INFOTRONICS

3 0 0 3

INTRODUCTION: Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance and vehicle monitoring. (9)

TELEMATICS: Global positioning system, geographical information systems, navigation system, architecture, automotive vision system and road recognition. (9)

SAFETY SYSTEMS: Active and passive safety, airbags, seat belt tightening system, forward collision warning systems, child lock, anti lock braking systems, EBD, ESP, traction control system and lane departure warning system. (9)

COMFORT SYSTEMS: Adaptive cruise control system, active suspension system, power steering, collapsible and tiltable steering column and power windows, Adaptive lighting system. (9)

SECURITY SYSTEMS: Anti theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system and number plate coding. (9)

Total L: 45

REFERENCES:

1. Ljubo Vlacic, Michel Parent and Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001.
2. Robert Bosch, “Automotive Hand Book”, SAE, 2000.
3. Ronald K Jurgen, “Navigation and Intelligent Transportation Systems – Progress in Technology”, Automotive Electronics Series, SAE, USA, 1998.
4. William B R, “Understanding Automotive Electronics”, Butter worth Heinemann Woburn, 1998.
5. Bechhold, “Understanding Automotive Electronics”, SAE, 1998.
6. Allan W M B, “Automotive Computer Controlled Systems”, Elsevier Butterworth-Heinemann ,2011.

15AE24 AUTOMOTIVE ERGONOMICS AND SAFETY

3 0 0 3

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human – machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling. (6)

INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, displays, speech communications. (3)

BIOMECHANICS : Biostatic mechanics, statics of rigid bodies, upper extremity of hand, lower extremity and foot, bending, lifting and carrying, biodynamic mechanics, human body kinematics, kinetics, impact and collision. (4)

BIOTHERMODYNAMICS AND BIOENERGITICS: Bio-thermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress. (5)

VEHICLE ERGONOMICS: Introduction, seating dimensions, interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. (10)

ENVIRONMENTAL CONDITIONS: Illumination, heat ventilation and air conditioning, noise, motion, speed and acceleration, sound, vibration. (7)

HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments. (5)

SAFETY: Seat belt, air bag, collapsible steering, warning systems, ABS braking system, collision safety systems, global safety standards in automotive applications. (5)

Total L: 45

REFERENCES:

1. Bridger R S, "Introduction to Ergonomics", Taylor and Francis, London, 2003.
2. Chandler Allen Phillips, "Human Factors Engineering", John Wiley & Sons, New York, 2000.
3. Martin Helandar, "A Guide to Ergonomics of Manufacturing", Taylor and Francis, 1996.
4. Mark S S, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.
5. John Fenton, "Hand Book of Automotive Power Train and Chassis Design", SAE, 1998.

15AE25 MECHATRONICS SYSTEM DESIGN

3 0 0 3

MODELING AND SIMULATION: Definition, Key elements, mechatronics approach for Design process, analogy approach of modeling, block diagram approach of modeling, simulation, software and hardware in loop simulation. (3)

SENSORS AND TRANSDUCERS: Sensors for motion and position measurement, force, torque, tactile, temperature sensors, ultrasonic sensors, magnetostrictive sensors. (4)

ACTUATORS FOR MECHATRONICS SYSTEM: Types of actuators and their working principles, control valves, direction, pressure and flow, comparison of hydraulic, pneumatic and electrical actuators, proportional pressure and flow valves. (5)

AUTOMATION SYSTEM DESIGN: Pneumatic elements, proportional pressure and flow control valves, electro pneumatic system, circuit design, examples, hydraulic elements, electro hydraulic system, circuit design, examples, cascade and Karnaugh Veitch Map methods. (9)

CONTROL SYSTEMS: Sequence control and programmable controllers, logic control and sequencing elements, ladder diagram, PLC, Programming the PLC. (6)

REAL TIME INTERFACING: Introduction of data acquisition and control system, overview of I/O process, interfacing of various sensors, Stepper Motor with PC, Virtual instrumentation. (7)

ADVANCED APPLICATIONS: Sensors for condition monitoring, mechatronic control in automated manufacturing, microsensors, case studies. (4)

MECHANICAL SYSTEMS AND DESIGN: Traditional Vs mechatronics approach – integrated product design. Mechanisms – load conditions, design, flexibility, modeling and simulation. Structures – load conditions, environmental isolation, modeling. Man-machine interface –industrial design and ergonomics, information transfer, safety. Bond Graph Technique, case studies of Mechatronics systems. (7)

Total L: 45

REFERENCES:

1. Sanjay Gupta and Joseoh John, "Virtual Instrumentation using Lab VIEW", Tata McGraw Hill, 2005.
2. HMT, "Mechatronics", Tata McGraw Hill publishing company, NewDelhi,2003.
3. Devdas shetty and Richard A K, "Mechatronics System Design", PWS Publishing Company, USA, 2005
4. Sabrie soloman, "Sensors and Control Systems in Manufacturing", McGraw Hill, 2006.
5. Bradley D A, Dawson.D, Buru N C and Loader.A.J., "Mechatronics", Chapman and Hall, 2003
6. Peter Rohner and Gordron Smith, "Pneumatic Control for Industrial Automation", John Wiley and Sons, 2007.

