UAU712C	VEHICLE DYNAMICS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

UNDAMPED FREE VIBRATION: Introduction, sinusoidal motion, single degree of freedom system, Newton's method, energy method and De'Alembert's principle, undamped free vibration - natural frequency of free vibration, problems.

DAMPED FREE VIBRATION: Single degree of freedom systems, different types of damping, concept of critical damping and its importance, response study of viscous damped systems for cases of under damping and over damping, logarithmic decrement, problems.

UNIT–II	10 Hrs.

FORCED VIBRATION: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force solution by complex algebra, vibration isolation - transmissibility ratio, energy dissipated by damping equivalent viscous damping, structural damping, sharpness of resonance, base excitation, problems.

SYSTEMS WITH TWO DEGREE OF FREEDOM: Introduction, principle modes and normal modes, co-ordinate coupling, generalised and principle co-ordinate, free vibrations in terms of initial conditions, Lagrange's equation, semi-definite systems, applications: Vehicle suspension, dynamic vibration absorber, dynamics of reciprocating engines, problems.

UNIT–III	10 Hrs.

NUMERICAL METHODS FOR MULTI DEGREE OF FREEDOM SYSTEMS: Introduction, influence coefficients, Maxwell's reciprocal theorem, Dunkerley's method, orthogonality principle, method of matrix iteration- method of determination of all the natural frequencies using sweeping matrix and orthogonality principle, Holzer's method for systems with free, fixed free and fixed ends, Stodola method, Rayleigh Ritz method for beam vibration.

UNIT–IV	10 Hrs.

VEHICULAR VIBRATION: Vibration due to road roughness, vibration due to engine unbalance, reciprocating and rotating unbalance, transmissibility of engine mounting vibration with two degree of freedom, compensated suspension systems forced vibration.

TYRE MECHANICS: Vehicle control - low speed cornering and static steering, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), roll steer, compliance steer, ride steer, slip angle steer, steady state handling - lateral acceleration gain, characteristic speed, yaw velocity gain, critical speeds.

Reference Books *

TEXT BOOKS:

1. Mechanical Vibration - G.K.Grover, Nemchand & Brothers,1989
2. Mechanical Vibration – V.P.Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd Edition, 2006.
3. Fundamentals of vehicle dynamics - Thomas D. Gillespie, SAE USA 1992

REFERENCE BOOKS:

1. Vibration Theory Mechanical Vibrations- S.S.Rao, Pearson Edu.Inc., 4th Edition, 2003
2. Theory & Problems of Mechanical Vibration - William W. Seto, McGrawHill (schaum's

outline series)

3. Problems in Automobile Mechanics - N.K.Giri, Khanna Pub.2004
4. Mechanics of Pneumatic Tyre - S.K.Clark, Prentice Hall
5. Mechanical Vibration Analysis- P.Srinivasan, TMH

Course Outcomes**

1. Classify and determine first and second order vibratory systems and formulate using basic approach.
2. Analyze the response of damped systems for varying degree of damping and compute the natural frequency of damped free vibration of mechanical systems.
3. Evaluate on numerical methods and their significance in multi degree freedom systems.
4. Illustrate the natural frequencies and mode shapes for multi-degree of freedom vibrating systems.
5. Investigate the response of vibrating systems due to engine unbalance
6. Asses the tire mechanics and analyze the vehicle control parameters

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1	2							1	2	3	3	2
CO2	3	3	2	2							1	2	3	3	2
CO3	3	3	1	2							1	2	3	3	3
CO4	3	3	1	2							1	2	3	3	2
CO5	3	3	3	2							1	2	3	3	2
CO6	3	3	2	2							1	2	3	3	2

UAU 721C	VEHICLE BODY ENGINEERING	Credits: 03
L:T:P - N_L :4 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, vans and pick-ups. Terms used in body building construction, angle of approach, angle of departure, ground clearance, cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, roof stick, roof longitude, rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

VEHICLE BODY MATERIALS: Properties, manufacturing methods and suitability for vehicle body construction Aluminum alloys, steel, alloy steels, plastics and composite materials, semi rigid PUR foams and sandwich panel construction. Paints and adhesives.

UNIT–II	10 Hrs.

AERODYNAMICS: Basics, various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, study of wind tunnels, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

LOAD DISTRIBUTION: Type of body structures, vehicle body stress analysis, vehicle weight distribution, calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

UNIT–III	10 Hrs.

INTERIOR ERGONOMICS: Introduction, seating dimensions, interior ergonomics, seat comfort, driver seat design, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, driver's visibility, methods of improving visibility, window winding mechanisms.

VEHICLE STABILITY: Introduction, longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

UNIT–IV	10 Hrs.

NOISE AND VIBRATION: Noise characteristics, sources of noise, noise level measurement techniques, body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

SAFETY: Impact protection basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

Reference Books *

TEXT BOOKS:

1. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 1956
2. "Giles J Pawlowski", Vehicle body engineering Business books limited, 1989
3. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.

REFERENCE BOOKS:

1. Hand book on vehicle body design – SAE publication
2. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
3. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.
4. Redesign of bus bodies – part I & part II – CIRT pune (Report), 1983

Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 1987

Course Outcomes**
1. To know and analyze classification, vehicle body construction, design and development of various types of vehicles and their layouts body design nomenclatures.
2. To know and analyze fixed and free control systems, aerodynamic styling, trimming, materials and paintings used in vehicle body design and development of various vehicles.
3. Analyze the forces and couples acting on vehicle during various running conditions.
4. Develop templates / prototypes and analyze the various aerodynamic forces and couples acting on the vehicle, pressure distribution analysis and flow visualization techniques while testing in wind tunnel.
5. To analyze and develop SFD and BMD for load distribution and stress analysis in vehicle body design.
6. To analyze space optimization techniques, visibility, body development skills, luxury, ergonomics for both driver and passengers. NVH analysis and safety.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	3	1							3	2	2	2
CO2	3	2	3	3	2							3	2	2	2
CO3	3	2	3	3	2							3	2	2	2
CO4	3	2	3	3	2							3	1	2	2
CO5	3	2	3	3	2							3	1	2	2
CO6	3	2	3	3	2							3	2	2	2

UAU723C	AUTOTRONICS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: Need for electronics in automotive control systems, structure of vehicle electronics systems, common features of vehicle systems, measurement system, sensors and actuators.

INTRODUCTION TO ELECTRONICS: Electronic components, diodes, transistors, electronic circuits, analog circuits, digital circuits, integrated circuits, microprocessor systems, systems approach to control and instrumentation.

UNIT–II	10 Hrs.

ELECTRONIC IGNITION SYSTEMS: Types of ignition systems, conventional ignition system, CDI, programmed ignition system, distributor-less ignition system, direct ignition.

ELECTRONIC FUEL CONTROL: Electronic control of carburetion, petrol injection system, single and multi point injection system, components, flow diagram, diesel fuel injection.

UNIT–III	10 Hrs.

ENGINE MANAGEMENT SYSTEM: Combined ignition and fuel management system, exhaust emission control, digital control techniques, complete vehicle control systems, artificial intelligence and engine management.

CHASSIS ELECTRICAL SYSTEMS: Anti-lock brakes, active suspension, traction control, electronic control of automatic transmission.

UNIT–IV	10 Hrs.

