

SEMESTER - VII

19A701 METROLOGY AND QUALITY ENGINEERING

3 0 0 3

INTRODUCTION TO METROLOGY : Introduction to Metrology - Fundamental principles and definitions - measurement standards / primary and tertiary standards - distinction between precision and accuracy. - Tolerance grades - Types of fits IS919 - GO and NO-GO gauges- Taylor's principle - design of GO and NO-GO gauges – filler gauges - plug gauges and snap gauges. (9)

COMPARATORS, INTERFEROMETERS AND SURFACE ROUGHNESS MEASUREMENTS : Constructional features and operation of mechanical, optical, electrical/electronic and pneumatic comparators - advantages, limitations and field of applications. - Principles of interference, concept of flatness - flatness testing - optical interferometer and laser interferometer. importance of surface conditions - roughness and waviness - surface roughness standards specifying surface roughness parameters- Ra, Ry, Rz, RMS value etc. - surface roughness measuring instruments – Tomlinson and Taylor Hobson versions - surface roughness symbols (9)

SCREW THREAD MEASUREMENT, GEAR MEASUREMENTS AND SPECIAL MEASURING INSTRUMENTS : Two wire and three wire methods - floating carriage micro meter. - Gear tooth comparator - Master gears measurement using rollers and Parkinson's Tester - Principles of measurement using Tool Maker's microscope - profile projector - 3D coordinate measuring machine. (9)

QUALITY CONTROL, SQC AND SQC TOOLS : Introduction, definition and concept of quality & quality control - set up policy and objectives of quality control - quality of design and quality of conformance - compromise between quality & cost - quality cost and planning for quality - Importance statistical methods in QC - measurement of statistical control variables and attributes - GANT charts - control charts - X chart, X bar charts - control charts - R charts, P charts and np charts their preparation, analysis and applications. - Elementary treatment on modern SQC tools. (9)

SAMPLING TECHNIQUES : Sampling inspection and basic concepts - OC curves - consumer & producer risk -single & double sampling plans and use of sampling tables. (9)

Total L: 45

TEXT BOOKS:

1. Gupta I.C , "Text Book of Engineering Metrology", Dhanapatrai Publishers, New Delhi, 2003.
2. Gerald M.S , "Statistical Process Control and Quality Improvement", Pearson Education, USA, 2004.

REFERENCES:

1. Jain R.K , "Engineering Metrology", Khanna Publishers, New Delhi, 2009.
2. Douglas Montgomery , "Introduction to Statistical Quality Control", John Wiley and Sons Inc., USA, 2005.
3. Stephen B.V , Marcur J.J , "Statistical Quality Assurance Methods for Engineers", John Wiley and Sons Inc., USA, 2000.

19A703 AUTOMOTIVE EMISSION & NVH 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 - Effect of fuel properties and additives - Emissions from alternate fuels. (9)

EMISSION TESTING : Emission test cycles - Constant volume sampling method - Non-dispersive infrared (NDIR) analyzer - Flame ionization detectors (FID) - Chemiluminescence analyzer - Smoke meters - Gas chromatograph. (9)

EMISSION CONTROL TECHNIQUES : Air fuel ratio (A/F) control - Crank case emission control - Fuel evaporation & control - EGR - SCR - Catalytic converters - Particulate traps - Effect of engine combustion modification and control technologies . (9)

NOISE AND NOISE CONTROL : Introduction to sound - Noise measurements - Control of air borne and structure borne noise - Use of absorber and criteria for the selection of materials - Engine noise and control - Brake noise and control - Tyre noise and control - Gear noise and control - Clutch noise and control - Resonators – Reactive and absorptive silencers. (9)

VIBRATION MEASUREMENT AND CONTROL : Introduction and elements of vibration - Source of vibration - Types of vibration - Measurement of vibration: FFT analyzer - Quarter car model analysis - Methods of vibration control:passive, active, semi active control - Vibration isolation - Engine and drive train vibrations. (9)

Total L: 45

TEXT BOOKS:

1. Pundir B P , "Engine Emissions: Fundamentals and Advances in Control", Alpha Science International Ltd, 2017.
2. Matthew Harrison, Butterworth-Heinemann, Burlington , "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", 2011.

REFERENCES:

1. James D. Halderman , "Automotive Fuel and Emissions Control Systems", 4th Edition, Prentice Hall, Pearson Education, 2016.
2. Gang Sheng , "Vehicle Noise, vibration and Sound quality", SAE International, 2012.
3. Rajesh Rajamani , "Vehicle Dynamics and Control", 2nd Edition, Springer, 2012.
4. Singiresu.S. Rao , "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010.

19A710 VEHICLE SERVICING LABORATORY**0 0 2 1****VEHICLE SERVICING LABORATORY :**

1. Inspection and servicing of different types of clutches.
2. Inspection and servicing of different types of gear boxes
3. Measurement of backlash and run out of differential unit
4. Servicing of transaxle assembly
5. Servicing of different types of rear axle assembly
6. Servicing of steering gear boxes and verification of Ackerman steering geometry
7. Head light beam alignment, tuning of electric horn system and wind screen wiper system
8. Brake system troubleshooting and servicing
9. Electrical system diagnostics
10. Wheel balancing and wheel alignment

Total P: 30**REFERENCES:**

1. Anderson Ashburn , " Automotive Trouble shooting and Maintenance ", McGraw-Hill Book Company , 1990.", 1990.
2. Tom Denton , "Advanced Automotive Fault Diagnosis", Elsevier Butterworth-Heinemann, 2011.

19A711 PROJECT WORK I**0 0 4 2**

1. Identification of a real life problem in thrust areas.
2. Developing a mathematical model for solving the above problem.
3. Finalization of system requirements and specification.
4. Proposing different solutions for the problems based on literature survey
5. Future trends in providing alternate solutions.
6. Consolidated report preparation of the above.

SEMESTER - VIII**19A810 PROJECT WORK II****0 0 8 4**

The project work involves the following:

1. Preparing a project brief proposal including Problem identification
 - a. A statement of system / process specification proposed to be developed (Block diagram / concept tree)
 - b. List of possible solutions including alternative and constraints
 - c. Cost benefit analysis
 - d. Time Line of activities
2. A report highlighting the design finalization (based on functional requirements & standards (if any))
3. A presentation including the following:
 - a. Implementation Phase (Hardware / Software / both)
 - b. Testing & Validation of the developed system
 - c. Learning in the Project
4. Consolidated project report preparation

Total P:120**PROFESSIONAL ELECTIVES****19A001 AERODYNAMICS OF ROAD VEHICLES****3 0 0 3**

INTRODUCTION : Fundamentals of fluid mechanics - flow phenomenon related to vehicles - external and internal flows. (6)

AERODYNAMIC DRAG OF CARS : Cars as a bluff body - flow field around car - air flow to passenger compartment - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic development - low drag profiles. (10)

SHAPE OPTIMIZATION OF CARS : Front end shape modifications - front and rear wind shield angle - A and C pillar - front and rear spoilers - Roof modifications - rear end shape modifications - boat tailing - hatch back - fast back and square back - dust flow patterns at the rear - effects of gap configuration - effect of fasteners. (10)

VEHICLE HANDLING : Origin of forces and moments on a vehicle - lateral stability - methods to calculate forces and moments - vehicle dynamics under side force and winds - steady and cornering effect - steering angle and slip angle - under steer and over steer gradient - suspension effects on cornering - roll moments on front and rear axles - dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles. (10)

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. (9)

Total L: 45

TEXT BOOKS:

1. Thomas Christian Scheutz , "Aerodynamics of Road vehicles", 5th Edition SAE International 2012
2. William Siebert , ' Aerodynamics of Road vehicles", 3rd Edition, Prentice Hall 2007

REFERENCES:

1. McCallen R, Browand F, Ross J , "The Aerodynamics of Heavy Vehicles: Trucks, Buses, and Trains", Springer, 2004.
2. SAE , "Vehicle Aerodynamic", SP-1145, SAE, 1996.

19A002 AUTOMATIC TRANSMISSION

3 0 0 3

MECHANICAL : Principle of centrifugal clutches - comparison between conventional and centrifugal clutches - centrifugal clutches used in two wheeler - over drives – Principle - operation - types - advantages and limitations (9)

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 - Typical automatic transmissions - Advantages and limitations (9)

HYDROSTATIC DRIVES : Principles of hydrostatic drives - different systems of hydrostatic drives - fixed displacement pump and fixed displacement motor - variable displacement pump and fixed displacement motor - fixed 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

TEXT BOOKS:

1. Jack Erjavec , "Automatic Transmissions", Delmar Publishers, 2009.
2. Heinz Heisler , "Advanced Vehicle Technology", SAE, 2012.

REFERENCES:

1. Theraja B.L , "Fundamentals of Electrical Engineering and Electronics", S Chand & Company Ltd, 2009.
2. Tucker H.F , "Automatic Transmission", Van Nostrand Reinhold Company, 1999.
3. Mathias F.B , "Automatic Transmission", Prentice Hall, 1998.
4. John J.P, Tyler G.H , "Industrial Hydraulics", MGH Published, 2010.

19A003 AUTOMOTIVE ELECTRONICS

3 0 0 3

ELECTRONICS IN AUTOMOBILE : Introduction- Body and convenience electronics: vehicle power supply controllers and lighting modules - door control modules - Safety electronics: active safety systems: ABS - ASR - ESP passive safety systems: Restraint systems and their associated sensors in an automobile. Infotainment electronics: Dashboard/instrument cluster - car audio - telematic systems - navigation systems - multimedia systems. (10)

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 - L- Jetronic Fuel Injection Systems. (9)

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

INTRODUCTION TO RTOS : Comparison of conventional OS with RTOS. Tasks & task states (Pre-emptive & Non- preemptive - 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 (μ C/OS-II). (10)

COMMUNICATION PROTOCOLS : Introduction to control networking - Communication protocols in embedded systems - SPI - I2C - USB. Vehicle communication protocols - Introduction to CAN - LIN - FLEXRAY - MOST – AUTO SAR. (7)

Total L: 45

TEXT BOOKS:

1. Denton T , " Automobile Electrical and Electronic Systems", Routledge, 2013.
2. Bosch , "Automotive Electric and Automotive Electronics", 5th Edition, Springer Fachmedien Wiesbaden, 2014.

REFERENCES:

1. William B.Riddens , "Understanding Automotive Electronics: An Engineering Perspective", 8th Edition, Elsevier, 2017.
2. Nicholas Navit , "Automotive Embedded System Handbook", CRC Press Publications, 2013.

19A004 AUTOMOTIVE PRODUCT DEVELOPMENT STRATEGIES

3 0 0 3

INTRODUCTION TO PRODUCT DESIGN : Introduction - principles of new product development - success and failure in new products - risk management - funnel and its stages - quality control of product development and meeting targets - the principles of product styling-virtual perception of product style - attractiveness and product styling process. (9)

PRODUCT PLANNING : Product planning process - aim and opportunities in product planning - competing product analysis - style planning - factors of contextual styling and Intrinsic styling - styling specifications. (9)

GLOBAL PRODUCTS AND ITS PROBLEMS : Importance - challenges and opportunities of global products - changes and complexity in global products - global product problems - multiple causes and its effects - root cause and network of causes and measures - everyday product problems and action. (9)

PLM ENABLING GLOBAL PRODUCTS : Product lifecycle management (PLM) - key characteristics and functions - benefits of PLM - metrics and targets of PLM - PLM applications and data/document management - part/product management - process/workflow management - program/project management. (9)

CHANGES FOR GLOBAL PRODUCTS : Changing roles of product organizations - increased regulation of product - better managed product - multiple of new products - breakthrough computer aided product development. (9)

Total L: 45

TEXT BOOKS:

1. Karl Ulrich, Steven Eppinger, Maria C. Yang , "Product Design and Development", 7th Edition, McGraw-Hill Education, 2019.
2. John Stark , "Global Products", Springer-Verlag London Ltd, 2011.

REFERENCES:

1. Anil Mital, Anoop Desai, Anand Subramanian, Aashi Mital , "Product Development", Butterworth-Heinemann Publications, 2008.
2. Michael Z. Brooke, William Ronald Mills , "New Product Development", Jaico Publishing House, 2008.

19A005 MECHATRONICS**3 0 0 3**

INTRODUCTION TO MECHATRONICS SYSTEM : Definition of Mechatronics - introduction to mechatronics systems – need and applications - role of Mechatronics in automation, manufacturing, products and design - elements of Mechatronics - open loop and closed loop control - introduction to sampled data, digital control and multivariable control systems - mathematical model for mechanical and electrical systems, transfer function (12)

TRANSDUCERS AND SENSORS : Importance of sensors in mechatronics - static and dynamic characteristics of sensors - Classification – transducers for measurement of displacement - strain - position - velocity - flow - pressure - temperature - humidity - vibration - liquid level and light sensors (8)

CONTROL ELEMENTS AND ACTUATORS : Control elements - ON/OFF push buttons - control relays - contactors - selector switches - micro switches and solid state switches. Actuators - solenoids - AC and DC motors - servo - stepper and linear motors. Hydraulic and Pneumatic controls - control valves - cylinders and hydro motors. (8)

MICROPROCESSORS AND MICROCONTROLLER AND INTERFACING : Microprocessors - introduction - 8085 architecture - development of simple programs - 8051 Microcontroller architecture - applications- temperature control and stepper motor speed control - Basic concepts of I/O - I/O mapping and memory mapping - 8255 block diagram - port structure. Applications- seven segment display interface - keyboard interface (12)

MEMS : Introduction - MEMS and micro system products - application of micro systems in the automotive industry - working principles of micro systems – micro sensors - micro actuation - MEMS with micro actuators and micro accelerometers (5)

Total L: 45**TEXT BOOKS:**

1. Robert H. Bishop, 'Mechatronics an Introduction' , "Mechatronics", Taylor and Francis 2011, .
2. GodfreyC.Onwbolu , "Mechatronics: Principles and Application ",Elsevier 2009, .

REFERENCES:

1. Nitaigour , "Mechatronics principles, concept and application", 2nd Edition Tata-McGraw ,2013.
2. Rajesh Rajamani , "Vehicle Dynamics and Control", Springer-Verlog 2008 , .

19A006 AUTOMOTIVE EMBEDDED SYSTEMS**3 0 0 3**

INTRODUCTION TO EMBEDDED SYSTEMS : 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. Embedded system programming - Up - loaders, ISP, ROM emulators, incircuit emulators. Debug Interfaces - BDM and JTAG (10)

HARDWARE MODULES : 16 - bit microcontrollers - architectural overview of C166 family - memory organization, fundamental CPU concepts and optimization measures, on - chip system resources, peripheral event controller (PEC) ad interrupt control, external bus interface, parallel ports, general purpose timers(GPT), watchdog timer, serial channels, capture/compare units, pulse width modulation unit, analog to digital converter, real time clock, on chip I2C bus module, universal serial bus (USB) interface (10)

SOFTWARE DEVELOPMENT TOOLS : 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. (9)

INTEGRATION OF HARDWARE AND SOFTWARE : Introduction to microcontroller development kit (easy kit), developing project using IDE software, downloading embedded software into target system, introduction to on - chip debugging resources (JTAG), debugging target system using on - chip debugging support (OCDS). (9)

DRIVE-BY-WIRE : Challenges and opportunities of X - by - wire system and design requirements, steer - by - wire, brake - by - wire, electronic throttle including adaptive cruise control, shift - by - wire. (7)

TEXT BOOKS:

1. Nicolas Navet and Françoise Simonot-Lion , ""Automotive Embedded Systems Handbook", CRC press, 2009.
2. James K Peckol , ""Embedded Systems – A contemporary Design Too", John Wiley, 2013.