15AE26 AUTOMOTIVE EMBEDDED SYSTEMS

3 0 0 3

INTRODUCTION: Challenges, Requirements, Specifications, Processor embedded into a system, Embedded hardware units and devices, Embedded software, Design process, Classification. (7)

MICROCONTROLLER: Architecture, Registers, Addressing modes, Interrupts, Port structure, Timer blocks and applications, Temperature control and stepper motor speed control, Automotive microcontrollers-an overview. (8)

INTERFACING: Basic concepts of I/O, I/O mapping and memory mapping, port structure, Interrupts, multiple interrupt processing. Applications-seven segment display interface, keyboard interface, Introduction to RISC, CISC. (7)

SOFTWARE DEVELOPMENT AND DEBUGGING: Introduction to assembler, Compiler, Cross-compiler, Linker, Integrated development environment, Debugging strategies, Simulators, Emulators, Logic analyzers. (8)

IDE ENVIRONMENT: Introduction to integrated development environment (IDE), creating new project, creating new file, adding files to project, options for target, compile and building project, simulation and debugging, set breakpoints, monitor on-chip peripherals using simulators, study of example programs. (7)

INTELLIGENT AUTOMOTIVE SYSTEMS: Vision system - Driver assistance in highway, urban traffic and object recognition, Radio communication system, GPS, Adaptive cruise control. Adaptive lighting system, Vehicle to vehicle communication. Automotive wiper systems. (8)

Total L: 45

REFERENCES:

1. Ljubo Vlacic, Michel Parent and Furnio Harshima, “Intelligent Vehicle Technologies: Theory and Applications”, Butterworth-Heinemann publications, 2001.
2. Navet and Francoise Simonot-Lion, “Automotive Embedded Systems Handbook”, CRC Press, USA, 2008
3. David E S, “An Embedded Software Primer”, Pearson Education, New Delhi, 2009.
4. Sriram V I and Pankaj Gupta, “Embedded Real-Time Systems Programming”, Tata McGraw Hill, New Delhi, 2011.
5. Rajkamal, “Embedded Systems”, Tata McGraw Hill, New Delhi, 2010.

15AE31 SIMULATION OF IC ENGINES

3 0 0 3

INTRODUCTION: Simulation, advantages of computer simulation, step – by – step approach, reactive processes, heat of reaction, measurement of U_{RP}, measurement of H_{RP}.. (5)

COMBUSTION STOICHIOMETRY: Combustion equation for hydrocarbon fuels – minimum air required for combustion – excess air supplied, conversion of volumetric analysis to mass analysis. (8)

ADIABATIC FLAME TEMPERATURE: Complete combustion C/H/N/O/ systems, constant – volume adiabatic combustion, constant – pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. (10)

SIMULATION: SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions. (11)

SIMULATION OF NEW ENGINE CONCEPTS: Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine. (11)

Total L: 45

REFERENCES:

1. Ganesan V, “Computer Simulation of spark ignition engine process“, Universities Press (I) Ltd, Hyderabad, 2001.
2. Ferguson C R, Kirkpatrick A T, “Internal Combustion Engines- Applied Thermosciences”, Wiley, New York, 2001.
3. Ganesan V, “Computer Simulation of compression ignition engine process”, University Press (I) Ltd, Hyderabad, 1996.
4. Ramoss A L, "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
5. Ashley Campbell, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.

15AE32 FINITE ELEMENT ANALYSIS FOR AUTOMOTIVE ENGINEERS

3 0 0 3

INTRODUCTION: Historical background, Concept of finite element method, boundary, initial and eigen value problems, Finite element formulation starting from governing differential equations – Weighted residual method, Finite element formulation based on stationary of a functional. Review of static analysis using 1D elements. (8)

STATIC ANALYSIS USING 2D AND 3D ELEMENTS: Triangular and quadrilateral elements, Isoparametric formulation, problems using 2D elements, shape functions for axisymmetric and 3D elements, shape functions for higher order elements. Introduction to plates and shells. (9)

DYNAMIC ANALYSIS: Equations of motion for dynamic problems. Consistent and lumped mass matrices. Formulation of element mass matrices. Free vibration problem formulation, Solution of Eigen value problems using 1D elements, Time dependent one-dimensional bar analysis. (8)

HEAT TRANSFER ANALYSIS: Basic differential equations of heat transfer, one dimensional and two dimensional finite element formulation using variational and Galerkin's method, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples, transient thermal analysis. (10)

NON-LINEAR ANALYSIS: Introduction, Non-linear differential equation, Solution procedures for non-linear problems, Linearization and directional derivative, Material non-linearity-analysis of axially loaded bars, Geometric non-linearity-Basic continuum mechanics concepts, Governing differential equations and weak forms, Introduction to contact problems. (10)

Total L: 45

REFERENCES:

1. Logan D L, "A First Course in the Finite Element Method", Thomson Learning, 2007.
2. Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Pearson Education, New Delhi, 2007.
3. Rao S S, "The Finite Element Method in Engineering", Elsevier, 2005.
4. Rene De Borst, Mike Crisfield, Joris Remmers, Clemens Verhoosel, Nonlinear Finite Element Analysis of Solids and Structures, Wiley, 2012
5. Rajasekaran S, "Finite Element Analysis in Engineering Design", S Chand, 2008.

15AE33 SKETCHING AND GEOMETRIC MODELING FOR AUTOMOTIVE STYLING

3 0 0 3

INTRODUCTION: Drawing in product design, drawing by hand, drawing by computer, mass production, geometric versus naturalistic drawing, modernist design. Basic drawing skills - Perspectives, metric projections, spherical projections, orthographic projections, sections and scrap views. (9)

COMPUTER SYSTEMS: The computer processor, system software, the central processing unit, memory, frame buffers, display, input devices, hardcopy output, 3D output devices, networking, healthy and safety. Concept design - Satisfying the client, sketch, schematic, evaluating the design, 3D modeling concepts, hybrid approach, commercial computer solutions, drawing in space, creating organic forms. (9)

PRESENTATION DRAWING AND VISUALS: From watercolor washes to markers, painting by numbers, the art of design, visual tricks, making marker drawing, 2D computer programs: paint and vector, 3D computer aided styling (CAS), creating virtual reality, shading a computer model, ray tracing and radiosity, adding texture, fractals and commercial modelers. (9)