ELECTRONICS FOR COMFORT, SAFETY AND SECURITY: Electric seats, mirrors and sun-roof operation, central looking and electric windows, cruise control, In Car Entertainment (ICE) and communications, adaptive noise control, airbags and seatbelt tensioners, obstacle avoidance radar, security systems - engine immobilizer, ICAT.

Reference Books *

TEXT BOOK:

1. Automotive electrical and electronic systems: Tom Denton, 3rd edition, SAE International.

REFERENCE BOOKS:

1. Automotive electronics: Eric Chowanietz, Newnes, 1995.

2. Understanding automotive electronics, William B Ribbens, Butterworth-Heinemann.

3. Automotive Electrics Automotive Electronics, Robert Bosch.

Course Outcomes**

1. To justify the need of Autotronic systems and explain the construction of various electronically controlled chassis and vehicle safety systems.
2. The student will be able to analyze the working of electronic control systems used in modern automobiles
3. To apply the knowledge of working of various sensors in the control of vehicular systems
4. To compare the working of programmed control systems with conventional vehicular control systems

5. To evaluate the performance of vehicle embedded with engine management systems
6. To justify the need of Autotronic systems and explain the construction of various electronically controlled chassis and vehicle safety systems.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2	2	3	1	1			1	1	1		1	
CO2	3	2	2	2	2	1	1			1	1	1	1	3	2
CO3	3	2	2	2	2	1	1			1	1	1	1	3	3
CO4	3	2	2	2	3	1	1			1	1	1	1	2	2
CO5	3	2	2	2	3	1	1			1	1	1	1	2	2
CO6	3	2	2	2	3	1	1			1	1	1	1	2	1

UAU761E	MODERN MACHINING PROCESSES	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: History, classification, comparison between conventional and non-conventional machining process selection.

ULTRA SONIC MACHINE(USM): Introduction, equipment, tool materials and tool size, abrasive slurry, cutting tool system design: effect of parameter: effect of amplitude and frequency and vibration, effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool and work material.

UNIT–II	10 Hrs.

ABRASIVE JET MACHINING(AJM): Introduction, equipment, variables in AJM: carrier gas, type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. abrasive particles per unit volume of the carrier gas, work material, Stand Off Distance(SOD), nozzle design, shape of cut. Advantages and disadvantages of AJM. Water Jet Machining: principle, operation, application, advantages and limitations of water jet machinery.

ELECTROCHEMICAL MACHINING(ECM): Introduction, study of ECM machine, elements of ECM process: Cathode tool, anode work piece, source of DC power, electrolyte, chemistry of the process, ECM process characteristics - material removal rate, accuracy, surface finish, ECM tooling: ECM tooling technique and example, tool and insulation materials, tool size electrolyte flow arrangement, handling of slug, economics of ECM, advantages, limitations.

UNIT–III	10 Hrs.

CHEMICAL MACHINING(CHM): Introduction, elements of process, chemical blanking process: Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps - masking, etching, process characteristics of CHM: material removal rate accuracy, surface finish.

ELECTRICAL DISCHARGE MACHINING(EDM): Introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) electrode feed control, electrode manufacture, electrode wear , EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement.

UNIT–IV	10 Hrs.

PLASMA ARC MACHINING(PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, applications, advantages and limitations.

LASER BEAM MACHINING(LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, process characteristics, applications, advantages and limitations.

ELECTRON BEAM MACHINING(EBM): Principle, equipment, operations, applications, advantages and limitation of EBM.

Reference Books *

TEXT BOOKS:

1. **Modern Machining Process -** by Pandey and Shah, TATA McGraw Hill 2000
2. **New Technology -** by Bhattacharya, 2000

REFERENCE BOOKS:

1. **Production Technology –**HMT, TATA McGraw Hill. 2001
2. **Modern Machining Process** – Aditya, 2002
3. **Non-Conventional Machining -** P.K.Mishra, The Institution of Engineers (India) Test book series,

Narosa Publishing House – 2005.

4. **Metals Handbook** - Machining volume 16 Joseph R. Davis (Editor), American Society of Metals (ASM)

Course Outcomes**

1. Define and Classify different non - traditional machining techniques and their working principle.
2. Classify the NTM systems based on applications and limitation.
3. Ability to analyze the working parameters for optimize productivity.
4. Compare two or more NTM methods on the basis of merits and demerits.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	1								2	2	2	1
CO2	3	2	1	1								2	2	2	1
CO3	3	2	1	1								2	2	2	1
CO4	3	3	1	1								2	2	2	1

UAU762E	ROCKET AND JET PROPULSION SYSTEM	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: Review of thermodynamic principles, principles of aircraft propulsion, types of power plants, basics of heat transfer; conduction, convection, radiation, diffusion mass transfer basic concepts and governing equations.

FUNDAMENTALS OF GAS TURBINE ENGINES ILLUSTRATION OF WORKING OF GAS TURBINE ENGINE: Thrust equation - factors affecting thrust - effect of pressure, velocity and temperature changes of air entering compressor - methods of thrust augmentation - characteristics of turboprop, turbofan and turbojet - performance characteristics.

UNIT–II	10 Hrs.

SUBSONIC AND SUPERSONIC INLETS FOR JET: Engines internal flow and stall in subsonic inlets - boundary layer separation - major features of external flow near a subsonic inlet - relation between minimum area ratio and eternal deceleration ratio - diffuser performance - supersonic inlets - starting problem on supersonic inlets - shock swallowing by area variation - external declaration - models of inlet operation.

COMBUSTION CHAMBERS AND NOZZLES: Classification of combustion chambers - important factors affecting combustion chamber design - combustion process - combustion chamber performance - effect of operating variables on performance - flame tube cooling - flame stabilization - use of flame holders - theory of flow in isentropic nozzles - convergent nozzles and nozzle choking - nozzle throat conditions - nozzle efficiency - losses in nozzles - over expanded and under - expanded nozzles - ejector and variable area nozzles - interaction of nozzle flow with adjacent surfaces - thrust reversal.

UNIT–III	10 Hrs.

COMPRESSORS PRINCIPLE OF OPERATION OF CENTRIFUGAL COMPRESSOR: Work done and pressure rise - velocity diagrams - diffuser vane design considerations – Concept of pre whirl - rotation stall - elementary theory of axial flow compressor - velocity triangles - degree of reaction - three dimensional - air angle distributions for free vortex and constant reaction designs - compressor blade design - centrifugal and axial compressor performance characteristics**.**

INTODUCTION TO TURBINES: Types of turbines - operating principle - design consideration - velocity triangles - degree of reaction - performance parameters - basics of blade design principle.

UNIT–IV	10 Hrs.

RAMJET PROPULSION: Operating principle - sub critical, critical and supercritical operation - combustion in ramjet engine - ramjet performance - sample ramjet design calculations - introduction to scramjet - preliminary concepts in supersonic combustion - integral ram- rocket.

FUNDAMENTALS OF ROCKET PROPULSION: Types and classification of rockets operating principle - specific impulse of a rocket - rocket nozzle classification - rocket performance considerations.