REFERENCES:

1. Arnold Berger , "Embedded System Design: An Introduction to Processes, Tools, and Techniques", CMP Book, , 2001.
2. David E Simon , "An Embedded Software Prime", Pearson Education, Asia, 2009.
3. Wayne Wolf , "Computers as Components", Morgan Kaufmann Publishers, 2009

19A007 VEHICLE CONCEPT STYLING AND DESIGN

3 0 0 3

INTRODUCTION : Drawing in product design - mass production - geometric versus naturalistic drawing - modernist design. basic drawing skills - perspectives - metric projections - spherical projections - orthographic projections - sections and scrap views - tools and materials. (9)

COMPUTER SYSTEMS : The computer processor - system software - display - input devices - hardcopy output - 3D output devices - concept design - 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

TEXT BOOKS:

1. Alan Pipes , "Drawing for Designers", Laurence King Publishing, 2011.
2. Erik Olofsson, Klara Sjölen , "Design Sketching", Keeos Design Books AB, 2005.

REFERENCES:

1. Tony Lewin, Ryan Borroff , "How to Design Cars Like a Pro", Motor Books International, 2010.
2. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray , "H-Point: The Fundamentals of Car Design & Packaging", Design Studio Press, 2009.
3. Thom Taylor , "How to Draw Cars Like a Pro", Motor Books International, 2006.

19A008 SIGNALS AND SYSTEMS

3 0 0 3

SIGNALS AND SYSTEMS INTRODUCTION : Introduction – Continuous Time (CT) and Discrete Time (DT) signals – Signal operations - Basic CT & DT signals - Representation of signals using impulse function – Classification of CT & DT signals – CT & DT Systems – Basic System Properties (9)

LINEAR TIME INVARIANT SYSTEMS : Discrete time LTI systems - Convolution Sum – Continuous time LTI systems: Convolution Integral – Properties of LTI systems – Unit step response of an LTI system – LTI systems described by linear constant - coefficient differential and difference equations (9)

FOURIER ANALYSIS OF CT SIGNALS AND SYSTEMS : Response of LTI systems to complex exponentials - Representation of CT periodic signals by Continuous Time Fourier Series (CTFS) – Convergence of CTFS – Properties of CTFS - Representation of CT aperiodic signals by Continuous Time Fourier Transform (CTFT) – Convergence of CTFT – Fourier transform for CT periodic signals - Properties of CTFT - Frequency response of systems characterized by linear constant - coefficient differential equations (11)

SAMPLING : Representation of CT signal by samples – Impulse train sampling – Zero order hold sampling – Reconstruction of CT signal from samples - Effect of under sampling – Aliasing (7)

FOURIER ANALYSIS OF DT SIGNALS AND SYSTEMS : Representation of DT periodic signals by Discrete Time Fourier Series (DTFS) - Properties of DTFS - Representation of DT aperiodic signals by Discrete Time Fourier Transform (DTFT) – Convergence of DTFT – Fourier transform for DT periodic signals - Properties of DTFT - Frequency response of systems characterized by linear constant - coefficient difference equations (9)

Total L: 45

TEXT BOOKS:

1. Alan V Oppenheim, Alan S Wilsky, and S Hamid Nawab , "Signals and Systems", 6th Edition, PHI Learning Private Limited, New Delhi, 2014.
2. Dimitris G Manolakis and Vinay K .Ingle , "Applied Digital Signal Processing Theory and Practice", 4th Edition, Cambridge University Press, Cambridge University, 2011.

REFERENCES:

1. Simon Haykin and Barry Van Veen , "Signals and Systems", 5th Edition, John Wiley, New Delhi, 2012.
2. Samir S Soliman and Srinath M D , "Signals and Systems", 6th Edition, PHI, New Delhi, 2010.
3. Lathi B P , "Linear Systems and Signals", 4th Edition, Oxford University Press, Chennai, 2010.

19A009 AUTOMOTIVE INSTRUMENTATION

3 0 0 3

INTRODUCTION TO TRANSDUCERS AND SENSORS : Transducers- types-resistive, capacitive and inductive based sensors with linear transfer characteristics- thermistor- LVDT- inductive pickup- capacitance- strain gauges- semiconductors- piezoelectric accelerometer- proximity sensors- micro switches-encoders- piezoelectric pressure sensors- instruments-ammeter- voltmeter- speedometer--pressure gauge- vacuum gauge- analog and digital- calibration- cathode ray oscilloscope. (9)

AMPLIFIERS AND SIGNAL CONDITIONING CIRCUITS : Analogue signal acquisition with operational amplifier circuits basics- analysis of operational amplifiers circuits - selected examples of basic circuits (Amplifier - Integrator - Adder - Sign Switch - Comparator and Schmitt Trigger) - digital signal acquisition- theory of digital to analog and analog to digital conversion- DAC principles- ADC circuits- recorders- signal conditioning and filtering. (9)

VEHICLE INSTRUMENT CLUSTER : Typical INS cluster- analog and digital dash instruments – speedometer – odometer – warning - temperature – pressure – ABS – signaling circuits – seat belt restrainer – fuel level – Tyre pressure monitoring – infotainment and telematics – overview- diagnostic trouble codes (DTC) – on-board diagnostics (OBD). (9)

VEHICLE SERVICING INSTRUMENTATION : Wheel alignment gauges - laser alignment- exhaust gas analyzer- emission norm standards - flasher instrumentations - wheel balancing – calibrations- dynamometer- starter motor- dynamometer calibrations - fuel ignition calibration - ignition timer calibration – stroboscope- tachometer- tyre air pressure instrument- head light alignment - head light intensity study- smoke meter- macro inspection of interior parts using fiber optics-boroscopes (9)

NVH INSTRUMENTATION : Sound level meters - acoustic measurement - FFT analyzer- anechoic chamber- varechoic chamber- sound level measurements- NVH standard- accelerometers - Triaxial sensors. (9)

Total L: 45

TEXT BOOKS:

1. Ernest O Doebelin , "Measurement systems – Application and Design", McGraw Hill publishing company, 2010.
2. Halderman J , "Diagnosis and Troubleshooting of Automotive Electrical, Electronics and Computer Systems", Pearson Education, Professional Technical Series, 2012.

REFERENCES:

1. Beakwith T G, Buck N L , "Mechanical Measurements", Pearson Education, New Delhi, 2007.
2. Jurgen R , "Automotive Electronics Handbook", McGraw Hill, New York, 2000.
3. Tom Denton , "Advanced Automotive Fault Diagnosis", Elsevier Butterworth-Heinemann, 2006.

19A010 AUTOMOTIVE TESTING

3 0 0 3

VIBRATION AND BODY TESTING : 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. (9)

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 SYSTEM FOR DIRECTIONAL CONTROL : Analysis of constant radius test - constant steer angle test - constant speed variable radius test - constant speed variable steer angle test - response gain test. (9)

CORNERING AND WHEEL TESTING : 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. (9)

BRAKING PERFORMANCE TESTING : Air and hydraulic brake test - air brake actuator - valves test – performance requirements. Parking brake – drawbar pull test - grade holding test. (9)

Total L: 45

TEXT BOOKS:

1. Crouse W.H, Anglin D.L , "Automotive Mechanics", Tata McGraw Hill Publishing Company, 2004.
2. Rangan, Mani, Sharma , "Instrumentation", Tata McGraw Hill Publishers, New Delhi, 2009.

REFERENCES:

1. SAE Hand book , "Hand book", SAE Publications, 2000.
2. Jain R K . , "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.
3. Tim Giles , "Automotive Service", Delmar Publishers, 1998.
4. Beckwith TG, Buck N L , "Mechanical Measurements", Addition Wesley Publishing Company Limited, 1995.

19A011 AUTOMOTIVE PRODUCT LIFE CYCLE 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 BOM. (9)

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. (9)

PRODUCT VISUALISATION : CAD neutral environment and visualization of products - Standard software - Use of visualization in several stages of lifecycle - Reviews - Mark up - case studies. (9)

ROLE OF PLM IN INDUSTRIES : Automotive sectors - Ten step approach to PLM - Benefits of PLM. (9)

DETAILS OF MODULE : Details of modules in a PDM/PLM software - Basics on customization and implementation of automotive PDM/PLM software. (9)

Total L: 45

TEXT BOOKS:

1. Stark John , "Product Lifecycle Management (Volume 1)", 4th Edition, Springer International Publishing, 2019.
2. Antti Saaksvuori, "Product Lifecycle Management", 3th Edition, Springer International Publishing, 2010.

REFERENCES:

1. Wang Lihui, Andrew Y C N , "Collaborative Design and Planning for Digital Manufacturing", Springer-Verlag London Limited, 2009.
2. Grieves Michael , "Product Life Cycle Management", 2nd Edition Tata McGraw Hill, 2006.

19A012 VIBRATION AND NOISE ENGINEERING

3 0 0 3

VIBRATION FUNDAMENTALS AND INSTRUMENTATION TECHNIQUES : Introduction - elements of vibration - types of vibration - Undamped & damped vibrations - Vibration transducers - transducer working principle - transient and steady state response of one degree of freedom system applied to vehicle systems - multi degree of freedom system (MDOF) - FFT analyser. (12)

SOURCES OF VIBRATION : Introduction - engine vibration- transmissibility- design of engine mounts – resonance and determination of natural frequencies and modes shapes- loss factor -loss modulus and storage modulus of damping material - damper requirements (8)

NOISE FUNDAMENTALS AND INSTRUMENTATION TECHNIQUES : Sound propagation - quantification of sound - frequency and wave length - sound pressure level , free field and far field - sound intensity level - vehicle noise specifications & standards - noise induced hearing losses. Exterior noise sources - Interior noise sources. Microphones & calibrators - Excitation devices - frequency analysis - sound pressure measurement - sound intensity measurement - sound intensity probes - data acquisition system - digital signal processing - semi-anechoic rooms. (9)

NOISE ANALYSIS AND CONTROL METHODS : : Transfer Path Analysis: single source structure-borne noise transmission path analysis - multiple reference transmission path analysis - Impedance modeling - modal analysis: definition of modal properties - modal analysis theory- determination of mode shapes of vehicle cabin - passive noise control methods: ducts & mufflers -types of mufflers - performance parameters – acoustics and backpressure - reactive and absorptive silencers - helmholtz resonators and side branch resonators (8)

DESIGN OF SOUND ABSORBERS : Introduction- different noise control material- Impedance tube testing – Delany –Bazely method – Transfer matrix method to determine TL- Green material used for sound absorption (8)

Total L: 45

TEXT BOOKS:

1. Mathew Harrison , "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles"", 2nd Edition, SAE International, USA, 2013.
2. Munjal M.L , "Acoustics of Ducts and Mufflers", 3rd Edition, John Wiley, UK, 2011.

REFERENCES:

1. Rajesh Rajamani , "Vehicle Dynamics and Control"", 2nd Edition, Springer, 2011.
2. Xu Wang , "Vehicle noise and vibration refinement", 3rd Edition, Wood Head Publishing, 2012.

19A013 VEHICLE DEVELOPMENT PROCESS

3 0 0 3

VEHICLE DEVELOPMENT PROJECTS : Categories of vehicle development projects - platforms and model lines - the product evolution process - vehicle project management - aspects of international development projects – cars that topped and cars that flopped - factors of success in the automotive industry. (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 problemmanagement - release and change management and quality management. (9)

CUSTOMER RELEVANT COMPLETE VEHICLE CHARACTERISTICS : Registrability - total vehicle costs – design appeal - cabin comfort - infotainment - passive safety. (9)

SECONDARY COMPLETE VEHICLE CHARACTERISTICS : Production integration - service integration. (9)

Total L: 45

TEXT BOOKS:

1. Weber Julian , "Automotive Development Processes", Springer, 2009.
2. Daniel Sörensen , "The Automotive Development Process", Springer, 2006.

REFERENCES:

1. John Stark , "Global Product", Springer Publisher, 2007.
2. Tony Lewin, Ryan Borroff , "How to Design Cars Like a Pro", Motor Books International, 2010.
3. Stuart Macey, Geoff Wardle, Ralph Gilles, Freeman Thomas, Gordon Murray , "H-Point: The Fundamentals of Car Design and Packaging", Design Studio Press, 2009.

19A014 MATHEMATICAL MODELING OF MECHANICAL SYSTEMS**3 0 0 3**

PRINCIPLES OF MATHEMATICAL MODELING OF MECHANICAL SYSTEMS : Introduction-Mathematical Modeling- Bars Under Axial Vibration- Bars Under Torsional Vibration Beams Under Flexural Vibration- Systems Governed by Second-Order PDEs- Properties of the Laplace Transform- Time Response via the Laplace Transform- The Inverse Laplace Transform- The Final and the Initial-Value Theorems. (9)

VIBRATION ANALYSIS OF TWO-DOF SYSTEMS : Constitutive Equations of Mechanical Elements- springs and dashpots – series and parallel arrays –Hysteric Damping- Coulomb damping-The Derivation of the Governing Equations-Equilibrium States-Linearization of the Governing Equations- Lagrange Equations of Linear Mechanical Systems. Introduction-Natural Frequencies and the Natural Modes-The Zero-Input Response of Two-DoF Systems. (9)

STEERING SYSTEM AND ROAD MODELING : Steering system forces and moments calculation- EPS motor torque requirement and influence different parameters – parking torque estimation- dynamics of rack and pinion steering–concept of road modeling - Deterministic Profiles –Random profiles. (9)

SUSPENSION AND TIRE MODELING : Quarter car model - Kinematics of a Double Wishbone Suspension - Modeling Aspects - Constraint Equations - Spring Damper in Series tire modeling- – Pacejaka magic formula- brush and Dugoff model- Introduction to full car model with 16 DoF. (9)

MATHEMATICAL MODELING OF ELECTROMECHANICAL SYSTEMS : Mathematical models of DC servomotors - Mathematical Modeling of Operational-Amplifier Systems - Mechanical-Electrical Analogies: Force-voltage analogy -Force-current analogy-Mathematical Modeling of Liquid-Level Systems (9)

Total L: 45**TEXT BOOKS:**

1. Van Den Bosch , "Modeling, Identification and Simulation of Dynamical systems", 4th Edition, CRC press, 2014.
2. Van Der Klauw and Alan Shearer , "Dynamic Modeling and Control of Engineering", 2nd Edition, Springer and Verlag, 2015.

REFERENCES:

1. Guillaume Dubois , "Modeling and Simulation: Challenges and Best Practices for Industry", 1st Edition, CRC press, 2012.
2. Francois Axisa, Jose Antunes , "Modeling of Mechanical Systems: Fluid-Structure Interaction", 3rd Edition, Elsevier, 2015.

19A015 MODEL BASED DESIGN**3 0 0 3**

VEHICLE MODELING : Introduction to MBD- Quarter car –half-car and full car mathematical model-Governing differential equations -Development of SIMULINK model. (9)

SUSPENSION SYSTEM MODELING : Introduction- semi-active and fully active suspension system modeling – preview control suspension system – mathematical modeling of dampers and air springs-Development of SIMULINK model. (9)

STEERING SYSTEM MODELING : Introduction- steering torque computation based on steering geometry and wheel alignment- EPS motor model – Electrically powered hydraulic steering model.-Development of SIMULINK model. (9)

MODEL IN-LOOP SIMULATION : Introduction- Model in-loop simulation- software in loop simulation-processor in loop simulation concepts –V and V testing. (9)

HARDWARE IN LOOP SIMULATION(HILS) : Introduction- HILS- case studies- integration of SILS and HILS.- HILS test bench basics, (9)

Total L: 45

TEXT BOOKS:

1. Manfred Hiller, Roberto Bardini , "Vehicle dynamics – Modeling and Simulation", 2nd Edition, Springer, 2013.
2. Ann Eriksson, John Nielsen , "Modeling and control of Engines and Drivelines", 3rd Edition, John Wiley and Sons, 2014.