FROM GENERAL ARRANGEMENTS DRAWING TO PRODUCTION: Technical production documentation, the general arrangement drawing, drafting standards, computer aided drafting, geometric constructions, controlling curves, parametric design, CAD data - Exchange standards and all change in the CAD market. (9)

TECHNICAL ILLUSTRATION: Art of technical illustration, techniques of technical illustration, thick and thin lines, sections, cutaways and ghosting, photo-tracing, annotation and labeling, computer aided illustration, interactive technical illustration and commercial solutions. (9)

Total L: 45

REFERENCES:

1. Alan Pipes, "Drawing for Designers", Laurence King Publishing, 2007.
2. Erik Olofsson, Klara Sjölén, "Design Sketching", Keeos Design Books AB, 2005.
3. Tony Lewin, Ryan Borroff, "How to Design Cars Like a Pro", Motor Books International, 2010.
4. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray, "H-Point: The Fundamentals of Car Design & Packaging", Design Studio Press, 2009.
5. Thom Taylor, "How to Draw Cars Like a Pro", Motor Books International, 2006.

15AE34 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

INTRODUCTION: Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types. (7)

DISCRETISATION: Finite difference method - forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods. (10)

GRID GENERATION: Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements, adaptive grids. (8)

CFD TECHNIQUES: Lax - Wendroff technique - MacCormack's technique, relaxation technique. Artificial viscosity, ADI technique, Pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting. (10)

TURBULENCE MODELING: Turbulence energy equation- one-equation model, the k-ω model, the k- ε model. Practical problem solving using CFD packages. (10)

Total L: 45

REFERENCES:

1. Muralidhar K and Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
2. Chung T J, "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
3. Versteeg H K and Malalasekara W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method', Longman, 1995.
4. John D A, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 1995.
5. David C W, "Turbulence Modeling for CFD", DCW Industries, 1993.

15AE35 AUTOMATIC TRANSMISSION

3 0 0 3

CONCEPT: Principles of automatic transmission, advantages, limitations, types - Mechanical, hydrodynamic, hydro mechanical, hydro static and electric. (2)

MECHANICAL: Principle of centrifugal clutches, comparison between conventional and centrifugal clutches, centrifugal clutches used in two wheelers, over drives – Principle, operation, types, advantages and limitations. (7)

HYDRODYNAMIC DRIVES: Principle of fluid coupling, construction, operation and characteristics, fluid coupling with conventional gear boxes. Introduction to torque converters, comparison between fluid coupling and torque converters, performance characteristics, slip, principles of torque multiplication, types of torque converters. (9)

HYDRO-MECHANICAL DRIVES: Major components, principle of planetary gear trains, actuating mechanism, controls system – Types - Manual, governor, throttle and hydraulic control systems. Principle of automatic gear shifting. Positive displacement pumps, automatic variable displacement pump. Typical automatic transmissions. (9)

HYDROSTATIC DRIVES: Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pump and constant displacement motor, variable displacement pump and constant displacement motor, constant displacement pump and variable displacement motor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor, advantages and limitations, typical hydrostatic drives. (9)
ELECTRIC DRIVES: Early Ward Leonard control system - Main features, generator, merits, reverse motion, modified Ward Leonard control system - Main features, modifications. Modern electric drives - Main features, performance characteristics, advantages and limitations. (9)

Total L: 45

REFERENCES:

1. Jack Erjavec, "Automatic Transmissions", Cengage Learning Yes Dee Publishing Pvt. Ltd, 2009.
2. Heinz Heisler, "Advanced Vehicle Technology", SAE, 2002.
3. Theraja B L, "Fundamentals of Electrical Engineering and Electronics", S Chand & Company Ltd, 2009.
4. Mathias F B, "Automatic Transmission", Prentice Hall, 1998.
5. John J P and Tyler G H, "Industrial Hydraulics", MGH Published, 1980.

15AE36 DESIGN FOR MANUFACTURING AND ASSEMBLY

3 2 0 4

PROCESS CAPABILITY AND TOLERANCES: Geometric tolerances: applications, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard, surface finish, review of relationship between attainable tolerance grades and different machining processes. Process capability, mean, process capability metrics, Cp, Cpk, cost aspects. Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions, Statistical tolerance indication in mechanical drawings population parameter zone in the μ, σ plane defined using C_p, C_{pk}. (5)

TOLERANCE STACK UP ANALYSIS: Dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method, equivalent influence method. (3)

SELECTIVE ASSEMBLY: Interchangeable part manufacture and selective assembly. Deciding the number of groups- Model-I: Group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal. Control of axial play - introducing secondary machining operations, laminated shims, selective assembly, examples. (6)

DATUM SYSTEMS AND FIXTURE DESIGN: Degrees of freedom, grouped datum systems - different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with

spigot and recess pair and tongue - slot pair - computation of translational and rotational accuracy, geometric analysis and applications. (5)

TRUE POSITION THEORY: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, compound assembly. (6)

FUNCTIONAL INSPECTION TECHNIQUES: Functional inspection techniques using CMM, optical comparators and paper layout gauging, gauge repeatability and reproducibility (GR & R) calculations. (2)

FORM DESIGN OF CASTINGS, WELDMENTS AND SHEET METAL COMPONENTS: Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, form design aspects of sheet metal components. (5)

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. (7)

REDESIGN FOR MANUFACTURE: Design features to facilitate machining: datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples. (4)

DESIGN FOR THE ENVIRONMENT: Introduction-environmental objectives-global issues-regional and local issues-basic DFE methods-design guidelines-example application. (2)

DFMA TOOLS: Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, poka-yoke, lean principles, six sigma concepts, DFMA as the tool for concurrent engineering, three DFMA criteria for retaining components for redesign of a product; design for manual assembly; design for automatic assembly; computer-aided design for assembly using software. (Self study)

TUTORIAL COMPONENT:

1. Process Capability study of shaft manufacturing – Calculation of C_p and C_{pk}
2. Tolerance stack up analysis on a mechanical assembly – Estimation of critical dimension in a pump assembly using sure fit law and normal law.
3. Control of radial play in an assembly of bush and pin using the principles of Selective Assembly – Grouping of bushes and pins.
4. Control of axial play in a mechanical assembly using the principles of Selective Assembly – Grouping of gaps and washers, choosing the right washer for a given assembly.
5. Experimental determination of location accuracies of a datum system and comparing with the theoretical results.
6. Experiment using Floating and Fixed fastener assemblies.
7. Inspection of components using plug, ring and functional gauges.
8. Preparation of Operation Sequence of engineering components like shafts and Identification of functional and manufacturing datum on them.
9. Centrality analysis on a prismatic component using Vernier Calipers

Total L: 45 + T: 30 = 75

REFERENCES:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
2. Matousek, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London, 1974.
3. Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., 1983.
4. Oliver R W, "Tolerance Control in Design and Manufacturing" Industrial Press Inc., New York, 1967.
5. Boothroyd G, Dewhurst P and Knight W, “Product Design for Manufacture and Assembly”, Marcell Dekker.
6. Graedel Tand Allen by B, “Design for the Environment Angle Wood Cliff”, Prentice Hall, Reason Publications, 1996.

15AE37 AUTOMOTIVE MATERIALS

3 0 0 3

INTRODUCTION: Metals, ceramics, glasses, elastomers, polymers, composites, smart materials, members of each class, MEMS, nano science materials, and shape memory alloys. Properties of engineering materials - mechanical, thermal, wear, corrosion / oxidation. Materials for automobile industry – auto body, engine components and other accessories. Materials for intelligent system. (9)

FERROUS ALLOYS: Iron carbon phase diagram. Steels – effects of alloying elements, types of steels, composition, structure and properties. Cast Iron – effects of alloying elements, types of cast iron, properties, structures, compositions and applications. Castability, formability, machinability, hardenability and weldability of the ferrous materials. Stainless steels, high temperature steels and super alloys.

(10)

NON FERROUS ALLOYS: Alloys of copper, aluminium, nickel, magnesium, titanium, lead, tin, zinc - compositions, heat treatments, structures, properties, applications, castability, formability, machinability, hardenability and weldability. (7)

COMPOSITES: Types of composites, volume fraction - lamellar composites production and properties of whiskers of silicon carbide, graphite, fibres of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibres applications. (7)

MATERIAL PROPERTY CHARTS AND MATERIAL SELECTION: Modulus - density, strength – density, modulus – strength, specific stiffness and specific strength, fracture toughness, modulus fracture etc. Selection strategy, property limits and material indices, function objectives and constraints, performance maximizing criteria. Shape factors, elastic extrusion, elastic body and twisting, failure, bending and twisting, axial loading and column buckling, efficiency of standard sections, material limits for shape factors, microscopic shape and shape factors. . (12)

Total L: 45

REFERENCES:

1. Michael F Ashby, “Materials Selection in Mechanical Design”, Butterworth Heinemann, 2005.
2. Myer Kutz, “Handbook of Materials Selection” , John Wiley and Sons, New York, 2002.
3. Daniel Yesudian C, “Materials Science and Metallurgy”, Scitech Publications (India), 2004.
4. Van Vlack L H, "Elements of Materials Science and Engineering", Addison wesley, New York, 1991.
5. Guy A G, “Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990.

15AE41 ELECTRIC AND HYBRID VEHICLES

3 0 0 3

ELECTRIC VEHICLES: Electric vehicle layout, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system, safety and challenges in electric vehicles. (9)

HYBRID VEHICLES: Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drivetrain, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles. (9)

ELECTRIC PROPULSION SYSTEMS: DC motors, AC motors, permanent magnet motors, brushless DC and reluctance motors, characteristics and regenerative braking. (9)

MOTOR CONTROLLERS AND CONTROL SYSTEMS: Control system principles, speed and torque control –DC motors and AC motors. (9)

ENERGY STORAGE DEVICES: Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency and ultra-capacitors. (9)

Total L: 45

REFERENCES:

1. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, 2012.
2. Seref Soylu “Electric Vehicles - The Benefits and Barriers”, InTech Publishers, Croatia, 2011.
3. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, New York, 2011.
4. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007
5. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.
6. Seth Leitman, “Build Your Own Electric Vehicle” MC Graw hill, NewYork, USA 2013.

15AE42 ELECTRIC DRIVES AND CONTROLS FOR ELECTRIC DRIVE VEHICLES

3 0 0 3

MOTOR AND DEVICE CHARACTERISTICS: Review of motor principles, motor load dynamics, starting, braking & speed control of dc and ac motors- power semiconductor SCRs, IGBTs and MOSFETs (9)

ELECTRIC DRIVE CONCEPTS: Basic drive, choice of electric drives, advantages, nature and classification of drives, control and stability of electric drives, feed back control of drives, thermal effects in electrical machines, selection of motor and rating. (9)

DC DRIVES: Transient analysis of separately excited dc motors, converter - single phase uncontrolled, half and fully controlled rectifiers, chopper control, closed loop control of solid state DC drives. (9)

AC DRIVES: Operation of induction and induction motor, direct torque and flux control of induction motor drives, starting methods and speed control of single phase induction motors, self controlled synchronous motor drive, selection of motor and rating vector control of synchronous motor. (9)

DRIVES FOR SPECIAL ELECTRICAL MACHINES: Drives for variable reluctance motors, microprocessor/ microcontroller –gate trigger signal generation applications to special electrical machines**,** switched reluctance motor drives, brushless DC motor drives, permanent magnet drives. (9)

Total L: 45

REFERENCES:

1. Gopal K D, "Fundamentals of Electric Drives", Narosa Publishing House Pvt. Ltd., 2011.
2. Pillai S K, "A first course on Electrical Drives", Wiley Eastern Ltd, Bombay 2011.
3. Ali Elamadi, "Handbook Automotive Power Electronics and Drives", CRC publishers, 2012.
4. Bimal K Bose, "Modern Power Electronics and Drives", Elsevier publishers, Butterworth Hinnemann, 2012.
5. Krishnan R, "Permanent Magnet synchronous and Brushless DC Motor Drives", CRC Publishers, 2010.
6. Krishnan R, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Applications", CRCPublishers, 2012.