Reference Books *

Text Books

1. V. Ganesan, " Gas Turbine", Tata McGraw Hill Pub. Co. Ltd., 1996 2. Hill, P.G. & Peterson,
2. C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999. 43

References

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman,
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York 1985
3. "Rolls Royce Jet Engine" – Third Edition – 1983. 5. Mathur, M.L. and Sharma, R.P., "Gas Turbine,

Course Outcomes**
1. Able to know the principles of aircraft propulsion, types of power plants
2. Able to know the fundamentals of gas turbine engines illustration
3. To study the subsonic and supersonic inlets
4. To study the compressors principle and types of compressor used in jets
5. Able to know the ram jet propulsion and operating principle
6. Able to know the principles of aircraft propulsion, types of power plants

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	1	1	1	1		1	1	1	1	2	1	2
CO2	2	2	2	1	1	1	1		1	1	1	1	2	2	2
CO3	2	1	1	1	1	1	1		1	1	1	1	3	2	3
CO4	2	1	2	1	1	1	1		1	1	1	1	2	2	3
CO5	2	2	2	1	1	1	1		1	1	1	1	1	2	2
CO6	2	2	2	1	1	1	1		1	1	1	1	1	2	2

UAU763E	ON AND OFF BOARD DIAGNOSTICS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
INTRODUCTION: DEFINITION OF DIAGNOSTICS: System structure, on-board diagnostics, off-board diagnostics, model based approach to diagnosis, VMBD (vehicle model based diagnosis) project, common rail demonstrator, DTI (distributor type injection) demonstrator. Prospects for failure diagnostics of automotive electronic control system. History of diagnostics tools, present state and changes in diagnostics techniques, OBD-II diagnostic logic, future trends of diagnostics technique. Further improvement of diagnostic function.	
UNIT–II	**10 Hrs.**
A new object oriented diagnostic system management for power train control units with OBD. Impact of legal regulation (OBD-II), challenges for OBD software. Description of the problem domain; basic objects and relations, integration with real time system. In-cylinder diagnosis by laser tomography; measurement methods. Portable on-board diagnostic OBD-II /CAN scan tool. An on-board diagnosis method for three way catalyst deterioration Engine knock detection. OBD-II Performance of three way catalysts. Product, tools and emerging research.	
UNIT–III	**10 Hrs.**
Evolution knock detection products, stages of knock detector development and tool requirements, next generation of knock systems. Virtual sensing**:** A neural network based intelligent performance and emissions prediction system for on-based diagnostics and engine control. Operation of virtual sensing system, virtual sensor architecture virtual sensors prediction and training, applications to diesel and petrol engine, applications of virtual sensing, engine diagnostics, engine control and engine modeling.	
UNIT–IV	**10 Hrs.**
High temperature measurements for on-board diagnostics of LEV/ULEV systems. Emissions after cold start, catalyst heating systems, temperature measurement systems. Heavy duty approach to on board diagnostics. An advanced electronic control and diagnostics systems for automatic transmission: Function, structure, software, sensors, actuators, operation, diagnosis. Fuzzy system for automotive fault diagnosis. OBD-II system in the Hyundai Accent (case study).	
Reference Books *	
BOOKS: Ronald Jurgen	
Course Outcomes**	
1. To study the introduction of diagnostics; System structure, on-board diagnostics, off-board diagnostics	
2. To study the risks and challenges of OBD software and description of the problem domain; basic objects and relations, integration with real time system.	
3. To study and analyse the neural network based intelligent performance and emissions prediction system for on-based diagnostics	
4. To study and analyse the fuzzy system for automotive fault diagnosis.	

Course Outcomes	Program Outcomes (POs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	2	2	1	1			1			1	1	1
CO2	2	2	1	1			1			1	1	1
CO3	2	2	1	1			1			1	1	1
CO4	2	1	1	1			1			1	1	1

UAU764E	ELECTRIC VEHICLES	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: Electric vehicles; early systems, charging techniques for lead acid batteries, charging techniques for nickel based batteries, charging techniques for non aqueous batteries, Battery state of charge measurement, battery management, connection methods, battery exchange, infrastructure implications, recharging/refueling of other power storage devices.
Economic and environmental comparison of alternative vehicle options.
Electric vehicles; configuration of EVs, performance, traction motor characteristics, tractive effort and transmission requirements.

UNIT–II	10 Hrs.

BATTERIES: Storage batteries; advanced lead acid, metal foil lead acid, nickel - iron, nickel - zinc, nickel - cadmium, sodium - sulphur, sodium - nickel chloride, lithium - iron sulphide, lithium - solid polymer, lithium - ion, aluminum - air and zinc - air. Formation of GHG emissions from EV fuel cycle.
CONVERSION: Conversion overview, summary of EV conversion process. Controller; overview, solid state controller, manual switch versus solid state component.

UNIT–III	10 Hrs.

PROPULSION METHODS: DC Motors; series wound motors, shunt wound motors, compound wound motors, separately excited motors. AC Motors; induction motors, synchronous motors, brushless DC motors, switched reluctance motors, motor cooling, power train options for electric vehicles.
ELECTRIC PROPULSION SYSTEMS: DC motor drives, chopper control of DC motors. Drive train configuration and design objectives, control strategies.

UNIT–IV	10 Hrs.

VEHICLE DESIGN AND SAFETY: Effect of battery weight and volume, designing for minimum weight, safety of batteries, safety of alternative energy generating and storage systems, safety of other electrical systems, general design and safety issues, heating and air conditioning, auxiliary power subsystem, braking, suspension and wheel systems, rolling resistance.
Prototype and experimental electric cars**.**
CONTEMPORARY VEHICLE TECHNOLOGY: GM; EV1, Zafure, Ford; Think City, Ka Litmus, Nissan Hypermini, Toyota RAV 4 EV, Honda EV.

Reference Books *

TEXT BOOKS:

1. Vehicular Electrical Power Systems – Emadi, Ehasni, Mercel (Marcel Dekker)
2. Electronic Engine Controls – Steve V Hatch(Cengage learning)
3. Electric and Hybrid vehicles – Pistoia (Elsevier)
4. Fuel cells principles and applications - B.Vishwanath, M. Aulice Scibion (University Press)
5. Electrical vehicle machine and drives – K.T.Chau (Wiley)

Course Outcomes**

1. Able to know the principles of aircraft propulsion, types of power plants
2. Able to know the fundamentals of gas turbine engines illustration
3. To study the subsonic and supersonic inlets

4. To study the compressors principle and types of compressor used in jets
5. Able to know the ram jet propulsion and operating principle
6. Able to know the principles of aircraft propulsion, types of power plants

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	1	1	1	1	1	1	1	1	1	2	1	2
CO2	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2
CO3	2	1	1	1	1	1	1	1	1	1	1	1	3	2	3
CO4	2	1	2	1	1	1	1	1	1	1	1	1	2	2	3
CO5	2	2	2	1	1	1	1	1	1	1	1	1	1	2	2
CO6	2	2	2	1	1	1	1	1	1	1	1	1	1	2	2

UAU 716L	Automotive Reconditioning Lab	Credits: 1
L:T:P - N_L :0 N_T:0 N_P 2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

1. Study and Practice of Line reboring machine
2. Study and Practice of calibration FIP
3. Study and Practice of vertical cylinder reboring machine
4. Study and Practice of reboring small and big end of connecting rod ‘
5. Study and Practice on body repairs tinkering and painting
6. Study and Practice of refacing of given valve
7. Study and Practice of surface grinding machine
8. Study and Practice of crank shaft grinding machine

Laboratory Assessment:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
2. Allocation of 50 marks for CIE
    - Performance and journal write-up :
      Marks for each experiment = 30 marks/No. of proposed experiments.
    - One practical test for 20 marks. (5 write-up, 10 conduction, calculation, results etc., 5 viva-voce).