REFERENCES:

1. Galip Ulsoy, Hwei Peng , "Automotive Control systems", 2nd Edition, Cambridge University press, 2012.
2. Nicolas Navet, Francoise Simonot-Lion , "Automotive Embedded Systems Handbook", 3rd Edition, CRC press, 2016.

19A016 SURFACE FINISHING PROCESS**3 0 0 3**

METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING : Need and relevance of surface engineering - pretreatment of coating, General cleaning process for ferrous and non ferrous metals and alloys - selection of cleaning process – alkaline cleaning – emulsion cleaning - ultrasonic cleaning – acid and pickling salt bath des caling - abrasive bath cleaning - polishing and shot peening - classification of surface engineering processes. (9)

THERMAL SPRAYING PROCESSES AND ELECTRODEPOSITED COATINGS : Thermal spraying – flame, arc, plasma and HVOF processes – PLV process - design for thermally sprayed coatings - coating production - spray consumables principles of electroplating - Technology and control electroplating systems - properties and Faraday's Law - factors affecting throwing power - Applications of electrodeposites - non-aqueous and electroless deposition. (9)

HOT DIP COATING AND DIFFUSION COATINGS : Principles – surface preparation batch coating and continuous coating process – coating properties and applications - Principles of cementation - cladding - Diffusion coating of C.N. Al, Si, Cr and B - structure, properties and application of diffusion coatings - chemical vapour deposition - physical vapour deposition. (9)

NON-METALLIC COATING OXIDE AND COVENSION COATINGS : Plating coating – laequers - rubbers and elastomers - vitreous enamels - anodizing phosphating and chromating - application to aluminium, magnesium, tin, zinc, cadmium copper and silver - phosphating primers. (9)

QUALITY ASSURANCE, TESTING AND SELECTION OF COATINGS : The quality plan – design - testing and inspection of thickness adhesion - corrosion, resistance and porosity measurement - selection of coatings - industrial applications of engineering coatings. - Basic mechanisms of wear - abrasive, adhesive wear, contact fatigue - fretting corrosion - testing wear resistance practical diagnosis of wear. (9)

Total L: 45**TEXT BOOKS:**

1. S. Grainger, J. Blunt , ""Engineering coatings - design and application"", 2nd Edition, Abington Publishing, Woodhead Publishing Ltd, England, 2008
2. P. A. Dearnley , ""Introduction to Surface Engineering"", 1st Edition, Cambridge University Press, USA, 2017.

REFERENCES:

1. Parthasarathy. N.V , ""Electroplating Handbooks", Prentice Hall, 1992.
2. Gabe. D.R. , ""Principles of Metal surface treatment and protection", Pergamon, 1990.
3. Niku-Lavi , ""Advances in surface treatments"", Pergamon, 1990. ASM, 1994.

19A017 INTERNET OF THINGS**3 0 0 3**

INTRODUCTION : Industrial revolution - Germany's leadership role - digitalization as a megatrend - Industry 4.0 - smart products - smart engineering - platforms and ecosystems - artificial intelligence - big data - the cloud - reference architecture - standardization - projects in practical application. - intelligent worker assistance systems. (9)

EFFICIENT FACTORY : Applications - components and operating - materials as information carriers – paperless quality assurance - digital value stream mapping - status and energy monitoring - flexible. (9)

THE INDUSTRIAL INTERNET : Demands to a modern product development process - industrial internet - PLM to SysLM - demands to SysLM solutions. (9)

INDUSTRIE 4.0 - DIGITAL REDESIGN OF PRODUCT CREATION AND PRODUCTION : Projects at the production technology center - industrial information technology as the metronome of Industrie 4.0 - information factories. (9)

THE INTERNET OF THINGS, SERVICES AND PEOPLE : The "intelligence" of machines - shifting system barriers – data enables integrated operations - data scientists and process knowledge - step by step to the IoTSP. (9)

Total L: 45

TEXT BOOKS:

1. Ulrich, S , "The Internet of Things: Industrie 4.0 Unleashed", Springer-Verlag, 2018.
2. Jeschke S, Brecher C, Song H, Rawat D B , "Industrial Internet of Things: Cybermanufacturing Systems", Springer, 2017.

REFERENCES:

1. Stark John , "Product Lifecycle Management (Volume 1)", Springer International Publishing, 2015.
2. Alasdair Gilchrist , "The Industrial Internet of Things", Apress, 2016.
3. Sabina Jeschke, Christian Brecher, Houbing Song, Dana B. Rawat , "Industrial Internet of Things: Cyber- manufacturing Systems", Springer, 2017.

19A018 ARTIFICIAL INTELLIGENCE

3 0 0 3

INTRODUCTION : Artificial Intelligence - history - the state of the art - intelligent agents - structure - environment. (5)

SEARCH STRATEGIES : Breadth - first Search - uniform cost search - depth - first search - depth - limited search - iterative deepening search - bidirectional search - heuristic search techniques - A* Search - AO* Algorithm - adversarial search: Minimax algorithm - Alphabeta pruning. (12)

KNOWLEDGE AND REASONING : Representation - first order predicate logic – inference – unification - forward and backward chaining - resolution - reasoning with default information - truth maintenance systems - acting under uncertainty - statistical reasoning - probability and bayes theorem - certainty factors and rule based systems – dempster. (10)

PLANNING AND LEARNING : Planning with state space search: partial order planning - planning graphs - Examples. forms of learning: inductive learning - explanation based learning - statistical learning - learning with complete data. (10)

NATURAL LANGUAGE PROCESSING : Phrases - syntactic processing - semantic analysis - discourse and pragmatic processing (8)

Total L: 45

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig , "Artificial Intelligence - A Modern Approach", Fifth, Pearson Education, New Delhi, 2015.
2. Elaine Rich and Kevin Knight , "Artificial Intelligence", Third, Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCES:

1. Dan W Patterson , "Introduction to AI and Expert Systems", Fourth, Prentice Hall of India, New Delhi, 2010.
2. Eugene Charniak and Drew McDermott , "Introduction to Artificial Intelligence", Fifth, Pearson Education, New Delhi, 2010.
3. Nils J Nilsson , "Principles of Artificial Intelligence", Fourth, Narosa Publishing House, New Delhi, 2011.

19A019 INTRODUCTION TO DIGITAL SIGNAL PROCESSING

3 0 0 3

DISCRETE-TIME SIGNALS AND SYSTEMS : Need and benefits of Digital Signal Processing –Signal classification and basic operations on them – LTI system –Impulse response - Convolution sum and Correlation - I/O relationship - determination of Impulse response and Step response using Z transformation - A Typical DSP system. (9)

DISCRETE TRANSFORMS : Fourier Series and Fourier Transform - Discrete Fourier Transform (DFT) - Properties – DIT - FFT and DIF - FFT radix2 algorithms - linear filtering via circular convolution - inverse FFT (9)

DESIGN OF IIR DIGITAL FILTERS : Characteristics and applications of IIR filters - Design techniques for analog filters - frequency transformation - Digital IIR filter design: impulse invariant and bilinear transform methods – Canonical forms of Realization : direct, cascade, and parallel forms. (9)

DESIGN OF FIR FILTERS : Characteristics and applications of FIR filters - FIR filter design using Window functions - Canonical forms of Realization. Finite Word Effects- A/D quantization noise – Product round off errors - Finite word length effects in IIR filters and FFT algorithms - Computer architectures for signal processing – pipelining - hardware multiplier – accumulator - special instructions - extended parallelism : SIMD, VLIW, and super scalar processing. (9)

GENERAL-PURPOSE DIGITAL SIGNAL PROCESSORS : Computer architectures for signal processing – pipelining - hardware multiplier – accumulator - special instructions - extended parallelism : SIMD, VLIW, and super scalar processing (9)

Total L: 45

TEXT BOOKS:

1. Lonnie C Ludeman , "Fundamental of Digital Signal Processing", Wiley, New Delhi, 2011.
2. Emmanuel C Ifeachor, Barrie W Jervis , "Digital Signal Processing, A practical approach", Pearson Education, New Delhi,2012.

REFERENCES:

1. John G Proakis , "Digital Signal Processing : Principles , Algorithms, and Applications", Pearson Education, New Delhi, 2012.
2. Sanjit K Mitra , "Digital Signal Processing, A Computer based Approach", Tata McGraw-Hill, New Delhi, 2010.

19A020 MOBILITY AND INFRASTRUCTURE

3 0 0 3

MOBILITY : Need for sustainable personal mobility - combination of transformative ideas - implementation. (9)

THE NEW DNA OF THE AUTOMOBILE : The evolution of the automobile and its DNA - emerging problems and opportunities - synergies between electrification and connectivity - the emerging personal mobility revolution. (9)

THE MOBILITY INTERNET : Networked computing and control - trip times and congestion - dedicated smart vehicle lanes - new driving and riding experiences. (9)

REINVENTING THE AUTOMOBILE FOR URBAN USE : Limitations of existing vehicle designs for urban use - the simplicity of battery-electric vehicles - emerging vehicle concepts - personal urban mobility and accessibility - affordability. (9)

CLEAN, SMART ENERGY SUPPLY : New energy supply chains for automobiles - the complementary nature of electricity and hydrogen - the effects of energy density - the opportunity of evolving battery technology – design requirements for a charging infrastructure - potential electrification of roadways. (9)

Total L: 45

TEXT BOOKS:

1. William J. Mitchell, Bruce E. Hainley, Lawrence D. Burns , "Reinventing the Automobile – Personal Urban Mobility for the 21st Century", MIT Press, 2015.
2. Venkat Sumantran, Charles Fine, David Gonsalvez , "Faster, Smarter, Greener - The Future of the Car and Urban Mobility", MIT Press, 2017.

REFERENCE:

1. John Stark , "Global Products", Springer-Verlag London Ltd, 2007.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Dana B. Rawat , "Industrial Internet of Things: Cyber- manufacturing Systems", Springer, 2017.

19A021 VIRTUAL PRODUCT DEVELOPMENT

3 0 0 3

VIRTUAL REALITY TECHNOLOGY : A concept for a multipurpose - multi-modal interface for product engineering applications - virtual reality systems - Haptic systems - fully-isotropic parallel mechanisms - collision detection - virtual mechanisms. (9)

VIRTUAL REALITY AIDED DESIGN : Concept - framework - hand motions in conceptual shape design - use of VR in automotive industry. (9)

VIRTUAL TESTING AND PROTOTYPING : Modeling - simulation and visualization - virtual prototyping of automotive -virtual and real testing of products. (9)

VIRTUAL MANUFACTURING : Automated design analysis - assembly planning and motion - analysis of design and manufacturing tasks using Haptic and immersive. (9)

CASE STUDIES : Applications in automobile engineering. (9)

Total L: 45

TEXT BOOKS:

1. Talaba Doru, Amditis Angelos , "Product Engineering Tools and Methods Based on Virtual Reality", Springer, 2008.
2. Alan B Craig, William R Sherman, Jeffrey D Will , "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.

REFERENCES:

1. Tom Dieck M Claudia, Jung Timothy , "Augmented Reality and Virtual Reality", Springer, 2018.

19A022 MOTOR TRANSPORT

3 0 0 3

MODES OF TRANSPORT AND TRANSIT OPERATION : Modes of transport - road transport - Types of roads - advantages - motor transport in India. Route planning - Route location - stop location - route schedules – vehicle and labor scheduling. Traffic control - Traffic signals - signal timing. (9)

COSTS & FARES : Operating costs and types of vehicles - types of fare structure - types of fare collecting methods - Requirement of buses and frequency - construction of bus station. (9)

FORMS OF OWNERSHIP : Sole proprietorship - partnership - private limited company - public limited company - statutory company - local authority undertaking / municipal transport company - joint venture. (9)

GARAGE MANAGEMENT AND VEHICLE MAINTENANCE : Garage administration - types of garages - one spanner - two spanner - three spanner - break down truck symbol - government approved workshops – Tools- Objectives of maintenance - breakdown maintenance - preventive maintenance - tyre maintenance tips and failures. Fuel saving techniques and fitness certificate (9)

LEGAL ASPECTS : Motor vehicle act 1988 - Registration - necessity of permits - insurance - test of competence to drive - mistake / offences for which a driver can be punished - adult workers - Hours of work - running time – split duty - journey time - round journey time - layover - frequency (9)

Total L: 45

TEXT BOOKS:

1. John Dolu, Manage , "Fleet management", McGraw-Hill Co, 2009.
2. Crouse, William H, Anglin, Donald L , "Automotive Mechanics", McGraw-Hill Companies, 2007.

REFERENCES:

1. Government Publication , "The Motor vehicle Act 1988", 1988.
2. Kitchin L.D , "Bus operation", Illiffe and Sons Ltd, London, 1992.
3. Gilles, Tim , "Automotive Service – Inspection, Maintenance, and Repair", Alar Elken Publications, 2007.
4. Khanna O.P , "Industrial Engineering and Management", Dhanpat Rai Publications, 2010.

19A023 SOLAR VEHICLES

3 0 0 3

INTRODUCTION : Solar constant - solar time - angle of incidence - design of method - isotropic - transmittance - diffuse radiation - solar radiation - Measuring Sunlight - Sunlight Emulation - collecting sunlight (9)

PHOTOVOLTAIC CELLS : Photoelectric effect - metals, semiconductors, insulators - absorption of light - doping - drift current - diffusion current - semiconductor resistivity - semiconductor fundamental equations - the Poisson's equation - continuity equation - Photoelectric effect - metals, semiconductors, insulators - absorption of light - doping - drift current - diffusion current - semiconductor resistivity - semiconductor fundamental equations - the Poisson's equation - continuity equation (9)

DESIGN AND CONTROL OF DC-AC INVERTERS : Boost converters - MPPT - perturb and observe algorithm - incremental conductance - neutral point clamp - multi level inverter - active and reactive power control - multi level inverter. Solar electric drive - losses (9)

SMART-GRID INTERACTION WITH ELECTRIC VEHICLES : Electric Vehicle Integration with a Smart Grid – Electric Vehicle Integration with Renewable Energy - V2G: Impact, Potential, and Challenges (9)

SOLAR VEHICLE INSTRUMENTATION : Current - voltage - temperature - speed - battery charge - radiation - instrument panel - telemetry - solar Racer—concept generation and selection (9)

Total L: 45

TEXT BOOKS:

1. Springer International Publishing, Vancouver, 2015.
2. Gary B, Erickson J, Eugene L, Robinson and Jessica , "Solar Powered Charging Infrastructure for Electric Vehicles: A Sustainable Development", First, CRC, New York, 2017.

REFERENCES:

1. Seba T , "Solar Trillions", beta edition, Tony Seba, Cincinatti, 2014. Taylor & Francis, New York, 2015.
2. Hayes.G and Goodarzi , "Electric Powertrain- Energy systems, power electronics and drives", First, Jhon Wiley, Sussex, 2018.