15AE43 ALTERNATIVE FUELS AND TECHNOLOGIES

3 0 0 3

GASEOUS FUELS: Properties, composition, production, storage, engine modifications, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of CNG, HCNG, LPG and hydrogen. (9)

ALCOHOL FUELS: Properties, composition, production, storage, engine modifications, blends, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of methanol ethanol, butanol, DME and DEE. (9)

BIO-FUELS: Properties, composition, production, engine modifications, treatment, blends, performance and emission characteristics, advantages and disadvantages of straight vegetable oils, bio-diesel and biogas. (9)

SOLAR TECHNOLOGY: Fundamentals of solar energy conversion, solar cells, optical engineering, photoelectrochemical cells, thermoelectric generators, energy storage, distribution systems, design of solar panels for automobiles and cost analysis. (9)

FUEL CELL TECHNOLOGY: Fuel cell thermodynamics, operating principle, fuel cell technologies, fuel cell performance characteristics, fuel reforming and fuel cells for automotive applications. (9)

Total L: 45

REFERENCES:

1. Thipse S S, "Alternate Fuels – Concepts, Technologies and Developments", Jaico Publishing House, New Delhi, 2010.
2. Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007.
3. Fuel Cells for automotive applications – professional engineering publishing, UK, 2004.
4. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005.
5. Matthew M M, "Fuel Cell Engines", John Wiley & Sons, Inc., New Jersey, 2008.

15AE46 EMISSION, NOISE, VIBRATION AND HARSHNESS CONTROL

3 0 0 3

EMISSIONS FROM SI AND CI ENGINES: Emission formation in SI and CI engines – factors influencing emission, effect of pollution on environment and human health. Emission norms - EURO & Bharat norms, emission test cycles - Effect of fuel properties and additives on emissions, use of alternate fuels. (9)

EMISSION MEASUREMENT: NDIR analyzer, flame ionization detectors, chemiliuminescent analyzer, smoke meters, gas chromatograph. (5)

EMISSION CONTROL TECHNIQUES: Crank case emission control, fuel evaporation & control, EGR, intake temp control, catalytic converters. Particulate traps. (7)

NOISE AND NOISE CONTROL: Sound wave –properties, propagation, noise measuring instruments, control of air borne noise - use of noise absorber, barrier, different materials, criteria for the selection of materials, control of in cabin noise- damping materials for hood liner and head liner, evaluation of natural frequencies of critical members, resonance, ill effects of resonance. sound isolation- machine enclosures, silencers and mufflers. (12)

VIBRATION MEASUREMENT AND CONTROL: Measurement of vibration, FFT analyzer. Methods of vibration control -excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials-viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitative treatment only), untuned viscous damper, vibration isolation. (12)

Total L: 45

REFERENCES:

1. Barry Hollembeak, “Automotive Technology (Fuels and Emissions)”, Cengage Learning Yes Dee Publishing Pvt. Ltd, 2011.
2. John Fenton, “Handbook of Automotive Power Train and Chassis Design”, Sae 1998.
3. Rao S S, "Mechanical Vibrations", Addison Wesley Longman, New Delhi, 1995.
4. Heinz Heisler, “Advanced Engine Technology”, SAE 1995.
5. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New York, 1990.
6. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.

15AE47 AERODYNAMICS OF ROAD VEHICLES

3 0 0 3

INTRODUCTION: Scope, historical developments, fundamentals of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine. (9)

AERODYNAMIC DRAG OF CARS: Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles. (8)

SHAPE OPTIMIZATION OF CARS: Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. (9)

VEHICLE HANDLING: Origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles. (9)

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS: Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. (10)

Total L: 45

REFERENCES:

1. Hucho W H, “Aerodynamic of Road vehicles ", Butterworth Co. Ltd., 1997.
2. Pope A, “Wind Tunnel Testing ", John Wiley & Sons, New York, 1974.
3. Automotive Aerodynamic: Update SP-706, SAE, 1987.
4. Vehicle Aerodynamic, SP-1145, SAE, 1996.
5. McCallen R, Browand F and Ross J, “The Aerodynamics of Heavy Vehicles: Trucks, Buses, and Trains”, Springer, 2004.

15AE81 SPECIAL PURPOSE VEHICLES

3 0 0 3

TRACTORS: General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled - Bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits. (4)

CRANES AND EXCAVATORS: General description, specifications and functions, excavator mounted cranes, mobile cranes with strut and cantilever type jibs, tractor towed and tractor mounted cranes. General description, specification and functions, classification based on attachments, face shovel, drag shovel, hoe, drag-line and grab or clam shell, advantages and limitations. (10)

GRADERS: Description, specification of tractor towed graders and motor graders, classification and functions of graders, functional details of spreading, mixing, ditching, bank sloping, snow removal, stripping, scarifying, and finishing, elementary details of transmission system (coupling, clutches, gear box, driving axles, propeller shafts), running gear and operating equipment air braking system; hydraulic system and its components, steering system of lights, medium and heavy graders, merits and limitations of graders. (8)

HAULAGE VEHICLES AND LIFT TRUCKS: General description, specification and functions, self-propelled and tractor towed haulage vehicles and pneumatic – tires, dumpers – front tipping; trucks – rear tipping, tractor towed semi-trailers and trailers (rear and side tipping, bottom dumping). General description, specification and functions, fork lift trucks, alternative front end equipment (attachments) – Jib arm, shovel bucket, squeeze clamp, boom, fork extensions, barrel forks. Scissors lift trucks - Applications in industry, advantages and disadvantages. (7)