3. Allocation of 50 marks for SEE

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	2	2	1	2	2	2	2	3	1	2	1
CO2	3	3	2	2	2	2	1	2	2	2	2	3	1	2	1
CO3	3	3	3	2	2	2	1	2	2	2	2	3	1	2	1
CO4	3	3	3	2	2	2	1	2	2	2	2	3	2	2	1

UAU 777P	PROJECT PHASE – I	Credits: 05
L:T:P - N_L :0 N_T: 0 N_P 10		CIE Marks: 50
Total Hours/Week: 10		SEE Marks: 50

- Project Batch may consist of maximum of Four Students however under exceptional conditions it may be extended up to 5 students.
- Guide/s may be identified by the students or it may be allotted by the department.
- The students along with the respective guides have to decide the project work and submit the title and synopsis of the project work to the Departmental committee (DC) consisting of 1) HOD or HOD Nominee 2) Project Coordinator and 3) Respective Project Guide/s
- Each student in the batch is directed to maintain the project progress record book to enter the progress of project work during the contact hours with the respective guides.
- The contact hour schedule may be defined by the guides in consent with their batches as per convenience
- The CIE evaluation is to be conducted for 50marks by the guide by reviewing the progress of the project work, attendance through the record books conducting at least one demo/seminar presentation for the same project work before SEE examination.
- Students have to submit the synopsis in 2 copies containing objectives, methodology, literature review, etc as a project report-I for VII Semester SEE Examination purpose. (one report to the Guide and one report to DC)
- The SEE examinations will be conducted by DC separately for each project batch for 50marks.

In case of the change of the title/synopsis/project work, may be done in consent with the respective guides before SEE examination and the same should be brought to the notice of DC.

Project- I

Examination	CIE	SEE
Marks	50	50

Course Outcomes**

1. Applying knowledge of basic science, core and elective engineering subjects to identify and execute the problems.
2. Conduct and analyze the literature survey in the identified fields and define the objectives, proposed action plan and methodology.
3. Able to interact, analyze and create the directions and dimensions for problem solving.
4. Skill developments in project report preparation, presentation, communication and justification.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	2	2	1	2	2	2	2	3	3	3	3
CO2	3	3	2	2	2	2	1	2	2	2	2	3	3	3	3
CO3	3	3	3	2	2	2	1	2	2	2	2	3	3	3	3
CO4	3	3	3	2	2	2	1	2	2	2	2	3	3	3	3

UAU718I	INTERNSHIP	Credits: 02
L:T:P - N_L : N_T: N_P		CIE Marks: 50
Total Hours/Week: 0		SEE Marks: 50

Students have to submit a report of the training undergone. Evaluation will be done at the end of the semester by evaluation committee set by the department.

Scheme of Evaluation for Internship (Mandatory)

- Students should complete 4 weeks
- Scheme of evaluation consists of both CIE and SEE.

➢ **CIE consists of 3 phases**

A report about the industry / institute and objectives after **1** weeks of internship

A report on study/ methodology of internship after **2** weeks

➢ A presentation on internship after completion of **4** weeks

Total: 50 Marks

- SEE to be conducted along with 7th semester examination, which includes viva-voce and report submission (both internal examiners)

Viva Voce	**25 marks**
Report	**25 marks**
Total	**50 marks**

The report should be in the format prescribed by department.

UAU821E	ALTERNATIVE ENERGY SOURCES	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
ALTERNATIVE ENERGY RESOURCES: Types of energy sources need for energy sources, availability, merits and demerits. Green house gases and climate change. Renewal energy sources: definition, classification and comparison with conventional fuels. **SOLAR ENERGY**: Solar radiation, geometry, radiation measurement devices; pyranometer and pyreliometer, solar energy collectors and their types, performance characteristics of collectors, applications of solar energy, solar energy storage system, photovoltaic conversion, solar cell characteristics.	
UNIT–II	**10 Hrs.**
BIOMASS ENERGY: Introduction, definition of biomass, types of biomass, biomass conversion techniques, bio gas, composition, bio gas generation process, factors affecting bio gas generation, selection of biogas plant, types of bio gas plants, construction and their working, problems involved in production and transportation, application of bio gas for IC engines, dual fuel approach, modifications required. Producer gas: Production through pyrolysis, composition, performance modifications needed.	
UNIT–III	**10 Hrs.**
ALCOHOL FUELS: Introduction, suitability, production of methanol and ethanol; through municipal solid wastes, grains and sugarcane. Properties; comparison of alcohols and gasoline as engine fuels, exhaust emission study, performance of IC engines using pure ethanol and methanol, ethanol and methanol blends, change in properties of alcohol - gasoline blends, alcohols as diesel fuels; performance and limitations. General implications; crop pattern, food shortages through grain and sugarcane based alcohols. **BIODIESEL**: Introduction, feed stock for biodiesel production, non edible oils, raw materials for sustainable biodiesel. Vegetable oils, types, properties. Animal fat wastes for bio diesel production. Thermodynamic characteristics. Biodiesel esterification. Biodiesel emissions.	
UNIT–IV	**10 Hrs.**
HYDROGEN ENERGY: Scope and scale of hydrogen as fuel, issues and challenges of hydrogen as fuel, properties; comparison with gasoline, production methods; electrolysis, thermochemical, coal gasification, solar photolysis, storage; gas, liquid and metal hydrides, transportation; pipe line, liquid and solid, combustion, utility, safety and management, emission and performance characteristics of hydrogen engine, engine modifications required. Natural gas, Liquefied Petroleum Gas (LPG), composition, properties, LPG kits, modification, natural gas engines, performance and pollution study. Fuel cell; utility and methods.	
Reference Books *	
TEXT BOOKS: 1. Theory of IC engines: Mathur and Sharma 2. Non-conventional energy sources: G.D. Rai. 3. Solar energy: S.P.Sukatme	
Course Outcomes**	
1. Able to know the need, availability, classification of renewable energy sources and its environmental impact	
2. Able to know the solar energy and its applications with collectors and their types.	
3. To know and analyze of bio mass and its utility with its derived products and their application in IC 3engines and subsequent modification	

4. Ability to study and the use of alcohol fuels, its properties and its comparison with conventional fuels.
5. To study and analyze the use of biodiesel, LPG and natural gas properties and its performance
6. Analyze the issue and challenges associated with hydrogen as an energy carrier, properties, production, storage and transportation and utilization with modifications involved.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	1	2		2	3	1		2		2	2	1	2
CO2	2	1		2		2	3	1		2		2	2	2	2
CO3	2	2	1	2		2	3	1		2		2	2	2	2
CO4	2	2	1	2		2	3	1		2		2	2	2	2
CO5	2	1	1	2		2	3	1		2		2	2	2	2
CO6	2	2	1	2		2	3	1		2		2	2	2	2

UAU 823E	INTELLIGENT TRANSPORT SYSTEM AND FUTURE TRENDS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTELLIGENT TRANSPORT SYSTEM (ITS): Overview and structure, history, application and architecture. Emergence and characteristics of ITS. Structure of ITS, technology and user services. ITS standards. Benefits and constraints of ITS deployment. Advanced driver assistance system; Overview, research. Infrastructure based automated driving vehicles, cyber cars. Future of driver assistances. Long -term goal- autonomous driving. BVS Systems: requirements, (special and general), advantages, components of bus, access methods, network topology.