19A024 VEHICLE COMMUNICATION SYSTEMS

3 0 0 3

AUTOMOTIVE COMMUNICATION SYSTEMS : Introduction to Bluetooth – Pairing - HFP - A2DP - PAN - PBAP - DUN. Concepts of MOST network - DLNA - AVB. Concepts of TCP/IP - Ethernet - WiFi - WiFi Direct - MyWiFi and CAN - Mirror link - Tethering. (9)

INFOTAINMENT SYSTEMS FUNDAMENTALS : Introduction to In Vehicle Infotainment (IVI) systems - Use of operating systems in IVI - GENIVI Alliance-Tuner- AM/FM - XM/Sirrus - DAB/DMB - Software Defined Radio - Ensemble - Traffic Announcements - Spread Spectrum-Multimedia: Types of Media. Navigation- Points of Interests - Routes - Waypoints - Dead Reckoning position - Traffic Info - GLONASS - GNSS - RTK - GPS - and SBAS/GBAS - INS - System Architecture – Design Patterns - Proxies - Adaptors - Interfaces - Singleton - Factory method. (9)

TELEMATICS AND SECURITY SYSTEMS : Telematics-Global positioning systems - geographical information systems - navigation systems - automotive vision system - road recognition - driver assistance systems. Security Systems- Vehicle Immobilizers - Anti theft technologies - smart card system - number plate coding. (9)

COMFORT SYSTEMS : Introduction - driver support systems – driver information - driver perception - driver convenience - driver monitoring. Vehicle support systems – general vehicle control - collision avoidance - vehicle status monitoring -HMI Systems-collapsible and tilt table steering column - power windows - X-by wire technologies-Steer by wire system - Brake by wire system and Drive by wire system (9)

ADVANCED DRIVER ASSISTANCE AND SAFETY SYSTEM : Active Safety Systems -and Passive Safety Systems - Advanced Driver Assistance Systems (ADAS)-Combining computer vision techniques as pattern recognition - feature extraction - learning - tracking - 3D vision to assist the driving activity. Examples of assistance applications- Lane Departure Warning - Collision Warning - Automatic Cruise Control - Pedestrian Protection – Headlights Control - Connected Cars technology and trends towards Autonomous vehicles. (9)

Total L: 45

TEXT BOOKS:

1. William B Ribbens , "Understanding Automotive Electronics", Butter worth Heinemann Woburn, 2012.
2. Yunpeng Wang, Daxin Tian, Zhengguo Sheng, Wang Jian , "Connected Vehicle Systems: Communication, Data, and Control", 2nd Edition , CRC publisher, 2017.

REFERENCES:

1. Dennis Foy , "Automotive Telematics", Red Hat Publishers, 2002.
2. Markus Mueck, Ingolf Karls , "Networking Vehicles to Everything: Evolving Automotive Solutions", DEG Press, 2018.

19A025 AUTOMOTIVE STYLING**3 0 0 3**

VISION : Identifying opportunity - defining a vision - setting targets - opportunities in portfolio - research examples of personal - design manifesto and design movements - spreading the word and generating a mission statement - understanding the interplay between brand and design brief - creating a design brief. (9)

IDEATE : Explore various vehicle packages and technical solutions based on the needs of target customer and market opportunity - structure and a framework for vehicle architecture - explore unique visual DNA for a vehicle based on objectives - begin to explore surface language - selecting key directions and identifying themes - understanding segmentation and competitive benchmarking. (9)

DEVELOP : Character development and processing imagery - establishing an architectural and visual foundation - design development in full-size - refining proposals and making a final selection - creating an initial design prototype - final theme selection. (9)

MODEL : Virtual 3D and the digital design process - digital sketch modeling - 3D data development – rapid validation mockups. (9)

BUILD AND LAUNCH : Vetting an idea - engineering - processing - market research - early-stage vetting for designers - presenting to clients management and key stakeholders - pitching to prospective users - selling new viewers on an idea - launching a vehicle. (9)

Total L: 45**TEXT BOOKS:**

1. Jordan Meadows , "Vehicle Design: Aesthetic Principles in Transportation Design", Taylor & Francis Group, 2018.
2. Tony Lewin, Ryan Borroff , "How to Design Cars Like a Pro", Motor Books International, 2010.

REFERENCES:

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

19A026 ELECTRIC VEHICLE DESIGN**3 0 0 3**

BEVS DYNAMICS, POWERTRAIN COMPONENT MODELING, AND HEAT TRANSFER MODELLING : Battery electric vehicle (BEV) powertrain - Vehicle dynamics - Vehicle dynamics - Transmission - auxiliary loads - Electric Vehicle Chassis and Body Design - Body/Chassis Requirements - Layout - Strength, Rigidity and Crash Resistance - Designing for Stability - Suspension for Electric Vehicles - Chassis used in Modern Battery and Hybrid Electric Vehicles (12)

DRIVE DESIGN FOR EVS : Different drives - induction machines - BLDC –SRM motors - constant power - constant torque regions - Number of phases - Frequency - Rated output in kW - Type of duty - Voltage connections - Temperature rise - Speed - Pullout torque - Starting torque - Starting current - Power factor - Efficiency/losses -Class of insulation (10)

ELECTRIC MOTOR AND DRIVE TRAIN CONTROLLER DESIGN : Brushless motor design considerations – innovative drive scheme - motor cooling - efficiency - size and mass - improving motor efficiency (8)

ENERGY STORAGE MODELLING : Purpose of Battery Modelling - Equivalent Circuit - Modelling Battery Capacity - Simulating a Battery at a Set Power - Calculating the Peukert Coefficient - Approximate Battery Sizing – Battery Swapping (7)

DESIGN OF ANCILLARY SYSTEMS : Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks (8)

Total L: 45

TEXT BOOKS:

1. Larmine J and Lowry J , "Electric Vehicle Technology Explained", First, John Wiley & Sons, Vancouver, 2012.
2. Hayes.G and Goodarzi , "Electric Powertrain- Energy systems, power electronics and drives", First, Jhon Wiley, Sussex, 2018.

REFERENCES:

1. Mi Chris and Masur Abul , "Hybrid electric vehicles", 3rd Edition, John Wiley, 2018.
2. Liu Wei , "Introduction to Hybrid vehicle systems Modeling and Control", 1st Edition, John Wiley, 2017.

19A027 POWER TRAIN DESIGN (ELECTRIC AND HYBRID)

3 0 0 3

CONCEPT OF ELECTRIFICATION : Constituents of a conventional vehicle - Vehicle and propulsion load - drive cycles and drive terrain - constituents of a PHEV - vehicle model - EV powertrain component sizing – electrically peaking hybrid concept - gradability Requirement (9)

ADVANCED HEV ARCHITECTURES AND DYNAMICS OF HEV POWERTRAIN :Principle of Planetary Gears - Operating Principle of the Two-Mode Powertrain - Gear Shift Schedule - DCT-Based Hybrid Powertrain - Regenerative Braking Mode - Electric CVT Mode - Energy Recovery Mode (9)

PLUG-IN HYBRID ELECTRIC VEHICLES : Plug-In Hybrid Electric Vehicles - Blended PHEVs - Equivalent Electric Range of Blended PHEVs - Utility Factor - Power Management of PHEVs - Component Sizing of EREVs (9)

MODELING AND SIMULATION OF ELECTRIC AND HYBRID VEHICLES : Fundamentals of Vehicle System Modeling - Hybrid Powertrain Modeling - Modeling of Vehicle Dynamics - Bond Graph Modeling Techniques - Consideration of Numerical Integration Methods. (9)

HEVS COMPONENT SIZING AND DESIGN OPTIMIZATION : Algorithm Description - Flow Chart - Operators and Selection Method - Particle Swarm Optimization - Model-in-the-Loop Design Optimization Process - Genetic Algorithm modelling (9)

Total L: 45

TEXT BOOKS:

1. Mi Chris and Masur Abul , "Hybrid Electric Vehicles", Fourth, John Wiley, Heidelberg, 2018.
2. Liu Wei , "Introduction to Hybrid vehicle systems Modeling and Control", Third, John Wiley, Zurich, 2018.

REFERENCES:

1. Emadi Ali , "Advanced Electric Drive Vehicles", First, Taylor & Francis, New York, 2015.
2. Yangsheng Xu, Huihuan Qian, Jingyu Yan and Tin Lun Lam , "Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids", 1st Edition, McGraw Hill, New York, 2014.

19A028 POWER ELECTRONICS AND DRIVES

3 0 0 3

INDUCTION MOTOR DRIVES : Speed control of 3 phase Induction Motors - Stator control - PWM &V/f control - rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Kramer and Scherbius drives - Introduction to Vector Controlled Induction Motor Drives (9)

SYNCHRONOUS MOTOR AND BLDC MOTOR DRIVES : Speed control of 3 phase Synchronous Motors - True synchronous and self-controlled modes of operation - PMSM: principle-flux density distribution-Types - BLDC motor : Principle-drive scheme - converter topologies (9)

RELUCTANCE MOTOR DRIVES : DC servo drives -principle of operation - AC servo drives- principle of operation - Stepper motor – principle of operation - SRM drives - principle of operation - drives - Introduction to synRM drives (9)

DIGITAL CONTROL AND DRIVE APPLICATIONS : Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives - networking of drives - Selection of drives and control

schemes for Steel rolling mills - Paper mills - Cement mills - Machine tools - Lifts and Cranes. Solar and battery powered drives. (9)

ADVANCED MOTOR DRIVES : Magnetic gear drive- Converted magnetic gears - field modulated magnetic gears - MG Machines- Principle- Modeling- Inverters-MG motor control - Vernier Permanent Magnetic motor- principle - modelling- inverters- PM motor control - Advanced Magnetless motor drives - Planetary-gear electric variable transmission system - double rotor electric variable transmission system (9)

Total L: 45

TEXT BOOKS:

1. Stefanos Manias , "Power Electronics and Motor Drive System", Elsevier, 2010 , .
2. Gonzalo Abad , " Power Electronics and Electric Drives For Traction Applications", 2nd Edition, John Wiley 2012, .

REFERENCES:

1. Krishnan R , "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India, 2013
2. Vedam Subramanyam , "Electric Drives: Concepts and ApplicationsII", Tata McGraw-Hill,, 2009

19A029 AUTOMOTIVE COMMUNICATION PROTOCOLS

3 0 0 3

BASICS OF DATA COMMUNICATION NETWORKS AND AUTOMOTIVE COMMUNICATION PROTOCOLS : Need for networks - Types of networks - Need for standards - TCP/IP model - Topologies - Error detection and correction mechanisms - Encoding schemes - Serial/parallel transmission - Bits - Baud and bandwidth - Synchronous and asynchronous - Need and benefits of IVN - Classes of IVN protocols - Multiplexed electrical systems – Vehicle multiplexing - Bitwise contention - Network elasticity - Error processing and management and Case Study (9)

CONTROLLER AREA NETWORK (CAN) PROTOCOL : History and foundation of CAN - CAN Applications - Main characteristics of CAN - CAN in OSI Reference Model - CAN Data Link Layer - Principles of data exchange in CAN - Arbitration - Data Frame - Remote Frame - Error detection and management in CAN - CAN physical Layer - Bit encoding - Bit timing and synchronization - Relationship between data rate and bus length - Single wire and twin wire media - CAN repeaters - Medium-to-medium gateway - Protocol handlers - Micro-controllers and line drivers - TimeTriggered CAN (TTCAN) - Comparison with other IVN protocols - CANoe based applications development (9)

CAN HIGHER LAYER PROTOCOLS AND LIN : CAN Higher Layer Protocols: CAN in Automation (CiA) - CANopen - CANopen device model - CANopen features - DeviceNet - DeviceNet Model - Device Object Model - DeviceNet Features - SAEJ1939 - SAE J1939 Reference Model - CANkingdom and Case Study Local Interconnect Network (LIN) Protocol: Introduction to LIN - LIN consortium - LIN specification - LIN features - Technical overview - Work flow concept - LIN operation - LIN frame format - Scheduling table - Network management of LIN cluster - LIN Transport Layer - LIN node configuration and identification - LIN diagnostics - LIN physical layer - Comparison with other IVN protocols and Case Study (9)

FLEXRAY AND MOST PROTOCOL : FlexRay Protocol: Future on board systems - Need for FlexRay - Origin of FlexRay - FlexRay consortium - FlexRay Objectives - FlexRay Features - Application requirements - Working of FlexRay - Network topologies - FlexRay frame format - Error control - Medium Access Control - Clock Synchronization - Comparison with other IVN protocols and Case Study Media Oriented System Transport (MOST) Protocol: Emerging in car systems - Introduction to MOST - Cables and Connectors - Data Types - Topology - Frame Format - Application Areas - System Description - Specification - Device Model - Device Implementation - Diagnostics and Case Study (9)

IN VEHICLE NETWORK DIAGNOSTICS : Process of Automotive Fault Diagnostics - Fault Codes - Vehicle Systems (open-loop and closed-loop) On- and Off- Board Diagnostics - OBD-I - OBD-II - Engine Analyzers - Steps taken to diagnose a fault - Diagnostics Protocol-KWP2000 - SAE-J1587 - SAE-J1708 and Case Study (9)

Total L: 45

TEXT BOOKS:

1. Gilbert Held , "Inter- and Intra-Vehicle Communications", CRC Press, 2007.
2. Wayne Tomasi , "Introduction to Data communication and Networking", Pearson, 2017.

REFERENCE:

1. Behrouz Forouzan , "Data Communications and Networking", McGraw-Hill, 2007.

19A030 VEHICLE DIAGNOSTIC SYSTEMS

3 0 0 3

INTRODUCTION FAULT DIAGNOSIS : Introduction to fault diagnosis - safe working practices and techniques. Diagnostics on paper - mechanical and electrical diagnostic techniques faults codes - systems and standards. On- and - Off board diagnostics. Data sources - tools and equipments. Oscilloscopes - Scanners/Fault code readers - engine analyzers. Application methods and procedures. (9)

ON AND OFF BOARD DIAGNOSTICS : Introduction to Oscilloscope Diagnostics - Sensors and actuators associated with Oscilloscope Diagnostics - On-Board Diagnostics various perspectives - Petrol/Gasoline On-Board Diagnostics - On-board sensors and actuators - sensors and actuators - comparative case Study. (9)

ENGINE SYSTEM DIAGNOSIS : Introduction to engine systems diagnostics engine operation and fuel system ignition system and emission system fuel injection - Starting and charging system power flow control and energy efficiency analysis. Engine management and fault finding Information. Air supply - exhaust system - cooling and lubrication system. (9)

CHASSIS AND BRAKE SYSTEM DIAGNOSIS : Introduction To engine system diagnostics - Anti-lock braking system diagnostics - Traction control system diagnostics - Steering and tires transmission systems diagnostics - Automobile engineering diagnostics on steering and tires - Case study on diagnostics of sub assemblies. (9)

ELECTRICAL SYSTEMS DIAGNOSIS : Introduction to electronic components and circuits - multiplexing and De multiplexing lighting system faults and auxiliary faults in-car. Entertainment security and communications implementation body-electrical systems - instruments system faults - heating ventilation and air conditioning - Cruise control - air bags and belt tensioners - Cycle test-I - Cycle test-II. (9)

Total L: 45

TEXT BOOKS:

1. Tom Denton , "Advanced Automotive Fault Diagnosis", Elsevier Butterworth-Heinemann linacre House, 2016.
2. Tom Denton , "Automotive Electronics Handbook", 2nd Edition, TATA McGraw-Hill Publishing Co. 2007.

REFERENCES:

1. Routledge , "Automobile Electrical and Electronic Systems", Fourth, 2012.
2. Newnes , "Understanding Automotive Electronics", 6th Edition, 2003.