ROOTERS, SCARIFIERS AND SCRAPERS: General description, specification and functions, tractor towed rooters and scarifiers - Heavy duty, light duty. General description, specification and functions, tractor towed and motorized scrapers, scraper work in cutting, cambering, side hill cutting, spreading on embankments, compaction of fill merits and demerits. (8)

COMPACTION VEHICLES AND OTHER SPECIAL PURPOSE VEHICLES: General description, specification and functions, smooth wheeled rollers, pneumatic tired rollers, agricultural Rollers, sheep's foot rollers, vibrating compactors. General description, specification and functions, Ambulance, oil tankers, surveillance vehicle, television recording mobile unit, reefer vehicle, double decker bus, vestibule bus, fire fighting vehicle. (8)

Total L: 45

REFERENCES:

1. Peurifoy R L "Construction Planning, Equipment and Methods", Tata McGraw-Hill, New Delhi, 2002.
2. Ian Graham, "Off-Road vehicles", Heinemann Library, 2008.
3. Wong J "Terramechanics and Off-Road Vehicle Engineering", Butterworth-Heinemann, 2009.
4. Roninson E G, "Motor Graders", MIR Publications, Moscow, 1985.
5. Rodhiev and Rodhiev, "Tractors and Automobiles", MIR Publishers, Moscow, 1984.
6. Greenwich and Soreking, "Tractors", MIR Publishers, Moscow, 1967.

15AE82 VEHICLE COMPONENT MANUFACTURING

3 0 0 3

ENGINE COMPONENTS: Engine block – Casting – Conventional and expendable pattern. Cylinder head – Casting and machining. Crank shaft, connecting rod – Forging, machining and heat treatment. Piston - Gravity, squeeze, die casting, machining and finishing. Gudgeon Pin - Machining and Finishing, Valve forging, friction welding, machining, heat treatment and surface improvement. Cylinder Liners, Piston ring - Centrifugal, HPDC, LPDC, machining and finishing. (12)

TRANSMISSION COMPONENTS: Flywheel - Casting and Machining. Clutch - Friction plate, clutch housing, pressure plate – conventional and fine blanking, composite friction lining. Gearbox - Casting, precision forging, powder metallurgy, heat treatment and finishing.Propeller shaft - Continuous casting, extrusion, dies heat treatment and surface hardening. Axle - Forging, casting and machining. Leaf and coil spring - Forging and machining, composite leaf spring and wrap forming of coil spring. (12)

BODY COMPONENTS: Body Panel - Thermoforming and hydro forming, press forming, welding – Resistance welding and other welding processes. Instrument Panel - Principle of injection molding, injection molding of instrument panel. Bumpers - Molding of bumpers, reinforced reaction injection molding, tooling and tooling. Manufacture of polymer panels. (9)

CHASSIS COMPONENTS: Vehicle Frame Manufacturing, Brake drum manufacturing. Steering systems. (3)

MISCELLANEOUS: Tire and tube manufacturing, spray painting, powder coating, , chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sealants, sound proof materials, structural adhesives (9)

Total L: 45

REFERENCES:

1. Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education, 2005.
2. John A S, "Introduction to Manufacturing Processes", Tata McGraw-Hill, 2012.
3. Philip F O and Jairo Munuz, "Manufacturing Processes and Systems", John Wiley & Sons, New York, 1998.
4. Degarmo E P, "Materials and process in Manufacturing", Macmillan Publishing Co, 1997.
5. Heldt P M, "High Speed Combustion Engines", Oxford IBH publishing Co., Calcutta, 1996.

15AE83 ECONOMICS FOR ENGINEERS

3 0 0 3

INTRODUCTION: Present economic policy, liberalization, privatization, globalization, scope for industrial growth, Interest and time value of money,cash-flow diagram, simple interest, compound interest, single payments, uniform series payments, interest factors and tables, nominal and effective interest rates, continuous compounding, uniform continuous payments. (5)

METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES: Present worth comparison - equal, unequal lived assets, study period, assets with infinite life, capitalized cost, bond valuation. Equivalent uniform annual cost comparison, situations for EUAC, rate of return comparisons – IRR – MARR – IRR misconceptions. (6)

REPLACEMENT ANALYSIS: Review of conventional approach, group replacement, analysis with time value accounting, replacement due to deterioration, obsolescence, inadequacy, economic life for cyclic replacements, current salvage value of the defender, defender and challenger with different lives, additional one year assessment. (4)

PROJECT FEASIBILITY ANALYSIS: Case study, report preparation. Depreciation, reasons, depreciation accounts, causes of declining value, depreciation methods. Cost, volume, profit analysis: review of conventional approach, analysis with time value, linear, non-linear, multi product break even analysis. Review of project management, PERT – CPM, crashing, cost system. Product costing. (6)

MARKETING FEASIBILITY: Types of market, identification of investment opportunities, market and demand analysis, forecasting demand (review), forecast control, secondary sources of information. (4)

TECHNICAL FEASIBILITY: Product design, concept of concurrent engineering, make Vs buy decisions, BPO, value analysis, FAST approach, product life cycle management. (8)

FINANCIAL FEASIBILITY: Means of financing, financial institutions, all India, state level, profitability, cash flows of a project, financial leverage of a business. Tax factors in investment analysis, effects of inflation in economic analysis (7)

RISK AND MULTI STAGE SEQUENTIAL DECISION ANALYSIS: Recognizing risk, including risk in economic analysis, expected value, payoff table, decision tree, discounted decision tree. (5)

Total L: 45

REFERENCES:

1. James L R, David D B and Sabah U R, “Engineering Economics”, McGraw Hill, 2004.
2. Prasanna Chandra, "Projects - Preparation, Appraisal and Implementation", Tata McGraw Hill, 2004.
3. William G S and others, “Engineering Economy”, Pearson Education Inc., 2001.
4. John A White et al, "Principles of Engineering Economic Analysis", John Wiley and Sons, 1998.
5. Leland T B and Anthony J T, "Engineering Economy", McGraw Hill Book Company, 1998.
6. Norman N B, "Economic Analysis for Engineering and Managerial Decision Making", McGraw Hill Book Company, 1983.