UNIT–II	10 Hrs.

EVOLUTION AND FUTURE TRENDS; safety and energy efficiency, navigation/telematic services; comfort and safety benefits, traffic information services, client feed back. Traffic management. Lane assistance.

DATA ACQUISITION: Introduction, data types, vehicle dynamic sensors, inertial sensors, acceleration sensors, rotation rate sensors, steering angle sensors. Human machine interface design in modern vehicles.

UNIT–III	10 Hrs.

STEER- BY- WIRE: System architecture, potential and challenges. Concept sketching, full size tape drawing, clay modeling, ergonomics in the automotive industries. Control system in automobiles: Open loop, feed forward, closed loop or feedback control, sequential control. Vehicle navigation : Functions of navigation, digital map near vision system; application, far – infrared system (FIR), near infrared (NIR) ; operating principles.

AUTOMATED DRIVING: Requirements, sensor technology, actuator technology, legal aspects. Sports car engines characteristics.

UNIT–IV	10 Hrs.

BODY DESIGN: Styling process, studios; working environment and structure. Mechanical design, design possibilities, advances in manufacture methods, material advances, energy conversation, power system, vehicle sales. Automotive embedded systems, infotainment and navigation systems, automotive antennas, urban and extra urban vehicles, rethinking the vehicle design.

ELECTRICAL AND ELECTRONIC POSSIBILITIES: electronic advances in power train design, electronically controlled valve actuation, electronic transmission control, electronic developments in chassis system.

Reference Books *

BOOKS: Encyclopedia of automobile engineering (vol. 4, 5 and 6)

New trends and developments in automotive system engg –Maxcello Chiaberge (INTECH)

Course Outcomes**

1. Able to know the overview and structure, history, application and architecture of intelligent Transport Systems(ITS)
2. To study the evolution and future trends of ITS and data acquisition systems
3. To study the steer- by- wire system architecture, potential and challenges
4. Able to know the details and dynamics of automated driving
5. To study the body design and electrical and electronic possibilities of ITS

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	1	2	2	2	1		1	1	2			
CO2	2	1	1	1	2	2	2	1		1	1	2			
CO3	2	2	1	1	2	2	2	1		1	1	2			
CO4	2	2	2	1	2	2	2	1		1	1	2			

UAU824E	ROBOTICS AND AUTOMATION	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION AND MATHEMATICAL REPRESENTATION OF ROBOTS:

Types of robots, notation, position and orientation of a rigid body, successive rotations, Euler angles for fixed frames X-Y-Z and moving frame ZYZ. Transformation between coordinate system, homogeneous coordinates, types of joints: rotary, prismatic joint, cylindrical joint, spherical joint, representation of links using Denvit-Hartenberg parameters: link parameters for intermediate, first and last links, link transformation matrices, transformation matrices of SCARA manipulator.

UNIT–II	10 Hrs.

KINEMATICS OF SERIAL MANIPULATORS:

Direct kinematics of 2R, 3R, RRP, RPR manipulator Stanford arm, inverse kinematics of 2R, 3R manipulator. Velocity and statics of manipulators: 7 hours differential relationships, Jacobian, differential motions of a frame (translation and rotation), linear and angular velocity of a rigid body, linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, velocity ellipse of 2R manipulator, singularities of 2R manipulators, statics of serial manipulators, static force and torque analysis of 3R manipulator, singularity in force domain.

UNIT–III	10 Hrs.

DYNAMICS OF MANIPULATORS:

Kinetic energy, potential energy, equation of motion using Lagrangian, equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, inertia of a link, recursive formulation of dynamics using Newton Euler equation, equation of motion of 2R manipulator using Lagrangian, Newton-Euler formulation. Trajectory planning: joint space schemes, cubic trajectory, joint space schemes with via points, cubic trajectory with a via point, third order polynomial trajectory planning, linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning.

UNIT–IV	10 Hrs.

CONTROL:

Feedback control of a single link manipulator - first order, second order system, PID control, PID control ofmulti link manipulator, force control of manipulator, force control of single mass, partitioning a task for force and position control lever, peg in hole hybrid force and position controller, actuators and sensors in industrial robots.

Reference Books *

TEXT BOOKS:

1. Fundamental Concepts and Analysis, Ghosal A., Robotics, Oxford,2006
2. Introduction to Robotics Analysis, Systems, Applications, Niku, S. B., Pearso Education, 2008

REFERENCE BOOKS:

1. Introduction to Robotics: Mechanical and Control, Craig, J. J., 2nd Edition, Addison-Welsey, 1989.
2. Fundamentals of Robotics, Analysis and Control, Schilling R. J., PHI, 2006.

Course Outcomes**

1. To understand features of various robot.
2. To understand the features robot drives and controls.

3. To know how the sensor technology used in robotics.
4. To use the programs for simple robot tasks.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	2	1	1	1	1	2	1	1	1	1
CO2	3	3	3	2	2	2	1	1	1	1	2	1	2	2	2
CO3	3	3	3	2	2	2	1	1	1	1	2	1	2	2	2
CO4	3	3	3	2	2	2	1	1	1	1	2	1	3	2	2

UAU832E	COMPOSITE MATERIALS	Credits: 03
L:T:P - N_L : $3N_T$:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION TO COMPOSITE MATERIALS:
Definition, classification and characteristics of composite materials - fibrous composites, laminated composites, particulate composites.
FIBER REINFORCED PLASTIC PROCESSING: Lay up and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pull forming, thermo-forming, injection molding, blow molding.

UNIT–II	10 Hrs.

CHARACTERISTICS OF FIBER-REINFORCED LAMINA:
Fundamentals, Elastic properties of a lamina, unidirectional, continuous fiber zero degree and angle-ply lamina. Lamina to laminate, lamination theory, lamina strains and stresses due to applied loads. Inter-laminar stresses. A, B, D matrices, simple problems.

UNIT–III	10 Hrs.

METAL MATRIX COMPOSITES:
Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC"s and its application, mechanical properties, isostress, iso strain for fiber reinforced MMC"s applications and mechanics of fiber reinforced plastics: automobile, aircraft missiles. Space hardware, electrical and electronics, marine, recreational and sports equipment

UNIT–IV	10 Hrs.

FABRICATION PROCESS FOR MMC'S:
Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.
STUDY PROPERTIES OF MMC'S: Physical , mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties.

Reference Books *

TEXT BOOKS:

1. Composite Science and Engineering by K. K. Chawla Springer Verlag 1998.
2. Introduction to composite materials by Hull and Clyne, Cambridge University.