19A031 ADVANCED MATERIALS FOR GREEN VEHICLES

3 0 0 3

INTRODUCTION : Composite materials- Foam cored steel composite box beams -Plastic mouldings for open canopy shells- Reaction injection molding –Resin transfer molding – sheet Molding compounds- Ultra light weight construction case study (9)

GREEN COMPOSITE MATERIALS FROM LIQUEFIED BIOMASS : Introduction|- Liquefaction technique|- Foams|- Polyurethane foams (PUFs) from liquefied lignocellulosics Phenolic foam from liquefied lignocellulosics|- 1Molding materials- Liquefied wood as replacement in novolac-type resin- based composites|- Epoxy-type resins from liquefied biomass (9)

GREEN FIBERS : Introduction- Kenaf- Hemp- and Flax fibers- advantages and limitation- mechanical properties and comparison with Glass fiber- limitation- Binders used- Thermal resistance and chemical resistance (9)

BIODEGRADABLE POLYMER MATRIX : Poly-lactic acid (PLA) – synthesis- mechanical properties - thermal and creep properties- compression and injection molding - Factors Influencing Processing of Green Composite - Performance of Green Composite (9)

DESIGN OF GREEN BIO-COMPOSITES : Basics of green composite design- Failure Prediction in a Unidirectional Lamina- Maximum Stress Theory- Maximum Strain Theory- Tasi-Wu Failure Theory- Failure Prediction in Random Fiber Laminates- Tensile Testing of Bio-Composites- Impact Test of Bio-Composites (9)

Total L: 45

TEXT BOOKS:

1. Srikanth Pilla, Charles Lu , "Biocomposites in Automotive Applications", 2nd Edition, SAE International,, 2015.

2. Amar K. Mohanty, Manjusri Misra , "Natural Fibers, Biopolymers, and Biocomposites", 2nd Edition, CRC Taylor and Francis, 2009.

REFERENCES:

1. Georgios Koronis, Arlindo Silva , "Green Composites for Automotive Applications", 1st Edition, Woodhead Publisher, 2017.
2. Caroline Baillie , "Green Composites: Polymer Composites and the Environment", 1st Edition, Woodhead Publishing Limited, 2005.

19A032 FLEXIBLE MANUFACTURING SYSTEM

3 0 0 3

PRODUCTION SYSTEMS : Types of production - Job Shop, Batch and Mass production - Functions in manufacturing - Plant layouts: Process, product - fixed position - cellular layouts - Automated production systems; Automation principles and strategies - automated assembly lines (9)

FMS IMPLEMENTATION : Characteristics, types, equipments and its functions - Types of flexibility and performance measures - Planning phases, integration, system configuration - FMS layouts, simulation, FMS project development steps - Project management: Equipment development - host system development - functions of FMS host computer - FMS host - area controller function distribution - hardware and software development (9)

GROUP TECHNOLOGY AND PROCESS PLANNING : Group technology: Formation of part families-part classification - coding system, OPITZ and multi class coding systems - Production flow analysis-machine cell design - clustering methods, modern algorithms - benefits of GT - system planning - Process planning- approaches to automated process planning - study of a typical process plan - Manufacturing planning and control (9)

AUTOMATED MATERIAL HANDLING AND STORAGE : Automated material handling: Functions, types - analysis of material handling equipment - Design of conveyor and AGV systems - AS/RS; Storage: System performance, carousel storage system - WIP storage system - Interfacing material handling and storage with manufacturing (9)

MODELING AND ANALYSIS OF FMS : Simulation and petrinet modeling techniques - Lean and agile manufacturing concepts - JIT - Kanban - Poke Yoke (9)

Total L: 45

TEXT BOOKS:

1. H. K. Shivanand, M M Benal, V. Koti , ""Flexible Manufacturing System"", 1st Edition, New Age International Private Limited, Bengaluru, 2009.
2. Mikell P. Groover , ""Automation Production Systems & Computer Integrated manufacturing"", 4th Edition, Prentice Hall of India, New Delhi, 2016.

REFERENCES:

1. David J. Parrish , ""Flexible Manufacturing"", Butterworth-Heinemann, USA, 1993.
2. Radhakrishnan P, Subramanyan S, Raju V , ""CAD/CAM/CIM"", 4th Edition, New Age International Pvt. Ltd, 2018.
3. Joshi S B, Smith J S. , ""Computer Control of Flexible Manufacturing Systems"", Springer, 2012.

19A033 VEHICLE STABILITY AND CONTROL

3 0 0 3

LATERAL VEHICLE DYNAMICS AND CONTROL : Introduction -Kinematic Models - Dynamic Bicycle Model – From Body Fixed to Global Coordinates- State Feedback - Steady State Analysis- Steady State Cornering (9)

LONGITUDINAL VEHICLE DYNAMICS AND CONTROL : Introduction -Longitudinal Vehicle Model - Driveline Dynamics- Cruise control - Control System Architecture - Adaptive Cruise Control 4) Individual Vehicle Stability and String Stability - Automated Highway Systems - Longitudinal Control for Vehicle Platoons - String Stability with Inter- Vehicle Communication - Overview of Tire Models (9)

ELECTRONIC STABILITY CONTROL : Introduction -Vehicle Model - Control Design for Differential Braking Based Systems - Control Design for Steer-by-Wire Systems - Independent All Wheel Drive Torque Control (9)

AUTOMOTIVE SUSPENSION CONTROL : Introduction- LQR Formulation for Active Suspension Design- Performance of the Sky-Hook Damping Controller -Control with Hydraulic Actuators Optimal Semi-Active Suspensions- Interpretation of the Optimal Semi-Active Control Law - Calculation of Transfer Function Plots with Semi-Active Control Law (9)

ROLLOVER PREVENTION CONTROL : Introduction- Rollover Dynamics - Rollover Index and Active Rollover Prevention - Comparison of Performance with Various Rollover Indices- Roll prevention by braking and engine control – Roll control using damper (9)

Total L: 45

TEXT BOOKS:

1. Dean Karnopp , "Vehicle Stability", 2nd Edition, Marcel and Decker, NEw York, 2009.
2. A. Galip Ulsoy, Huei Peng, Melih Çakmakci , "Automotive Control Systems", 1st Edition, Cambridge University Press, 2012.

REFERENCES:

1. Wuwei Chen, Hansong Xiao, Qidong Wang , "Integrated Vehicle Dynamics and Control", 1st Edition, Wiley Publisher, 2009.
2. Wong J Y , "Theory of Ground Vehicles ,", 4th Edition, John Wiley and Sons, 2012.

19A034 ALTERNATIVE SOURCES OF ENERGY

3 0 0 3

ENERGY DEMAND & SUPPLY : Energy supply-fossil fuel- nuclear fuel- renewable –energy prices- OPEC-politics- energy reserves- resources- the finite life of a resource. (9)

ENERGY STORAGE : Need to Store Energy- Electromechanical Storage - Thermal Storage - Chemical Storage: Batteries-Hydrogen Storage: The Hydrogen Economy- Fuel Cells- High-Temperature Fuel Cells – Thermodynamic Losses and Fuel Cell Efficiency. (9)

ECONOMICS OF ENERGY PROJECTS : Fundamental Concepts and Definitions- The Decision Making Process- The Time-Value of Money - Simple and Compound Interest- Cash Flow - Equivalence and Present Value – Cash Flow Calculations- Investment Appraisal Methods- NPV and Governmental Incentives or Disincentives. (9)

PHOTOVOLTAIC POWER PLANTS : Generation of electricity- output characteristics- dark-current electric parameters of a photovoltaic panel- model of a PV panel consisting of n cells in parallel- electric power supply- economic analysis of solar energy. (9)

POWER PLANT FUEL CELLS : Practical issues related to fuel cell stacking- low- and high-temperature fuel cells- constructional features - proton exchange-membrane fuel cells-DMFC-Solid oxide- load curve peak shaving with fuel cells- Maximal Load curve flatness at constant output power- reformers - electrolyzer systems - and related precautions. (9)

Total L: 45

TEXT BOOKS:

1. Michaelides E , "Alternate Energy Sources", Springer Heidelberg Dordrecht, London, 2012.
2. Faret F, Simoes , "Integration of Alternative Sources of Energy", John Wiley & Sons, 2010.

REFERENCES:

1. Neresian , "Energy for the 21st Century: A comprehensive guide to Conventional and Alternatives Sources", Springer, Berlin, 2012.
2. Mariano Martín , "Alternative Energy Sources and Technologies: Process Design and Operation", Springer international Publishing, 2016.

19A035 VEHICLE TESTING AND TROUBLE SHOOTING

3 0 0 3

WIND TUNNEL TEST : Test requirements - ground boundary simulation-wind tunnel selection and Reynolds number capability, model requirements, model details, model mounting - test procedure (9)

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 (9)

ENERGY CONSUMPTION TEST : Engine cooling fan, air conditioning and brake compressors, hydraulic pumps power consumption - Antilock brake systems energy consumption. (9)

VEHICLE SIMULATION AND TESTING : Fault insertion testing in system model - brake fluid leakage test in from single to all wheels - steering – vehicle in loop testing – braking test on split - conditions - Traction loss and roll instability simulation (9)

TROUBLE SHOOTING : Diagnosis of driveline systems - Diagnosis of chassis systems. (9)

Total L: 45

TEXT BOOKS:

1. Crouse W.H.and Anglin D.L. , ""Automotive Mechanics"" , Tata McGraw Hill Publishing Company,, New Delhi, 2004.
2. Rangan, Mani and Sharma , ""Instrumentation"" , Tata McGraw Hill Publishing Company,, New Delhi, 2004.

REFERENCES:

1. SAE Hand book , "SAE Hand book, Vol. 3," SAE Publications,, 2000.
2. Hucho W H , ""Aerodynamic of Road vehicles "" , Butterworth Co. Ltd., 2011.
3. Tim Gilles , ""Automotive Service"" , Delmar Publishers, 1998..
4. Beckwith TG. and Buck N L, ""Mechanical Measurements"" , Addition Wesley Publishing Company Limited,, 1995.

19A036 MODERN VEHICLE TECHNOLOGY

3 0 0 3

TRENDS IN AUTOMOTIVE POWER PLANTS : Hybrid Vehicles – Stratified charged / lean burn engines – Hydrogen Engines-battery vehicles – Electric propulsion with cables – Magnetic track vehicles. (9)

SUSPENSION BRAKES AND SAFETY : Air suspension-Closed loop suspension-anti-skid braking system - Retarders - Regenerative braking safety cage -air bags-crash resistance (9)

PASSENGER COMFORT NOISE & POLLUTION : Reduction of noise – Internal & external pollution control through alternate fuels/ power plants-Catalytic converters and filters for particular emission. (9)

VEHICLE OPERATION AND CONTROL : Computer Control for pollution. noise control and for fuel economy- Transducers and operation of the vehicle like optimum speed and direction (9)

VEHICLE AUTOMATED TRACKS : Preparation and maintenance of proper road network-National highway network with automated roads and vehicles-Satellite control of vehicle operation for safe and fast travel. (9)

Total L: 45

TEXT BOOKS:

1. Heinz Heisler , "Advanced Vehicle Technology", 2nd Edition, Butterworth and Heimenn, 2013.
2. James E. Duffy , "Modern Automotive Technology", 3rd Edition, Goodheart-Willcox Company, 2012.

REFERENCES:

1. Ljubo Vlacic, M. Parent, Fumio Harashima , "Intelligent Vehicle Technologies", 3rd Edition, Elsevier Publisher, 2014.
2. Julian Happian-Smith , "Introduction to Modern Vehicle Design", 3rd Edition, Butterworth and Heinemann Publisher, 2010.

19A037 ELECTRICAL CHARGING SYSTEM

3 0 0 3

INTRODUCTION : Introduction to energy management issues - energy consumption in road network - distribution of charging facilities - interaction with the power grid (9)

TRAFFIC MODELLING FOR ELECTRIC VEHICLES : Basic notions of Markov Chains and Graph Theory - energy consumption - traffic load control - selfish routing for EVs - collaborative routing under feedback – balancing charging loads - protocol implementation (9)

CHARGING EVS : EV charging schemes - control architectures - communication requirements - degree of control actuation - measurement and forecasting requirements - operational time scales - operational time scales - charging policies - Wireless charging (9)

VEHICLE TO GRID CHARGING : V2G and G2V management of EVs - assumptions and constraints - management of active/reactive power exchange - V2G power flows - unintended consequences of V2G operations (9)

SHARING ELECTRIC CHARGE POINTS AND PARKING SPACES : Introduction - setting: parking spaces - dimensioning and statistics - dimensioning formulae efficient allocation of premium spaces - turning private charge points into public ones smart charging unit (9)

Total L: 45

TEXT BOOKS:

1. Crissostomi E, Shorten R, Studli S and Wirth F , "Electric and Plug-in Hybrid Vehicle Networks –Optimization and Control", First, Taylor & Francis Group, New York, 2018.
2. Emadi. A , "Advanced Electric Drive Vehicles", First, Taylor&Francis, New York, 2015.

REFERENCES:

1. Hayes.G and Goodarzi , "Electric Powertrain- Energy Systems, Power Electronics and Drives", First, Jhon Wiley, Sussex, 2018.
2. Liu Wei , "Introduction to Hybrid vehicle systems Modelling and Control", 1st Edition, John Wiley, 2016.
3. Mi Chris and Masur Abul , "Hybrid electric vehicles", 1st Edition, John Wiley, 2018.

19A038 AUTOMOTIVE HVAC

3 0 0 3

REFRIGERATION : Methods of refrigeration - Air Refrigeration System and its applications - Vapour compression refrigeration system - Vapour absorption refrigeration system - Applications of refrigeration & air conditioning - Automobile air conditioning - Air conditioning for passengers, isolated vehicles, transport vehicles - Applications related with very low temperatures Classification, properties and selection criteria - Commonly used refrigerants - Alternative refrigerants - Eco-friendly refrigerants - Applications of refrigerants - Refrigerants used in automobile air conditioning (12)

PSYCHOMETRY : Psychometric properties, tables, charts - Psychometric processes - Comfort charts - Factor affecting comfort - Effective temperature - Ventilation requirements (6)

AIR CONDITIONING SYSTEMS AND LOAD ANALYSIS : Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc. Load Analysis: Outside & inside design consideration - Factors forming the load on refrigeration & air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance (9)

AIR DISTRIBUTION SYSTEMS : Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations. Air Routine & Temperature Control: Objectives - evaporator care air flow - Through the dash re - circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems. (9)

AIR CONDITIONING SERVICE AND CONTROL : Air conditioner maintenance & service - servicing heater system - Removing & replacing components - Trouble shooting of air conditioning system - Compressor service, methods of dehydration, charging & testing. Air Conditioning Control: Common control such as thermostats - Humidistat us - Control dampers - Pressure cutouts and relays (9)

Total L: 45

TEXT BOOKS:

1. Mark Schnubel , "Automotive Heating and Air Conditioning", 5th Edition, Today's Technician, 2013.
2. Steven Daly , "Automotive Air Conditioning and Climate Control Systems", 1st Edition, Butterworth Heinemann, 2006.

REFERENCES:

1. Norman C. Harris , "Modern Air-Conditioning Practice", McGraw-Hill Education, 1984.
2. R.J. Dossat , "Principles of Refrigeration", 5th Edition, Prentice Hall, 2001.
3. Paul Lung , "Automotive Air Conditioning", C.B.S. Publisher & Distributor, New Delhi, 1991.
4. Stoecker WF, Jones JW , "Refrigeration and Air-Conditioning", Tata McGraw Hill, New Delhi, 1982.

19A039 MODELLING AND SIMULATION OF INTERNAL COMBUSTION ENGINES

3 0 0 3

MODELLING OF IC ENGINES : Heat of reaction - Hrp and Urp calculations, adiabatic, constant volume combustion, constant pressure combustion, temperature drop due to fuel vaporization, adiabatic flame temperature, mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions. Spray models, flow models and combustion models. (9)

COMBUSTION IN SI ENGINES : Combustion in premixed flames - Stages of combustion, flame propagation, rate of pressure rise, cycle to cycle variation, abnormal combustion - Theories and effect of engine operating variables on combustion. (9)

COMBUSTION IN CI ENGINES : Combustion in diffusion flames - Droplet and spray combustion theory, stages of combustion, delay period, peak pressure, heat release, gas temperature and diesel knock. (9)

SIMULATION OF IC ENGINES : SI and CI engine simulation - Air standard cycle, fuel air cycle, progressive combustion cycle and actual cycle simulation - Part throttle, full throttle and supercharged conditions. (9)

SIMULATION OF NEW ENGINE CONCEPTS : Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine and controlled auto ignition engine. (9)

Total L: 45

TEXT BOOKS:

1. Ganesan V , "Computer Simulation of Spark-Ignition Engine Processes", Universities Press (I) Ltd, Hyderabad, 2009.
2. Ganesan V , "Computer Simulation of Compression-Ignition Engine Processes", University Press (I) Ltd, Hyderabad, 2010.