15AE84 AUTOMOTIVE PRODUCT LIFECYCLE MANAGEMENT

3 0 0 3

MOTIVATION AND INTRODUCTION: e-commerce, B to B, B to C forms of business, extended enterprise, concepts in PDM - product life cycle, business objects, work flows, versions, views, product structure, change processes, work list, information flow model in product development, engineering bill of materials and manufacturing bill of materials. (10)

COMPONENTS OF PLM SOLUTIONS: Object oriented approach in product development solutions, phase gate process in product design - disparate databases and connectivity, use of EAI technology (middleware) - cases for preparation of combined BOM and other reports. Component supplier management and sourcing. (10)

PRODUCT VISUALISATION: CAD neutral environment and visualisation of products, standard softwares, use of visualization in several stages of lifecycle, reviews, mark up - case studies. (8)

ROLE OF PLM IN INDUSTRIES: (like auto, aero, electronic) - other possible sectors, ten step approach to PLM, benefits of PLM.(7)

DETAILS OF MODULES IN A PDM/PLM SOFTWARE: Example (4)

BASICS ON CUSTOMISATION OF AUTOMOTIVE PDM/PLM SOFTWARE (6)

Total L: 45

REFERENCES:

1. Lihui Wang and Andrew Y C N, “Collaborative Design and Planning for Digital Manufacturing”, Springer-Verlag London Limited, 2009.
2. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.
3. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.
4. John Stark, “Product Lifecycle Management: 21 Century Paradigm for Product Realisation”, Springer Publisher, 2005.
5. Cortada, James W, “The Digital Hand: How Computers Changed the Work of American Manufacturing, Transportation and Retail Industries, Oxford University Press Inc., 2004.

15AE85 QUALITY ASSURANCE AND RELIABILITY

3 0 0 3

QUALITY IN MANUFACTURING ENGINEERING: Importance of manufacturing planning for quality – initial planning for quality – concept of controllability: self controls – defining quality responsibilities on the factory flow – self inspection – automated manufacturing – overall review of manufacturing planning – process quality audits – quality and production floor culture. (5)

QUALITY IN DESIGN ENGINEERING: Opportunities for improvement product design - early warning concepts and design assurance - designing for basic functional requirements – designing for time oriented performance (reliability) – availability – designing for safety – designing for manufacturability – cost and product performance – cost of quality – design review –concurrent engineering – improving the effectiveness of product development. (6)

QUALITY MANAGEMENT SYSTEM: Need for quality management system – design of quality management system – quality management system requirements – ISO 9001 and other management systems and models - improvements made to quality management systems. (5)

CONTINUOUS IMPROVEMENT: Basic quality engineering tools and techniques - statistical process control - techniques for process design and improvement - Taguchi methods for process improvement - six sigma - the 'DRIVE' framework for continuous improvement. (4)

CONCEPTS OF RELIABILITY: Definition of reliability- Reliability Vs Quality-Reliability function-MTTF – Hazard rate function-Bathtub curve – Derivation of the reliability function-constant failure rate model – Time dependent failure models- Weibull distribution – Normal distribution- The lognormal distribution. (5)

RELIABILITY OF SYSTEM AND MODELS: serial configuration – parallel configuration – combined series parallel systems, system structure function, Minimal cuts and Minimal paths – Markov analysis – Load sharing systems, standby system, degraded systems , three state devices – covariate models , static models, dynamic models, physics of failure models. (6)

DESIGN FOR RELIABILITY: Reliability design process- system effectiveness- Economic analysis and life cycle cost –Reliability allocation – ARINC, AGREE- Design methods- parts and material selection, Derating , stress-strength analysis –Failure Analysis – Identification of failure mode – Determine of causes – Assessment of effects – classification of severity omputation of critically index – corrective action- System safety and FTA. (7)

THE ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING: Data collection – Empirical methods – ungrouped and grouped complete, censored data – static life estimation- test time calculation – Burn in testing, Acceptance, sequential, binomial testing – Accelerated life testing – other acceleration models – Experimental design- Reliability growth processidealized growth curve-various growth models- Identifying failure and repair distributions. (7)

Total L: 45

REFERENCES:

1. Oakland J S, "Total Quality Management - Text with Cases", Butterworth – Heinemann – An Imprint of Elseiver, New Delhi, 2005.
2. Patrick D T, "Practical Reliability Engineering", John-Wiley and Sons Inc, 2002.
3. David J S, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002.
4. Way kuo, Rajendra Prasad V, Frank A and Tillman and Ching- lai Hwang, "Optimal Reliability Design and Applications", Cambridge University Press Pvt. Ltd, 2001.
5. Charles E Ebling, "An introduction to Reliability and Maintainability Engg.", Tata McGraw –Hill, 2000.