'REFERENCE BOOKS:

1. Fiber Reinforced Composites by P. K. Mallick, Marcel Dekker,Inc 2
2. Mechanics of Composite Materials, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998

Composite materials hand book, Meing Schwaitz," McGraw Hill book company.1984

Course Outcomes**

1. To understand the concepts of composite materials and their processing
2. To laminates for various automotive applications
3. Know of mechanical properties of metal matrix composite
4. To approaches for fabrication of MMC and applications

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	2	1	1			1	2	1	1			
CO2	2	2	2	1	1	1			1	2	1	1			
CO3	3	2	1	2	1	1			1	2	1	1			
CO4	2	2	2	1	1	1			1	2	1	1			

UAU833E	ENGINE TROUBLE DIAGNOSIS AND REBUILDING	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
DIAGNOSIS: Introduction, risk assessment and reduction, terminology. Fault code readers, systems, data sources. **TOOLS AND EQUIPMENT**: Basic equipment, scanners.	
UNIT–II	**10 Hrs.**
DIAGNOSTIC TECHNIQUES: Introduction, diagnostic process, mechanical and electrical diagnostic techniques, fault codes and systems. Sensors, actuators and oscilloscope diagnostics; Introduction, sensors, actuators, engine waveforms, communications networks. **ON-BOARD DIAGNOSTICS**: Gasoline OBD monitors, misfire detection, future developments in diagnostic systems.	
UNIT–III	**10 Hrs.**
ENGINE SYSTEMS DIAGNOSTICS: Engines, fuel system, ignition system, emission, fuel injection system, diesel injection system, engine management, exhaust and air supply, cooling and lubrication. **ENGINE TESTING INSTRUMENTS**; Tachometer, dwell meter, cylinder compression tester, vacuum gauge, exhaust gas analyzer, engine analyzer, oscilloscope, chassis dynamometer. **ENGINE TUNE-UP**: Meaning, significance and procedure.	
UNIT–IV	**10 Hrs.**
PRACTICAL APPROACH AND TROUBLE DIAGNOSIS: Engine trouble diagnosis; engine not cranking, engine runs but misses, engine lacks power, engine overheating, engine idles rough, engine backfires, engine carbonizing, engine run-on or dieseling, engine stalling, engine backfires, excessive fuel , excessive oil consumption, engine noises, low compression. **DIESEL ENGINE TROUBLE DIAGNOSIS.**	
Reference Books *	
BOOKS: Advanced automotive fault diagnosis - Tom Denton (third edition Rantledge) Automotive Mechanics - William Crouse	
Course Outcomes**	
1. To study the diagnosis of vehicle introduction, risk assessment and reduction, terminology. fault code readers, systems, data sources.	
2. To know the scope and utility of tools and equipment , basic equipment, scanners	
3. To study and analyze OBD monitors, misfire detection, future developments in diagnostic systems	
4. To study various engine testing instruments and tune-up techniques	
5. To study the diesel engine trouble diagnosis	

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	2	1				1	1	1	1	2	2
CO2	2	2	1	1	2	1				1	1	1	1	2	2
CO3	2	2	1	1	2	1				1	1	1	1	2	2
CO4	2	2	1	1	2	1				1	1	1	1	2	2
CO5	2	2	1	1		1				1	1	1	1	2	2

UAU834E	HYBRID VEHICLES	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
HYBRID DRIVES: Introduction, features , functional classification, start/stop system, mild hybrid, full hybrid, plug-in-hybrid, batteries for hybrid vehicles, optimization of hybrid configurations. Changing modes for conductive charging. Super capacitor, fuels cells, solar cells, the flywheel, the hydraulic accumulator, compressed air storage, thermal energy storage, non battery energy sources.	
UNIT–II	**10 Hrs.**
HYBRID ELECTRIC VEHICLES(HEVS) AND DRIVE STRUCTURES: Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive(electrical coupling), parallel hybrid electrical drive train(mechanical coupling), parallel hybrid drive train with torque coupling, power split hybrid drive, speed coupling, hybrid drive train with torque and speed coupling. Control of hybrid vehicles.	
UNIT–III	**10 Hrs.**
Road performance simulation of battery, hydrogen and hybrid cars, simulation of efficient IC Engine. Flywheel technologies, hybridization of energy storage, regenerative braking; braking energy versus vehicle speed, braking power, vehicle speed, vehicle deceleration rate. Electric motor drive design. Brake system of HEVs and FCV. Power train options for hybrid vehicles.	
UNIT–IV	**10 Hrs.**
FUEL CELLS: Fundamentals, operating principles of fuel cells, fuel cell system characteristics, fuel cell technologies, non-hydrogen fuel cells, fuel cell hybrid electric drive train design, configuration, control strategy, parametric design. Inductive charging. Factors affecting plug-in hybrid fuel consumption. Relative fuel economy potential of intelligent, hybrid and intelligent-hybrid passenger vehicle. Vehicle models for simulation studies, hybrid vehicles with telematics. Hybrid system configuration of BMW, Volkswagan, Fiat, Volvo, Toyota. All-electric hybrid vehicles, electromechanical hybrid vehicles, heat engine electric hybrid vehicles, production.	
Reference Books *	
BOOKS: Electric and hybrid vehicles - Gianfranco pistoia (elsevies)	
Course Outcomes**	
1. Able to classify drives in hybrid vehicles their principles and merits.	
2. Able to classify and analyze different electronic control system and their application.	
3. List different batteries their merits, demerits and specification.	
4. List different power sources used in hybrid vehicles and compare with analyze.	
5. To define vehicle safety system and working principles and applications.	
6. Able justify working principles of hybrid vehicles and carry out performance analysis.	

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	1				2					2	2	2	1
CO2	3	1	1				1					2	2	2	2
CO3	3	1	1				1					2	2	2	1
CO4	3	1	1				3					2	2	2	2
CO5	2	1	1				2	1				2	2	2	1
CO6	2	1	1				1	1				2	2	2	1

UAU852E	HYDRAULICS AND PNEUMATICS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION TO HYDRAULIC POWER: Pascal's law and problems on Pascal's law, continuity equations, introduction to conversion of units. Structure of hydraulic control system.

SOURCE OF HYDRAULIC POWER: Pumps; pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps.

HYDRAULIC ACTUATORS AND MOTORS: Linear hydraulic actuators [cylinders], mechanics of hydraulic cylinder loading, hydraulic rotary actuators, gear motors, vane motors, piston motors, hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.

UNIT–II	10 Hrs.

CONTROL COMPONENTS IN HYDRAULIC SYSTEMS: Directional control valves - symbolic representation, constructional features, pressure control valves - direct and pilot operated types, flow control valves.

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS: Control of single and double - acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

UNIT–III	10 Hrs.

MAINTENANCE OF HYDRAULIC SYSTEMS: Hydraulic oils - desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

INTRODUCTION TO PNEUMATIC CONTROL: Choice of working medium, characteristics of compressed air. Structure of pneumatic control system.

PNEUMATIC ACTUATORS: Linear cylinders - types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod - less cylinders - types, working advantages. Rotary cylinder types construction and application. Design parameters - selection.

UNIT–IV	10 Hrs.

DIRECTIONAL CONTROL VALVES: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Signal processing elements: Use of logic gates - OR and AND gates pneumatic applications. Practical examples involving the use of logic gates.

MULTI - CYLINDER APPLICATIONS: Coordinated and sequential motion control. Motion and control diagrams - signal elimination methods. Electro-pneumatic control: principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Compressed air: production of compressed air compressors, preparation of compressed air driers, filters, regulators, lubricators, distribution of compressed air piping layout.

Reference Books *

TEXT BOOKS:

1. Fluid Power with applications: Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2. Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co. 2000.