REFERENCES:

1. Ganesan V , "Internal Combustion Engines", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
2. Heywood J.B , "Internal Combustion Engine Fundamentals", McGraw Hill Book Co, USA, 1988.
3. Ramoss A L , "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co, 1992.
4. Ashley Campbell , "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986.

19A040 ADVANCED THEORY OF INTERNAL COMBUSTION ENGINES

3 0 0 3

COMBUSTION PROCESSES : Combustion in premixed and diffusion flames, combustion process in IC engines, adiabatic flame temperature, effect of super charging and scavenging on combustion. - Combustion in premixed and diffusion flames - combustion process in IC engines - adiabatic flame temperature - effect of super charging and scavenging on combustion. (9)

ABNORMAL COMBUSTION IN SI ENGINES : Stages of combustion - flame propagation - rate of pressure rise - cycle-to-cycle variation - abnormal combustion - theories of detonation - heat release. (9)

COMBUSTION AND KNOCK IN CI ENGINES : Droplet and spray combustion theory - stages of combustion – delay period - peak pressure - heat release - gas temperature - diesel knock. (9)

COMBUSTION OF FUELS : Combustion stoichiometry of petrol - diesel - alcohol and hydrogen fuels - chemical energy and heating values - chemical equilibrium and maximum temperature - flame velocity and area of flame front - fuel spray characteristics - penetration and atomization. (9)

ADVANCED IC ENGINES : Adiabatic and low heat rejection engines - homogeneously charged compression ignition engines & multi - fuel engines - stratified charged and lean burn engines. (9)

Total L: 45

TEXT BOOKS:

1. Heywood J B , "Internal Combustion Engine Fundamentals", McGraw Hill Book Co, USA, 2010.
2. Ganesan V , "Internal Combustion Engines", Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2008.

REFERENCES:

1. Lewis B, Pease R N, Taylor H S , "Combustion Process High Speed Gas dynamics and Jet Propulsion Series", Princeton University Press, New Jersey, 1999.
2. Taylor E F , "The Internal Combustion Engines", International Book Co, Pennsylvania, 2002.
3. Spalding D B , "Some Fundamental of Combustion", Butterworth Science Publications, London, 2004.
4. Ganesan V , "Computer Simulation of Spark Ignition Engine Processes", Universities Press (India) Ltd, Hyderabad, 1996.

19A041 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

INTRODUCTION : Application areas of CFD - Basic concepts of fluid flow - governing equations - conservation of mass - momentum and energy – Navier-stokes and energy equation for Newtonian fluid – Mathematical classification of flow - hyperbolic - parabolic - elliptic and mixed flow types. (9)

FINITE DIFFERENCE METHODS : Forward - backward and central difference schemes - Explicit and implicit methods: Numerical solution for heat transfer and fluid flow problems for steady state and transient conditions - Stability analysis and error estimation (12)

GRID GENERATION : Choice of grid - grid oriented velocity components - cartesian velocity components - staggered and collocated arrangements (6)

CFD TECHNIQUES : Lax - Wendroff technique - McCormack's technique - Relaxation technique. ADI technique - Pressure correction technique - SIMPLE algorithm. Fluid flow and convection problems: Upwind scheme - Stability criteria. (9)

TURBULENCE MODELING AND CASE STUDIES : Turbulence energy equation- one-equation model - the k- ω model - the k- ϵ model. Modeling and analysis of heat transfer - fluid flow and automobile components using CFD packages. (9)

Total L: 45

TEXT BOOKS:

1. John D Anderson , "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 2008.
2. Muralidhar K, Sundararajan T , "Computational Fluid Flow and Heat Transfer", Narosa Publications, NewDelhi, 2009.

REFERENCES:

1. Chung T J , "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
2. David C Wilcox , "Turbulence Modeling for CFD", DCW Industries, 1993.
3. Versteeg H K, Malalasekara W , "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", Longman, 1995.

19A042 VALUE ENGINEERING

3 0 0 3

INTRODUCTION : Value engineering concepts - advantages - applications - problem recognition - and role in productivity - criteria for comparison - element of choice. ORGANIZATION: Level of value engineering in the organization - size and skill of VE staff - small plant - VE activity - unique and quantitative evaluation of ideas (9)

VALUE ENGINEERING JOB PLAN : Introduction - orientation - information phase - speculation phase - analysis phase. Selection and Evaluation of value engineering Projects - Project selection - methods selection - value standards - application of value engineering methodology. ANALYSIS FUNCTION: Anatomy of the function - use esteem and exchange values - basic vs. secondary vs. unnecessary functions. Approach of function - Evaluation of function - determining function - classifying function - evaluation of costs - evaluation of worth - determining worth - evaluation of value (9)

VALUE ENGINEERING TECHNIQUES : Selecting products and operation for value engineering action - value engineering programmes - determining and evaluating function(s) assigning rupee equivalents - developing alternate means to required functions - decision making for optimum alternative - use of decision matrix - queuing theory and Monte Carlo method make or buy - measuring profits - reporting results - follow up - Use of advanced technique like Function Analysis System. (9)

VERSATILITY OF VALUE ENGINEERING : Value engineering operation in maintenance and repair activities - value engineering in non-hardware projects. Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties. Fast diagramming: cost models - life cycle costs (9)

VALUE ENGINEERING LEVEL OF EFFORT : Value engineering team - co-coordinator - designer - different services - definitions - construction management contracts - value engineering case studies. (9)

Total L: 45

TEXT BOOKS:

1. Anil Kumar Mukhopadhyaya , ""Value Engineering: Concepts Techniques and applications"", 1st Edition, SAGE Publications, New Delhi, 2010.
2. Del L. Younker , ""Value Engineering analysis and methodology"", Marcel Dekker Inc, New York, 2011.

REFERENCES:

1. Lawrence D. Miles , ""Techniques of Value Analysis and Engineering"", 3rd Edition, Eleanor Miles Walker, United States of America, 1989.
2. Abate O. Kassa , ""Value Analysis and Engineering Reengineered: The Blueprint for Achieving Operational Excellence and Developing Problem Solvers and Innovators"", 1st Edition, CRC Press, Taylor & Francis Group, USA, 2016.

19A043 COMMERCIAL FLEET OPERATION

3 0 0 3

INTRODUCTION AND TRANSIT OPERATION : Modes of transport, road transport - Types of roads, advantages, motor transport in India - Route planning - Route location, stop location, route schedules, vehicle and labor scheduling. Traffic control - Traffic signals, signal timing. (10)

FORMS OF OWNERSHIP : Sole proprietorship - partnership - private limited company - public limited company - statutory company - local authority undertaking / municipal transport company - joint venture. (8)

COSTS & FARES : Operating costs and types of vehicles - types of fare structure - types of fare collecting methods - Requirement of buses and frequency - construction of bus station. (8)

GARAGE MANAGEMENT AND VEHICLE MAINTENANCE : Garage administration - types of garages - one spanner - two spanner - three spanner - break down truck symbol - government approved workshops - Tools- Objectives of maintenance - breakdown maintenance - preventive maintenance - tyre maintenance tips and failures. Fuel saving techniques - fitness certificate. (9)

LEGAL ASPECTS : Motor vehicle act - Registration - necessity of permits - insurance - test of competence to drive - mistake / offences for which a driver can be punished - adult workers - Hours of work - running time - split duty - journey time - round journey time - layover - frequency. (10)

Total L: 45

TEXT BOOKS:

1. John E Dolce , "Fleet management", McGraw-Hill Co, 2004
2. Asvin Goel , "Fleet Telematics: Real-time management and planning of commercial vehicle", 8th Edition, Springer, 2008.

REFERENCES:

1. Kitchin L D , "Bus operation", Illiffe and Sons Ltd, London, 1992.
2. Tim Giles , "Automotive Service - Inspection, Maintenance, and Repair", Alar Elken Publications, 2007.
3. Khanna O P , "Industrial Engineering and Management", Dhanpat Rai Publications, 2010.

19A044 QUALITY ASSURANCE AND RELIABILITY

3 0 0 3

THE MEANING OF QUALITY AND QUALITY IMPROVEMENT DIMENSIONS OF QUALITY : history of quality methodology - quality control - Quality of design and quality of conformance - Quality policy and objectives - Economics of quality. Modeling process quality: Describing variation - frequency distribution - continuous and discrete - probability distributions - pattern of variation (9)

STATISTICAL QUALITY CONTROL: CONCEPT OF SQC : Chance and assignable causes of variation - statistical basis of control chart - basic principles - choice of control limits - sample size and sampling frequency - analysis of patterns on control charts. The magnificent seven. Control chart for variables: X-bar and R charts - X-bar and S charts - control chart for individual measurement. Application of variable control charts. - Statistical Quality Control: Concept of SQC - Chance and assignable causes of variation - statistical basis of control chart - basic principles - choice of control limits - sample size and sampling frequency - analysis of patterns on control charts. (9)

CONTROL CHART FOR ATTRIBUTES: CONTROL CHART FOR FRACTION NON CONFORMING : P-chart - NP-chart - C-chart and U-chart. Demerit systems - choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot - capability ratios and concept of six sigma. - Control chart for attributes: control chart for fraction non conforming P-chart - NP-chart - C-chart and U- chart. Demerit systems - choice between attribute and variable control chart - SPC for short production runs - Process capability analysis using histogram and probability plot - capability ratios and concept of six sigma. (9)

QUALITY ASSURANCE : Concept - advantages - field complaints - quality rating - quality audit. Acceptance Sampling: Fundamental concepts in acceptance sampling - operating characteristics curve. Acceptance sampling plans - single - double and multiple sampling plans - LTPD - AOQL - AOQ. Introduction to Quality systems like ISO 9000 and ISO 14000. (9)

RELIABILITY AND LIFE TESTING- FAILURE MODELS OF COMPONENTS : definition of reliability - MTBF - Failure rate - common failure rate curve - types of failure - reliability evaluation in simple cases of exponential failures in series - paralleled and series-parallel device configurations - Redundancy and improvement factors evaluations - Introduction to Availability and Maintainability - Introduction to Taguchi Method of Design of Experiments – Quality loss function. (9)

Total L: 45

TEXT BOOKS:

1. Charles E. Ebeling , "An Introduction to Reliability and Maintainability Engineering", 2nd Edition, Tata McGraw-Hill , 2010.
2. Douglas C Montgomery , "Introduction to Statistical Quality Control", 2nd Edition, Wiley, 2008.

REFERENCE:

1. E. L. Grant and Richard S. Leavenworth , "Statistical Quality Control", 2nd Edition, Tata McGraw-Hill, 2000.

19A045 TOTAL QUALITY MANAGEMENT

3 0 0 3

INTRODUCTION : Definitions of the terms - quality, quality planning, quality control, quality assurance, quality management, Total Quality Management (TQM) as per ISO 8402 - overview on TQM - The TQM axioms - Commitment - Scientific knowledge - Involvement - Consequences of total quality. ISO 9000 Series Quality System Standards: The structure of ISO 9000 series quality system standards - certification process - action plan development for cases. Study of quality audit (10)

THE DEMING AND JURAN APPROACH TO TQM : Deming's fourteen points on quality management - five DDs - implementing the Deming philosophy - action plan - the Deming cycle - questions and opinions of Deming. : Developing a habit of quality - Juran quality trilogy - the universal break through sequence - comparison Juran and Deming approaches. (10)

CROSBY AND THE QUALITY TREATMENT AND KAIZEN: : Crosby's diagnosis of a troubled company - Crosby's quality vaccine - Crosby's absolutes for quality management - Crosby's fourteen steps for quality improvement. Kaizen and innovation - the Kaizen management practices - total quality control (TQC) - approaches of Faigenbaum, Ishikawa - Kaizen and TQC - Kanban systems - small group activities - quality control circles - suggestion systems - comparison of Kaizen and Deming's approach (10)

SUPPORTING TOOLS, ACTIVITIES AND TECHNIQUES IN TQM PROJECTS: : Affinity diagram - bar chart - block diagram - brainstorming - cause and effect analysis - customer - supplier relationship checklist - decision analysis - flow charts - force field analysis - line graph/run charts - Pareto analysis - quality costing - Quality Function Deployment (QFD) - quality project approach and the problem solving process. Quality in auto service station. (8)

STRATEGIC QUALITY MANAGEMENT : Integrating quality into strategic management - Quality and the management cycle - Resources for Quality activities - Training for Quality - Self Managing Teams - Role of the Quality Director - Obstacles to achieving successful Strategic Quality Management. Five S study (7)

Total L: 45

TEXT BOOKS:

1. Dale H.Besterfield, Carol Besterfield, Geln and Mary , "Total Quality Management", Pearson Education, New Delhi, 2008.
2. Juran J.M, and Gryna F.M , "Quality Planning and Analysis - From Product Development through Use", Tata McGraw Hill, New Delhi, 2011.

REFERENCES:

1. Subburaj Ramasamy , "Total Quality Management", Tata McGraw Hill, New Delhi, 2010.
2. Logothetics. N , "Managing for Total Quality - From Deming to Taguchi and SPC", Prentice Hall, New Delhi, 2003.

19A046 MATERIALS FOR AUTOMOBILE INDUSTRY

3 0 0 3

INTRODUCTION : Classification and characteristics of metals, ceramics, polymers and composites. (5)

IRON AND STEELS : Cast iron - Austempered ductile iron, compacted graphite iron, steels - Plain carbon steels, low alloy steels, HSLA steels, IF steels, bake hardening steels, TRIP steels, ultra high strength steels, stainless steels - production, properties and applications. (12)

NON-FERROUS ALLOYS : Aluminum alloys - Cast alloys, wrought alloys, age hardenable alloys, working and heat treatment, applications in automobiles, Magnesium alloys - Cast and wrought alloys, working and heat treatment, applications. Titanium alloys. (12)

POLYMERS AND CERAMICS : Processing of polymers, brief description of equipment and process details of extrusion, injection molding, thermoforming, blow molding, concept of polymer design, and selection criteria - Preparation and forming of ceramics, applications. (11)

COMPOSITE MATERIALS : Production of composite materials and products, moulding and forming of composites, machining and joining of composites, application of composites in automobiles, metal matrix composites, polymer matrix composites and ceramic matrix composites, applications. (5)

Total L: 45

TEXT BOOKS:

1. Balram Gupta , "Aerospace Materials Vol. 1,2,3,4 and 5", S. Chand Publishing, New Delhi, 2002.
2. George E. Dieter , "Mechanical Metallurgy", 3rd Edition, McGraw Hill Education, 2017.