15AE86 INNOVATION MANAGEMENT

3 0 0 3

CREATIVITY AND INNOVATION: Practical experience, innovation In brief benefit of innovation for companies, innovation SWOT, rewarding innovation, lateral thinking, weakness of creativity, mechanics of innovation, creativity culture, future of creativity, creative organization-mapping Innovation-model of strategic innovation, types of innovation, incremental innovation, semi-radical innovation, ersatz radical innovation-risk management and innovation strategy, innovation strategy-a case study- strategy and the innovation rules. (12)

INNOVATION RULES: Measure innovation - roles of a measurement system - measurement and the innovation rules - rewarding innovation- the importance of incentives and rewards - motivation - performance evaluation and incentive contracts. (11)

INCENTIVES: delivery of compensation - key considerations in designing incentives systems for innovation - the negative effect on intrinsic motivation - incentives and rewards, and the innovation rules -learning innovation - the importance of learning - a model of learning - learning systems for innovation. (11)

INNOVATION MANAGEMENT: An introduction- Macro factors and innovation - managing innovation within firms- innovation and operations management-managing Intellectual property managing technology and knowledge- managing organisational knowledge-strategic alliances and networks- the role of technology transfer in innovation new product development- product & brand strategy - packaging and product development. (11)

Total L: 45

REFERENCES:

1. Tom Kelley, Jonathan Littman and Tom peters, “The Art of Innovation”.
2. Brain Clegg “Creativity and Innovation for Managers”, Butterworth Heinmann Publishers, 2005.
3. Marc J E, Robert Shelton and Tony Davila, “Making Innovation Work”, Wharton School Publishing, 2005.
4. Paul Trott, “Innovation Management and New Product Development”, Pearson Education, 2004.

15AE87 ELECTRO-CHEMISTRY OF FUEL CELLS

INTRODUCTION OF FUEL CELLS : Introduction-working and types of fuel cell-Low, medium and high temperature fuel cell, Liquid and methanol types, Proton exchange fuel cell solid oxide, hydrogen fuel cells-Thermodynamics and electrochemical kinetics of fuel cells. (5)

THERMODYNAMICS: Enthalpy change of a reacting system, systematic Gibbs free energy, Ideal efficiency of the energy conversion, energy balance in fuel cells (8)

ELECTRO CHEMISTRY: Nernst equation, relation of the fuel consumption versus current output, stoichiometric coefficients and utilization percentages of the fuel and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serious connection, over-potential and polarizations, DMFC operation scheme, generous issues -water flooding and water management, polarization in PEMFC. (12)

FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE : Fuel cell performance characteristics- Current/voltage, voltage efficiency and power density, Ohmic resistance, Kinetic performance, mass transfer effects-membrane electrode assembly components, fuel cell stacks, bi-polar plate, humidifiers and cooling plates. (12)

FUELING : Hydrogen storage technology-pressure cylinders, liquid hydrogen, metal hydrides, methods of hydrogen production, carbon fibres-reformer technology- steam reforming, partial oxidation, auto thermal reforming-CO removal, fuel cell technology based on removal like bio-mass. (8)

TOTAL : 45

REFERENCES:

1. Frano Babir, "PEM FUEL CELS : Theory and Practice", Elsevier Academic Press, USA, 2005.
2. Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2006.
3. Fuel cells for automotive applications - professional engineering publishing UK, 2004.
4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modem Electric, Hybrid Electric and Fuel cell Vehicles", Fundamental, Theory and design ",CRS Press, 2004.
5. Fuel cell Technology Handbook SAE International Gregor Hoogers CRC Press, 2003
6. Young G J, "Fuel cells", Rein hold publishing Copr., 1960.

ELECTIVE LABORATORY COURSES

15AE53 AUTOMOTIVE STYLING AND DESIGN LABORATORY

0 0 2 1

1. Automotive sketching
2. Automotive packaging design
3. Automotive class A modeling
4. Automotive Exterior design
5. Automotive Interior design

Total P: 30

REFERENCE:

1. Manual prepared by the Department of Automobile Engineering, 2015.

15AE54 AUTOMOTIVE EMBEDDED SYSTEMS LABORATORY

0 0 2 1

1. Simulation of Automotive Sensors and Actuators
2. Interfacing of Sensors and Actuators
3. Development of Embedded Systems

Total P: 30

REFERENCE:
1. Manual prepared by the Department of Automobile Engineering, 2015.

15AE55 AUTOMOBILE ENGINEERING LABORATORY

0 0 2 1

1. Preparation and characterization of bio diesel.
2. Performance and Emission Studies on IC Engine fueled with alternative fuels.
3. Study on the effect of varying compression ratio, fuel injection pressure and fuel injection timing on the engine Performance and Emission.
4. Automotive NVH characteristics and properties measurement.
5. Study of analysis of different electric and Hybrid power train architecture
6. Wheel balancing & Wheel Alignment

Total P: 30

REFERENCE:
1. Manual prepared by the Department of Automobile Engineering, 2015.

ONE CREDIT COURSES

15AK01 CHARACTERIZATION OF TURBO MACHINERY USING CFD

1 0 0 1

INTRODUCTION: Trends in industrial use of CFD - Preliminary design and geometry definitions (4)

MODELING & MESHING: Methods for computing through-flows, blade-to-blade flows and geometry generation -Mesh influence on solution accuracy (4)

SIMULATION: Multiple Frames of Reference (MFR) / Multistage Analysis (4)

APPLICATION: Industrial use of CFD and the points of view of the designers (3)

Total L: 15

REFERENCES:
1. John D, Anderson, “Computational Fluid Dynamics”, McGraw Hill Series in Mechanical Engineering, 1995.
2. Dixon, S. L., “Fluid Mechanics”, Thermodynamics of Turbomachinery”, Elsevier, 1998.

15AK02 CHARACTERIZATION OF HEAT EXCHANGERS USING CFD

1 0 0 1

INTRODUCTION: Heat Exchangers, its classification (4)

MODELING & MESHING: Preliminary design and geometry definitions - Mesh influence on solution accuracy (6)

SIMULATION: Analysis of heat exchanger (5)

Total L: 15

REFERENCES:
1. Sadik Kakaç, Hongtan Liu and Anchasa Pramuanjaroenkij, “Heat Exchangers: Selection, Rating and Thermal Design”, CRC press, 2012.
2. John D. Anderson, “Computational Fluid Dynamics”, McGraw Hill Series in Mechanical Engineering, 1995.