REFERENCE BOOKS:

1. Oil Hydraulic Systems – Principles and Maintenance: S.R. 2002 Majumdar, Tata Mc Graw Hill publishing

company Ltd. 2001.

Course Outcomes**

1. To draw block diagram and explain working principles of fluid power systems
2. To analyze given hydraulic and pneumatic circuits
3. To compute dimensions of various hydraulic and pneumatic components using analytical equations
4. To design basic hydraulic and pneumatic circuits for a given application
5. To design electro-hydraulic and electro-pneumatic circuits for a given application

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2		1								1	2	1	1	1
CO2	2	2	1	2							1	2	2	2	2
CO3	3	3	2	2							1	2	2	3	2
CO4	2	2	2	1							1	2	3	3	2
CO5	1	2	2								1	2	3	3	2

UAU 841E	AUTOMOTIVE VEHICLE SAFETY	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: xx03		SEE Marks: 50

UNIT-I	10 Hrs.
Introduction to vehicle safety: Objectives, general implications. Basic concepts of vehicle safety: Underlying principles, public health analogy, prioritization of effort, triology, cause and effect, immediate objectives. Driving forces for increased vehicle safety, safety legislation, accident data.	
UNIT–II	**10 Hrs.**
Accident avoidance: Human factors, comfort, ergonomics, acceleration and braking; adaptive cruise control, brake-by-wire, vehicle dynamics. Design requirement of frontal collision, rear end collision and roll over. Occupant protection: Restraint systems, seat belts, air bags for frontal impacts, side protection by air bags, additional air bag applications, sensors for systems.	
UNIT–III	**10 Hrs.**
Risk Evaluation, human error control, risk communication, universal design, occupant injury prevent; bio-kinetics. Human simulation application, crash testing, accident reconstruction. Development criteria and standards for vehicle. Compatibility, accident analysis, impact analysis; frontal impact, side impact, computer simulation.	
UNIT–IV	**10 Hrs.**
Body structure of small car in frontal vehicle to vehicle crash; introduction, safety improvement for small cars, new design concept, structure and crash performance. Compatibility requirement for cars in frontal and side impact: Introduction, collision type, geometry, mass and structure stiffness, car to car side impact, finite element modeling.	
Reference Books *	
Books: Automotive vehicle safety – George A Peters, Barbara j Peters (SAE) Automotive vehicle safety – Ulrich Seiffest, Lothar Wech Vehicle compatibility in automotive crashes – Stanley H Backaities(SAE)	
Course Outcomes**	
1. Able to know the vehicle safety objectives, general implications. basic concepts of vehicle safety	
2. To study the brake-by-wire, vehicle dynamics human factors, comfort, ergonomics.	
3. To study and analyze the risk evaluation, human error control and bio-kinetics	
4. To study the compatibility requirement for cars in frontal and side impact collision type; geometry, mass and structure	

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2		1		1	1	1	1	1			
CO2	2	2	1	2		1		1	1	1	1	1			
CO3	2	1	2	2		1		1	1	1	1	1			
CO4	2	2	2	2		1		1	1	1	1	1			

UAU 842E	ADVANCED I.C. ENGINES	Credits: 03
L:T:P - N_L :3 N_T: 0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

COMBUSTION IN SPARK IGNITION ENGINES: Thermodynamic analysis of SI engine combustion: burned and unburned mixture states. Analysis of cylinder pressure data, combustion process characterization, flame structure and speed; laminar burning speeds, partial burning and misfire: definitions, causes of cycle - by - cycle and cylinder to cylinder variations, partial burning, misfire and engine stability. Abnormal combustion: knock and surface ignition, knock fundamentals, fuel factors.

UNIT–II	10 Hrs.

COMBUSTION IN COMPRESSION IGNITION ENGINES: Types of diesel combustion systems: Direct injection systems, indirect injection systems, comparison of different combustion systems, analysis cylinder pressure data; combustion efficiency, DI engines, IDI engines, ignition delay: definitions and discussion, fuel ignition quality, auto ignition fundamentals.

UNIT–III	10 Hrs.

MODERN DEVELOPMENTS IN I.C.ENGINES:
Lean burn engines, ceramic and adiabatic engines, multi-valves, tuned manifolds, cam less valve gearing, variable valve timing, turbo and supercharging - waste gating, EGR, part-load charge stratification in GDI systems. Sports vehicle engines, Stirling engines, MPFI engines - operation and performance.

UNIT–IV	10 Hrs.

SPECIAL TYPES OF ENGINES: Introduction to working of stratified charged engines, Wankel engine, variable compression engine, surface ignition engines, free piston engines, current engines and future trends (e.g. convergence of SI and CI engine technology, control developments, fuel quality), effect of air cleaners and silencers on engine performance.

Reference Books *

TEXT BOOKS:

1. Internal Combustion Engines Fundamentals - John B. Heywood, McGraw Hill International Edition,
2. A course in I.C. Engines - Mathur & Sharma, Dhanpat Rai & sons, New Delhi,1994

REFERENCE BOOKS:

1. I.C.Engines by Taylor, MIT Press England 1989
2. I.C.Engines By Lichty., McGraw Hill
3. Fuels & Combustion By Smith & Stinson., McGrawHill
4. Motor Vehicle Engines by M.Khovakh., Mir Publishers
5. I.C. Engines by V.Ganesan, Tata Mc Graw Hill,1994

Course Outcomes**

1. Analyze the thermodynamic analysis and pressure variations in single and multiple cylinders of SI and CI engines and variation of mixture strength and emissions .
2. Analyze the combustion analysis, its phases and heat release patterns and their variations, air cleaners and silencers in SI and CI engines.
3. Analyze cycle – by – cycle fluctuations in single cylinder and cylinder to cylinder and problems of power /energy imbalance, misfiring in the SI engines and types of combustion chambers in both engines.
4. To know and analyze the causes of knocking and its impacts on engine performance and their controlling methods.

5. Analyze the various construction, working and applications of V- type, stratified charge, multi valve, lean burn, MPFI and VCR engines.
6. Analyze the principle and feature of supercharging, free piston, Stirling and Wankel engine.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1									2	2	2	1
CO2	3	1	1									2	2	2	2
CO3	3	1	1									2	2	2	1
CO4	3	1	1									2	2	2	2
CO5	3	1	1									2	2	2	1
CO6	3	1	1									2	2	2	1

UAU843E	FINITE ELEMENT METHODS	Credits: 03
L:T:P - N_L : $3N_T$:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

INTRODUCTION: Equilibrium equations in elasticity subjected to body force, traction forces, stress strain relations for plane stress and plane strain, Boundary conditions, Initial conditions, Euler's Lagrange's equations of bar, beams, principle of a minimum potential energy, principle of virtual work, Rayleigh-Ritz method Galerkins method and matrix techniques. Basic procedure: General description of Finite Element Method, discretization process; types of elements 1D, 2D and 3D elements, size of the elements, location of nodes, node numbering scheme, half bandwidth, stiffness matrix of bar element by direct method, properties of stiffness matrix, preprocessing, post processing. Engineering applications of finite element method. Advantages and disadvantages of FEM.

UNIT–II	10 Hrs.