REFERENCES:

1. ASM Handbook , "American Society for Metals Volume 1, 2, 4, 20 and 21", ASM International, 2018.
2. John Brown , "Foseco Ferrous and Non Ferrous Foundryman's Handbook", Butterworth- Heinemann, 1999.
3. Charles A Harper , "Handbook of Plastics, Elastomers and Composites", 3rd Edition, McGraw Hill, 1997.
4. Kurt Lange , "Handbook of Metal Forming", 2nd Edition, Society of Manufacturing Engineers, 2004

19A047 PROCESS PLANNING AND COST ESTIMATION

3 0 0 3

PROCESS PLANNING : Production drawing - Process plan - information required - production equipment and tooling selection - selection of process parameters - Process sheet - contents and preparation of process sheet - Group technology and automated process planning - part family, methods of forming part families - classification and coding systems - rank order clustering technique, composite part, cellular manufacturing - Automated process planning - variant and generative approaches (9)

ESTIMATION AND COSTING : Differences between estimation and costing - qualifications of an estimator - Estimation - types. Classification of costs - Cost grid, preparation of cost sheet - Labor cost - estimation of labour cost - Introduction to time study and labour norms - Job evaluation. incentive schemes and wage administration, learning curve (9)

MATERIAL, OVERHEAD COSTS : Material cost estimation - make or buy decision analysis - Overhead cost - elements in overhead cost - factory, administrative, sales and distribution expenses - Methods of absorbing overheads - direct labour, direct material, direct labour hour - machine hour rate methods - Activity based costing. Depreciation - purpose, various methods of depreciation. (9)

COST ESTIMATION : Estimating the cost of machined components - optimum machining conditions - Taylor's equation, optimum cutting speed for minimum cost - model for maximum production - Cost estimation of welded components, forgings and castings (9)

COST MANAGEMENT : Cost control, variance analysis - labor, material cost variances - Value engineering (VE) - steps, VE job plan, different phases, function analysis system technique (FAST) - Target costing. Benefit/cost analysis - Break even analysis - linear, non-linear models - different areas of applications, multi product break even analysis - Time value of money. (9)

Total L: 45

TEXT BOOKS:

1. Peter Scallan , ""Process Planning"", Butterworth Heinemann, 2004.
2. Sinha B P , ""Mechanical Estimating and Costing"", Tata McGraw Hill Education, 2015.

REFERENCES:

1. Groover M P , ""Automation, Production Systems and Computer-Integrated Manufacturing"", Pearson Education, 2015.
2. Lal Nigam B M, Jain I C , ""Cost Accounting"", Prentice Hall of India, 2007.
3. Richard J Park , ""Value Engineering – A Plan for Inventions"", CRC Press, 1998.
4. Chang T C, Wysk R A , ""An Introduction to Automated Process Planning Systems"", Prentice Hall Inc, 1984.

19A048 LEAN METHODS FOR AUTOMOBILE ENGINEERS

3 0 0 3

INTRODUCTION : SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition - Customer requirements - Requirements of other stake holders - Meaning of Lean Manufacturing System (LMS) - Meaning of Value and waste - Need for LMS - Symptoms of underperforming organizations - Meeting the customer requirement - Elements of LMS. (9)

PRIMARY TOOLS USED IN LMS : Meaning and Purpose of 5S Work place organization - 5S process – Sort - Set in order - Shine - Standardize - Sustaining - Implementing 5S - Meaning and purpose of TPM - Pillars of TPM - Conditions for TPM success - TPM implementation process - Overall Equipment Effectiveness and problems on computation of OEE. (9)

PRIMARY TOOLS USED IN LMS CONTD : Process Mapping and Value Stream Mapping (VSM) – Need for process maps - advantages - types and its construction - steps in preparing VSM; Concept of work Cell and its design - Line balancing algorithms and problems. (9)

SECONDARY TOOLS USED IN LMS : Cause and effect diagram - Pareto chart - Radar chart - Poke Yoke - Kanban - Automation - SMED - Standardized fixture - DFMA - JIT - Visual workplace - problems on Pareto analysis and computation of number of Kanban. (9)

LMS RULES : Stability - Management - Standardized work - Pull system - Continuous improvement. Lean Implementation: Training - selecting the projects - preparing project charter - project implementation - Project review. Implementing LMS for higher productivity: Operator - process - machinery and equipment – workplace organization - Inventory - LMS Design Process. (9)

Total L: 45

TEXT BOOKS:

1. Gopalakrishnan N , ""Simplified Lean Manufacture: Elements, Rules, Tools and Implementation"", PHI Learning Pvt Limited, New Delhi, 2010.
2. Pascal Dennis , ""Lean Production Simplified"", 2nd Edition, Productivity Press, New York, 2007.

REFERENCE:

1. Jeffrey Liker , ""The Toyota Way"", 19th Edition, Tata McGraw-Hill, New Delhi, 2004.

19A049 QUALITY MANAGEMENT SYSTEM FOR AUTOMOTIVE INDUSTRY

3 0 0 3

BASIC CONCEPTS OF QUALITY : quality, classification of quality systems and services - product quality design - quality engineering in design of production processes - quality in reliability and safety - quality engineering in production - quality engineering in service (9)

QUALITY MANAGEMENT SYSTEMS : quality management – a conceptual frame work - dimensions of quality - costs of quality - quality system standards - ISO 9000 clauses and its interpretations - ISO TS16949 clauses and interpretation (9)

MODERN MANAGEMENT TOOLS AND TECHNIQUES : Introduction to Modern Management Techniques - 5s concepts - Kaizen techniques - Six sigma methodologies - Quality circles - Taguchi loss function - POKE –YOKE Techniques (9)

ISO TS16949 REQUIREMENTS : Advanced Product Quality Planning (APQP) - Design Failure Mode Effects Analysis Process
Failure Mode Effects Analysis - Production Part Approval Process (PPAP) (9)

QUALITY TOOLS AND MEASUREMENT SYSTEMS ANALYSIS : Concepts of SPC detection vs. prevention - Data collection methods - Statistical Tools - Understanding of measurement systems - Variable Gauge R&R - Introduction to Hypothesis Testing - ANOVA - Correlation Analysis - Single and Multiple Regression (9)

Total L: 45

TEXT BOOKS:

1. David Hoyle , "Automotive quality system Handbook", 2nd Edition, Butterworth – Heinemann Ltd, Oxford, 2000.
2. William M Feld , "Lean Manufacturing: Tools, Techniques and How to Use Them", APICS, 2001.

REFERENCES:

1. Montgomery Douglas C , "Introduction to Statistical Quality Control", John Wiley and Sons, New Delhi, 2007.
2. Logo Thetis N , "Managing for Total Quality – From Deming to Taguchi and SPC", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Aiag , "Advanced product quality planning and control plan", 2nd Edition, Standards media, 2008.

19A050 ELECTRIC VEHICLE THERMAL ENGINEERING

3 0 0 3

Introduction: Introduction on Electric Powertrain Systems - Introduction to thermal management systems in EV - Source of heat generation in electric power train- Types of cooling architecture in EVs- Introduction to Thermodynamics and Heat transfer- Modes to heat transfer (9)

Thermal Management of electric Motor and HV Battery: Motor types and applications- Motor performance characteristics- Electric Motor thermal system – Modeling and simulation- HV battery classifications- Factors effecting battery performance-Types battery cooling methods- Control system design for BMS-Motor specifications for EVs (9)

Thermal Management of Power electronics and 3D Thermal simulation: Introduction- Power Loss Modelling- Parameter Identification- Sensitivity Analysis- Heat transfer Mechanism- Thermal influence & component protection, evaluation on Battery management system- Heat network across vehicle sub system[motor]- Concept design & different type of cooling channel design. (9)

HVAC Cooling: Introduction- Components of HVAC system- Power consumption from HVAC system-Impact of HVAC operation on EV performance- Modeling& Simulation of HVAC system (9)

Controller design for Thermal system: State space control & Design of Observer- Introduction to Vehicle Control unit & Thermal controls- Performance Optimization by Thermal control- Parameter Identification- Sensitivity analysis (9)

Total: 45 Hours

Text Book:

1. Ibrahim Dincer, Halim S Hamut and Nader Javani"Thermal Management of Electric Vehicle Battery Systems " John Wiley2017
2. Bruno Sacrasati and Werner Tillmatz "Advances in Battery Technology for Electric Vehicles " Elsevier Woodhead Publishing Series in Energy 2015

References:

1. Ali Emadi, "Advanced Electric Drive Vehicles" CRC Press, 2014.
2. Micah Toll, "The Ultimate Do It Yourself Ebike Guide: Learn How To Build Your Own Electric Bicycle" ISBN 978-09899067-9 1, 2013.

LANGUAGE ELECTIVES

19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS:

Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal Communication Activities (9)

FOCUS ON SOFT SKILLS:

Etiquette — Work Place etiquette — Telephone etiquette

Body Language

Persuasive Communication

Public Speaking

Critical Reasoning and Conflict Management based on Case Studies

Group Communication

Meetings

Interview Techniques

(14)

TECHNICAL WRITING:

Technical Writing Principles

Style and Mechanics

Technical Definitions – Physical, Functional and Process Descriptions

Technical Report Writing

Preparing Instructions and Manuals

Interpretation of Technical Data

(15)

BUSINESS CORRESPONDENCE:

Writing Emails

Preparing Resumes

Memos

Technical and Business Proposals

(7)

TECHNICAL COMMUNICATION:

Seminars

Process Description and Group Discussions

Use of Visual Aids

(15)

Total P: 60**TEXT BOOKS:**

1. Faculty Incharge "Course Material on "Communication Skills for Engineers"", PSG College of Technology., Coimbatore, 2019

REFERENCES:

1. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning., New Delhi, 2013
2. Jean Naterop B and Rod Revell "Telephoning in English", Cambridge University Press., Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley "Handbook for Technical Writing", Cengage Learning., New Delhi, 2011
4. Simon Sweeney "English for Business Communication", Cambridge University Press., New Delhi, 2012

19G002 GERMAN- LEVEL A1.1**0 0 4 2****GUTEN TAG! :**

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. Grammar: W — Questions, Verbs & Personal pronouns I. (10)

FREUNDE, KOLLEGEN UND ICH:

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural (10)

IN DER STADT:

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
2. Vocabulary: related to the topic
3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs (12)

GUTEN APPETIT! :

1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences
2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs (13)

TAG FÜR TAG/ZEIT MIT FREUNDEN:

1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments on phone
2. Vocabulary: related to the topic
3. Grammar: Time related prepositions, Possessive articles, Modalverbs (15)

Total P: 60

TEXT BOOKS:

1. Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt GmbH., München, 2013
2. Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

REFERENCES:

1. Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt GmbH., München, 2013
2. Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., München, 2004
4. Christiane Lemcke und Lutz Rohrmann "Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1

0 0 4 2

PARTS OF SPEECH:

1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis
3. Conjugation : présent, adjectifs possessifs
4. interrogation, décrire les personnes
5. La vie de quatre parisiens de professions différentes (12)

ELEMENTS OF GRAMMAR :

1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l'article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions (12)

SENTENCE STRUCTURE :

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait (12)

TENSES AND NUMBERS :

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport (12)

DISCOURSE :

1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d'un système éducation de France
3. parler de la technologie de l'information (12)

Total P: 60

TEXT BOOKS:

1. Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI, 2012
2. Myrna Bell Rochester "Easy French Step By Step", MCGrawhill Companies., USA, 2008

REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005, 5th
2. Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French", ..
3. Simone Renaud, Dominique van Hooff "En bonne forme", ..

19G004 BASIC JAPANESE

0 0 4 2

JAPANESE PEOPLE AND CULTURE :

1. Basic greetings and responses
2. Basic script—Method of writing hiragana and katakana —Combination sounds and simple words
3. Selfintroductions: "Hajimemashite" -Demonstratives "Kore", "Sore", "Are"—Demonstrative "Kono", "Sono", "Ano"
4. Possessive noun particle "no"—Japanese apartments: Greeting your neighbor (12)

PARTICLE "NI (AT)" FOR TIME :

1. kara (from) ~ made(until) — Particle "to (and)"
2. Time periods: Days of the week, months, time of day -Verbs (Present / future and pasttense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle "e". (12)

LIKES AND DISLIKES :

1. Potential verbs (wakarimasu and dekimasu) — “Kara (~ because)”
2. Adverbs — Asking some one out over the phone-Verbs denoting presence
3. Introduction to Adjectives (na and ii type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining) (12)

DIFFERENT USAGES OF ADJECTIVES :

1. Comparison — Likes and dislikes — Going to a trip- Need and desire (ga hoshii) — Wanting to . . . (Tabeti desu)- Going for a certain purpose (mi –ni ikimasu)
2. Choosing from a menu-Adjectives (“i” and “na” type) — Adjectives (Positive and negative useage) (12)

ROLE PLAYS IN JAPANESE :

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total P: 60

TEXT BOOKS:

1. Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)", . International publisher — 3A Corporation., Tokyo,2012

REFERENCES:

1. Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", ., 1999
2. Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", ., 2014
3. Minna No Nihongo "Translation & Grammatical Notes In English Elementary",.,

ONE-CREDIT COURSES

19AF01 GASOLINE ENGINE MANAGEMENT SYSTEM

1 0 0 1

GASOLINE ENGINE MANAGEMENT SYSTEM : Three way catalytic converter- conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases - idle speed control - acceleration and full load enrichment - deceleration fuel cut off. Fuel control maps - open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock. (15)

Total L: 15

REFERENCES:

1. Konrad Reif , "Gasoline Engine Management: Systems and Components", First Edition, Springer Vieweg Publisher, 2012.
2. Dave Walker , "Engine Management: Optimising Carburettors, Fuel Injection and Ignition Systems", First Edition, Haynes, Publishers, 2001.

19AF02 DIESEL ENGINE MANAGEMENT SYSTEM

1 0 0 1

DIESEL ENGINE MANAGEMENT SYSTEM : Fuel injection system parameters affecting combustion- noise and emissions in CI engines. Pilot - injection - advanced and post injection . Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector - fuel pump - rail pressure limiter - flow limiter - EGR valves - Emission management system - Closed loop control of detonation - NOx management systems (15)

Total L: 15

REFERENCES:

1. Konrad Reif , "Diesel Engine Management: Systems and Components", 2nd Edition, Springer Vieweg Publisher, 2014.
2. Charles O. Probst , "Corvette Fuel Injection & Electronic Engine Management", 2nd Edition, Bentley Publishers, 2001.

19AF03 VEHICLE SYSTEM ENGINEERING

1 0 0 1

VEHICLE SYSTEM ENGINEERING : Introduction to systems engineering –System modelling and design concept- steering system modeling – forces and moments calculation- suspension system modeling- elastokinematics of suspension systems – Brake system modeling – brake force to deceleration calculation – Maximum achievable deceleration- Introduction to multidegree degree of freedom model – Tyre modeling (15)

Total L: 15

REFERENCES:

1. Markus Maurer, Hermann Winner , "Automotive Systems Engineering", 2nd Edition, Springer Publishers, 2013.
2. Hermann Winner, Günther Prokop, Markus Maurer , "Automotive Systems Engineering II", 2nd Edition, Springer Publisher, 2007.

19AF04 COMPUTER AIDED INDUSTRIAL DESIGN FOR AUTOMOBILES

1 0 0 1

INTRODUCTION : Computer aided industrial design tools - Alias design products - Alias design interface. (5)

AN OVERVIEW ON COMPUTER AIDED INDUSTRIAL DESIGN : Features of curve - Creating curves - Transform tools - Creating a surface - Projecting curves on surface - Mirroring objects - Stretching a curve - Breaking a curve at inflections - Rebuilding and planarizing a curve and Advanced surface creation - Data transfer from CAID to CAD. (10)

Total L: 15

REFERENCES:

1. Sham Tickoo , "Learning Autodesk Alias Design 2016", CAD/CIM Technologies, 2016.
2. Tony Lewin, Ryan Borroff , "How to Design Cars Like a Pro", Motor Books International, 2010.
3. Alan Pipes , "Drawing for Designers", Laurence King Publishing, 2007.