INTERPOLATION MODELS: Polynomial form of interpolation functions - linear, quadratic and cubic, simplex, complex, multiplex elements, selection of the order of the interpolation polynomial, convergence requirements, static condensation. Penalty approach and elimination method. One dimensional bar element: Recall of 1D linear bar element. Lagrangian interpolation, higher order one dimensional elements- quadratic, cubic element and their shape functions, properties of shape functions, effect of temperature on 1D elements and stress calculation.

UNIT–III	10 Hrs.

TWO DIMENSIONAL ELEMENTS: Shape functions and stiffness matrix of 2D elements four - node quadrilateral, nine - node quadrilateral eight - node quadrilateral, serendipity and Lagrange comparison with 2D Pascals triangle. CST and LST shape functions , Jacobian matrix, stiffness matrix, force terms, stress calculation and numerical integration. Introduction to 3-D elements shape function of tetrahedron element.

UNIT–IV	10 Hrs.

TRUSSES AND BEAM ELEMENTS: Analysis of trusses and beam elements its shape functions, stiffness matrix and stress calculation heat transfer problems: steady state heat transfer, 1D heat conduction governing equation, boundary conditions, one dimensional element, functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1D heat transfer in thin fins.

Reference Books *

Text Books:

1. Finite Elements in engineering, Chandrupatla T.R., 3rd Pearson Edition.
2. Finite Element Analysis, C.S.Krishnamurthy,–Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1995.
3. "Fundamental Finite Element Analysis and Application" by "Asghar Bhatti" by PageTurner 2013.
4. "Advanced Topics in Finite Element Analysis of Structures with Mathematica and MATLAB Computations" by M. Asghar Bhatti by PageTurner 2013.

Reference Books:

1. The FEM its basics and fundamentals: O.C.Zienkiewicz, Elsevier, 6e.
2. Finite Element Method, J.N.Reddy, McGraw –Hill International Edition.
3. Finite Element Methods, by Daryl. L. Logon, Thomson Learning 3rd edition, 2001.

Course Outcomes**

1. Exposure to the fundamentals of continuum mechanics
2. Able to analyze the various interpolation models in FEM

3. To apply finite element procedures for simple 2D structural elements
4. To be able to compute the Jacobian matrix, stiffness matrix and force terms
5. Apply FEA method to analyze the various heat transfer problems

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	1	1					1	1	1			
CO2	2	2	1	2	2					1	1	1			
CO3	2	2	1	2	2					1	1	1			
CO4	2	2	1	2	1					1	1	1			
CO5	2	2	1	2	2					1	1	1			

UAU844E	EARTHMOVING EQUIPMENTS AND HEAVY DUTY TRUCKS	Credits: 03
L:T:P - N_L :3 N_T:0 N_P 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

EQUIPMENTS AND OPERATION: Different types of earth moving equipments and their applications. Dozers, loaders, shovels, excavators, scrapers, motor graders, rollers, compactors, tractors and attachments. Types of soil.

UNIT–II	10 Hrs.

R CARRIAGE AND SUSPENSION: Tyre and tracked vehicles, advantages and disadvantages, under carriage components like tracks, roller frames, drive sprockets, track rollers, track chains and track shoes.

SUSPENSION: Rubber spring suspension and air spring suspension.

TRANSMISSIONS AND FINAL DRIVES: Basic types of transmissions, auxiliary transmission, compound transmission, planetary transmission, constructional and working principles, hydroshift automatic transmission and retarders. Final drives; types of reductions like, single reduction, double reduction final drives and planetary final drives, PTO shaft

UNIT–III	10 Hrs.

HYDRAULICS: Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth and draft control systems.

STEERING AND BRAKES: Power steering types like, linkage type power steering, semi integral power steering and integral power steering. Steering of tracked vehicles: articulated steering, clutch /brake steering system. Brakes: types of brakes like, disc brake, engine brakes etc.

UNIT–IV	10 Hrs.

ODS OF SELECTION OF EQUIPMENTS: Selection of machines, basic rules of equipments including the nature of operation, selection based on type of soil, selection based on haul distance, selection based on weather condition.

CALCULATION OF OPERATING CAPACITY: Methods of calculating operating capacity, calculation of productivity of EMEs.

Reference Books *

TEXT BOOKS:

1. Diesel equipment: volume I and II by Erich J.schulz
2. Construction equipment and its management By S.C. Sharma

REFERENCE BOOKS:

1.Farm machinery and mechanism by Donald R. hunt and L. W.garner
2.Theory of ground vehicles by J.Y.Wong john wiley and sons
3.Moving the earth by Herbert Nicholas
4.On and with the earth by Jagman Singh, W.Newman and Co. culkatta

Course Outcomes**

1. List various types of earthmovers and explain their working principles and applications
2. Describe and differentiate the systems used in earth movers with conventional vehicles
3. Prepare maintenance schedules for earthmovers and tractors

4. To identify the hydraulic components and analyze hydraulic circuits used in earthmovers
5. Apply analytical methods to calculate productivity of earthmovers.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3											2	2	2	2
CO2	3	2										2	2	2	2
CO3	3	2	2	1								3	2	2	2
CO4	3	2										3	2	2	2
CO5	3	3	3	1								3	2	2	2

UAU 804P	PROJECT PHASE – II	Credits: 12
L:T:P - N_L :0 N_T:0 N_P 12		CIE Marks: 50
Total Hours/Week: 12		SEE Marks: 50

- The project work defined in project -I has to be continued for the project work – II.
- The guides have to review the progress of the project work continuously during the contact hours.
- The contact hour schedule may be defined by the guides in consent with their batches as per convenience
- CIE evaluation has to be done by DC based on the progress of the project work by conducting minimum of two demos/ seminar presentation for 25 marks each.
- The students of the project batches are supposed to submit the final project report earlier to SEE examination with the consent of the guide to the DC.
- The SEE examinations will be conducted by PEC consisting of 1) HOD/His Nominee, 2)Internal Examiner/Project Coordinator, 3)External Examiner separately for each project batch for 50marks

Project-II

Examination	CIE I	CIE II	SEE
Marks	25	25	50

Course Outcomes**

1. Applying knowledge of basic science, core and elective engineering subjects to analyze, design, develop and solve the problems.
2. Develop, fabricate and test the models, further analyze and compare performance results/ outcomes the projects.
3. Able to articulate and analyze the results and conclude with scope for future works and cost analysis.
4. Skill developments in presentation, communication and project report preparation

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	2	2	1	2	2	2	2	3	3	3	3
CO2	3	3	3	2	2	2	1	2	2	2	2	3	3	3	3
CO3	3	3										3	3	3	3
CO4	3	3							3	2	3	3	2	2	2

UAU805S	TECHNICAL SEMINAR	Credits: 01
L:T:P - N_L : N_T: N_P		CIE Marks: 50
Total Hours/Week: 00		SEE Marks: 50

Each student has to submit the synopsis of the seminar topic and gets approval from the department committee (DC) consisting of HoD, BoE and respective seminar guide. The department committee allots the guide for the student. Students are required to present the seminar on said topic in consultation with the guide.

Mode of Evaluation:

Sl. No	Particulars	Marks
1	Selection of seminar topic	4
2	Collection of information	12
3	Preparation of PPT	12
4	Presentation of seminar	12
5	Queries and discussion	10
	Total	50

Scheme:

Examination	CIE	SEE
Marks	50	50