19AF05 SKETCHING FOR DESIGNERS

1 0 0 1

INTRODUCTION : Study of geometry of elements in products and its application in object drawing. (3)

SKETCHING : Product presentation in various media like pencil, ink and colour. - Presenting thoughts and ideas in design through sketches, perspective and exploded views. - Presentation of product design concepts through simplified graphics presentation. - Typefaces, Typography and printing - Exposure to digital photography. (12)

Total L: 15

REFERENCES:

1. Powell, Dick , "Design Rendering Techniques", Little Brown Book Group, 2008.
2. Buxton, Bill , "Sketching User Experiences: Getting the Design Right and the Right Design", Morgan Kaufmann, 2007.
3. Caplin Steve, Banks Adam , "The Complete Guide to Digital Illustration", The Ilex Press, 2003.
4. Erik Olofsson, Klara Sjöln , "Design Sketching", Keeos Design Books AB, 2005.

19AF06 INDUSTRIAL DESIGN

1 0 0 1

INTRODUCTION TO BASIC ELEMENTS : Line - texture - color - form - symmetry - balance - scale - mass - unity and variety - Concept of visual language and visual design (3)

INDUSTRIAL DESIGN : Introduction to Gestalt laws - composition and figure and ground relationships - Introduction to concept of negative space - Use of symmetry - Generation of patterns and textures using simple elements - Introduction to

typography and fonts - Use of grids in graphic composition - Color circle - color combinations and its dimensions: hue - value and chroma - Color meanings in traditions and psychological use of colors. (12)

Total L: 15

REFERENCES:

1. Gail Greet Hannah , "Elements of Design", Princeton Architectural Press, 2002.
2. Itten Johannes , "The Art of Color", Wiley Publications, 2010.
3. Kepes Gyorgy , "Language of Vision", Dover Publications, 2011.
4. Elam Kimberly , "Geometry of Design: Studies in Proportion and Composition", Princeton Architectural Press, 2011.

19AF07 COMPUTER AIDED AUTOMOBILE STYLING

1 0 0 1

INTRODUCTION : Surface continuities - construction settings and its importance - curves and construction techniques - surface and surface modeling techniques - building basic volumes. (5)

COMPUTER AIDED STYLING : Sketch modeling exercise - full exterior modeling exercise - full interior modeling exercise - working with industry level class a quality - working with scan - patch planning and modeling. (10)

Total L: 15

REFERENCES:

1. Sham Tickoo , "Learning Autodesk Alias Design 2012", CADCIM Technologies, 2012.
2. Tony Lewin, Ryan Borroff , "How to Design Cars Like a Pro", Motor Books International, 2010.
3. Alan Pipes , "Drawing for Designers", Laurence King Publishing, 2007.

19AF08 VEHICLE DESIGN PROCESS

1 0 0 1

VEHICLE DESIGN PROCESS : Steps involved in design- product planning – Product Customization-concept generation- 3-D model development –design evaluation –Design based on packaging requirements - verification and validation- styling freeze- Prototype development and product testing- Accelerated testing –Environmental testing - Rapid prototyping concepts – 3D printing applications –Flexibility for up gradation- Product launch (15)

Total L: 15

REFERENCES:

1. Vivek D. Bhise , "Ergonomics in the Automotive Design Process", Third Edition, Taylor and Francis Publishers, 2009.
2. Julian Weber , "Automotive Development Processes: Processes for Successful Customer Oriented ...", Third Edition, Springer Publishers, 2012.

19AF09 ACTIVE SAFETY SYSTEMS

1 0 0 1

INTRODUCTION : Legislative Safety Requirements - ISO26262 Safety Requirements - ASIL standards. Active Safety Systems:AntilockBraking Systems - Electronic Stability Program - Traction Control Systems - Emergency Warning Braking - Adaptive Cruise Control - Sensotronic Brake Control - Brake By Wire. (9)

DRIVING SAFETY, CONDITIONAL SAFETY, PERCEPTIBILITY SAFETY, OPERATING SAFETY, PASSIVE SAFETY : Exterior safety - interior safety - deformation behavior of vehicle body - speed and acceleration characteristics of passenger compartment on impact. (6)

Total L: 15

REFERENCES:

1. Bosch , "Safety, Comfort and Convenience Systems", Jhon Wiley, 2011.
2. Powloski. J. , "Vehicle Body Engineering", Business books limited, 1969.

3. Ronald.K.Jurgen , "Automotive Electronics Handbook", McGraw-Hill Inc., 1999.

19AF10 PASSIVE SAFETY SYSTEMS

1 0 0 1

PASSIVE SAFETY SYSTEM : Introduction – SRS- Air bag system-Air bag faults- seat belts- occupant sensing systems – whiplash protection- child safety systems- pedestrian safety system- concepts and applications .- Retractable steering column-Front crash protection system- automatic door unlocking and seat belt unlocking during accident. (15)

Total L: 15

REFERENCES:

1. Ulrich Seiffert, Lothar Wech , "Automotive Safety Handbook", Third edition, SAE International, 2003.
2. Christopher Nwagboso , "Automotive Sensory Systems", Third Edition, Kluwer Academic Publishers, 2013.

19AF11 INTEGRATED PRODUCT DEVELOPMENT

1 0 0 1

INTEGRATED PRODUCT DEVELOPMENT : Product development flow diagram and timing chart - scope of vehicle development programs - verification and validation - Decomposition tree- customer need - business needs - government requirements- bench marking competitors vehicle- implementation of new technologies- design trade offs. (15)

Total L: 15

REFERENCES:

1. Vivek Bhise , "Automotive Product Development: A Systems Engineering Implementation", Fourt Edition, CRC Press, 2015.
2. Hirz Mario, Wilhelm Dietrich, Anton Gfrerrer , "integrated Computer-Aided Design in Automotive Development", Second edition, Springer, 2015.

19AF12 CAR DESIGN AND PACKAGING FUNDAMENTALS

1 0 0 1

CAR DESIGN : History of vehicle architecture in design - Design process overview - Anatomy of the package - Functions & segment - Packaging ideation - Size & proportion - Occupant packaging - Interiors & Cargo - Powertrain - Wheels & Tires - Body - Mobility. (15)

Total L: 15

REFERENCES:

1. Geoff Wardle, Stuart Macey, Ralph Gilles , "H-Point: The Fundamentals of Car Design and Packaging", Design Studio Press, 2014.
2. Sham Tickoo , "Learning Autodesk Alias Design 2016", CAD/CIM Technologies, 2016.

19AF13 AUTOMOTIVE COMMUNICATION PROTOCOLS

1 0 0 1

AUTOMOTIVE COMMUNICATION PROTOCOLS : Introduction - Vehicle communication modes- short range communication-need and applications- concepts - features- regulations - applications -A2B – Byteflight – CAN – D2B- FlexRay- LIN-MOST- Key word Protocol- SPI- VAN- J1850- Single wire – KWP 2000- AUTOSAR Regulations - Twisted pair – fibre optics- security and Privacy threats . (15)

Total L: 15

REFERENCES:

1. Nicolas Navet, Françoise Simonot-Lion. , "Automotive Embedded Systems Handbook", 4th Edition, CRC Press, London, 2008.

- Huaqun Guo , "Automotive Informatics and Communicative Systems: Principles in Vehicular networks and data exchange", 2nd Edition, Information Science Reference, 2012.

19AF14 CHALLENGES AND ISSUES IN FUEL CELL TECHNOLOGIES

1 0 0 1

CHALLENGES AND ISSUES IN FUEL CELL TECHNOLOGIES : Introduction – cost - Durability and Reliability.- System Size- Air - Thermal and - Water Management-Improved Heat Recovery Systems- Techno –economic challenges- Material challenges – Hydrogen Storage issues –Hydration problems- Hydrogen generation – delivery infrastructure (15)

Total L: 15

REFERENCE:

- Eshani.M, Gao. Y, Lngo. , "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", 2nd Edition, CRC Publisher, Newark, 3018.
- Barbir F. , "PEM Fuel Cells: Theory and Practice", 2nd Edition, Elsevier, Publisher, Burlington,, 2005.

19AF15 PRODUCT DEVELOPMENT PRACTICES

1 0 0 1

GLOBAL PRODUCTS AND ITS PROBLEMS : Importance - challenges and opportunities of global products - changes and complexity in global products - global product problems - multiple causes and its effects - root cause and network of causes and measures - everyday product problems and action. (7)

PLM ENABLED PRODUCTS : : Product lifecycle management (PLM) - key characteristics and functions - benefits of PLM - metrics and targets of PLM - PLM applications and data/document management - part/product management - process/workflow management - program/project management. (8)

Total L: 15

REFERENCES:

- John Stark , "Global Products London Ltd, 2010.", 2nd Edition, Springer-Verlag Publisher, London, 2010.
- Mike Baxter , "Product Design", 2nd Edition, Thornes Publishers Ltd., 2009.

19AF16 PRODUCT COSTING

1 0 0 1

COMPONENTS OF PRODUCT COSTING : Raw material cost - Process cost - Assembly cost - Inspection Cost - Packing Cost - Freight Cost - Warehousing Cost - Inventory Carrying Cost - Overheads -RFQ – New Products- Ansoff's Matrix – Inputs for product costing – Volume – SOP – Customer drawing – Customer Standard –Packing methods - Delivery methods - Raw material Cost : Type of material – Grades – Condition of Raw material – Indigenous /Imported - Landed Cost – Currency rates – Taxes (8)

PROCESS COST : Process sequence -Equipments required - Machine hour rates – Interest Cost – Depreciation – Power Cost- Manpower Cost- Tool Cost- Consumable Cost- Gauge Cost – Machine maintenance Cost Packing Cost - Returnable Containers – Packing Norms - Cartons - trays - Cost Calculation - Freight - Overheads - Inventory Carrying cost -Case studies –Fixed / Variable cost - Pricing policies– Sunk Cost (7)

Total L: 15

REFERENCES:

- Ralph S. Polimeni, Frank J. Fabozzi, Arthur H. Adelberg, Jacqueline A. Burke , "Product Costing: Concept and Applications", Third, McGraw-Hill Higher Education, 2009.
- Ian Ryan, Birgit Starmanns , "2. Product costing and manufacturing with SAP", 2nd Edition,, Rheinwerk Publishing Incorporated,, 2015.

ENGLISH

19GF01 INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

INTRA ORGANIZATIONAL COMMUNICATION : Communication Networks in an Organization; Intra- organizational communication (2)

INTER ORGANIZATIONAL COMMUNICATION : Flow Nomenclature; Workplace diversity and intercultural aspects of communication (2)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS : Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION : Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS : Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence (4)

Total L: 15

REFERENCES:

1. Bagchi Subroto , "The Professional", Penguin Publications, UK, 2011.
2. PMBOK guide , "A Guide to the Project Management Body of Knowledge", Project Management Institute Inc, USA, 2013.

19GF02 HUMAN VALUES THROUGH LITERATURE

1 0 0 1

PROSE : Kalam's vision of college education in Wings of fire - Emerson's advocacy of independence of Human will in Self-reliance - Harmony in Education-views of Betrand Russel (4)

POETRY : Maintaining Human relations in Robert Frost's Mending Wall - Quest for identity and freedom in Kamala Das's An Introduction (2)

DRAMA : Statesmanship and friendship in Girish Karnad's Tughlaq (3)

ONE-ACT PLAY : The theme of love in Chekhov's The Bear (3)

SHORT STORY : Empathy in Somerset maugham's Mr. Know-all - Family bond in Anita Desai's Devoted son (3)

Total L: 15

TEXT BOOKS:

1. Faculty - Department of English , "Course materials", PSG College of Technology, Coimbatore, 2019.

REFERENCES:

1. Abrams M.H, Harpham , "A Glossary of Literary Terms", Cengage, Boston, 2015.
2. Scholes R, et.al. , "Elements of Literature", IV, Indian Rpt. OUP, New Delhi, 2013.

HUMANITIES

19OFA1 EXPORT – IMPORT PRACTICES

1 0 0 1

INTRODUCTION : Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES : Obtaining an Export License – Export Credit Insurance – Procedures and Documentation (4)

FOREIGN EXCHANGE : Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES : Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES : Incentives - Institutional support (2)

Total L: 15

REFERENCES:

1. Ramagopal C , "Export Import Procedures - Documentation and Logistics", New Age International, 2014.
2. Cherian and Parab , "Export Marketing", Himalaya Publishing House, New Delhi, 2008.

3. Parul Gupta , "Export Import Management", MC-Graw Hill, 2017.
4. Justin Paul, Rajiv Aserkar , "Export Import Management", Oxford, 2013.

19OFA2 INSURANCE - CONCEPTS AND PRACTICES

1 0 0 1

INTRODUCTION TO INSURANCE AND RISK MANAGEMENT : Origin, History, Nature and Scope of insurance – Meaning, types and significance of risk. (3)

INSURANCE LAWS AND REGULATIONS : Insurance Act, IRDA Act, Consumer Protection Act, Ombudsman Scheme. (2)

INSURANCE UNDERWRITING AND RISK MANAGEMENT : Meaning of underwriting and underwriter, guidelines and steps in the process of underwriting – characteristics, significance and principles of risk management. (4)

FINANCIAL ASPECTS OF INSURANCE MANAGEMENT : Role and functions of financial institutions, determination of premium for various insurance products. (3)

SETTLEMENT OF INSURANCE CLAIMS : Documents needed during various claims, Factors affecting insurance claims (3)

Total L: 15

REFERENCES:

1. Scott Harrington, Gregory Niehaus , "Risk Management and Insurance", McGraw Hill Education, 2017.
2. George E Rejda , "Principles of Risk Management & Insurance", Pearson Education, 2017.
3. John Hull , "Risk Management & Financial Institution", John Wiley and Sons, 2018.
4. Arjun Mittal, D D Chaturvedi , "Insurance and Risk Management", Scholar Tech Press, 2017.

19OFA3 PUBLIC FINANCE

1 0 0 1

INTRODUCTION: Nature and Scope of public finance – Principles of taxation. (2)

PUBLIC REVENUE AND TAXATION: Sources of Revenue – Tax and non-tax revenue – Classification of Taxes, GST. (4)

PUBLIC EXPENDITURE: Importance – Types – Causes of increase in public expenditure – Effects of public expenditure in India. (3)

DEFICIT FINANCING AND BUDGET: Sources of public debt – Debt redemption – Budget – Types – Preparation of Budget in India. (3)

FEDERAL FINANCE: Centre-State financial relations – Finance commissions. (3)

TOTAL: 15

REFERENCE BOOKS:

1. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice" – Tata McGraw Hill Education, New Delhi, 2004.
2. Bhatia H.L, "Public Finance" – Vikas Publishing House, 29th Edition, New Delhi, 2012.
3. David N Hyman, "Public Finance: A contemporary application of theory and policy", Cengage Publication, 11th Edition, Noida, 2014.
4. Santhosh Dalvi and Krishnan Venkatasubramanian, "An introduction to Goods and Service Tax: The biggest tax reform in India", CCH Publisher, New Delhi, 2015.

19OFA4 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

1 0 0 1

INVESTMENT ENVIRONMENT : Financial Markets - Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITIES : Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS I : Industry Analysis – Estimation of Rates of Return. (2)

SECURITY ANALYSIS II : Company Analysis — Estimation of Rates of Return. (2)

PORTFOLIO MANAGEMENT : Measuring Risk and Returns and Treatment in Portfolio Management. (4)

Total L: 15

REFERENCES:

1. William F Sharpe, Gordon J. Alexander, Jeffery V Bailey , "Investments", Prentice Hall, 2012.
2. Prasanna Chandra , "Investment Analysis and Portfolio Management", TATA McGraw Hill Publishing, 2011.
3. Ranganathan , "Investment Analysis and Portfolio Management", Pearson, 2004.
4. Bhalla V K , "Investment Management", TATA McGraw Hill Publishing, 2011