

<b>UAU523H</b>	<b>Entrepreneurship and Industrial Management</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>		<b>10 Hrs.</b>
<p><b>MANAGEMENT:</b> Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of management - Management as an art or science, art or profession Management &amp; Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches.</p> <p><b>PLANNING:</b> Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning only) - Decision making – Importance of planning - steps in planning &amp; planning premises - Hierarchy of plans.</p>		
<b>UNIT-II</b>		<b>10 Hrs.</b>
<p><b>ORGANISING AND STAFFING:</b> Nature and purpose of organization -Principles of organization - Types of organization - Departmentation -Committees – Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of Staffing - Process of Selection &amp; Recruitment (in brief).</p> <p><b>DIRECTING &amp; CONTROLLING:</b> Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance – Coordination, meaning and importance and Techniques of Co - ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief)</p>		
<b>UNIT-III</b>		<b>10 Hrs.</b>
<p><b>ENTREPRENEUR:</b> Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Barriers to entrepreneurship.</p> <p><b>SMALL SCALE INDUSTRY:</b> Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI – Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT, Supporting Agencies of Government for S.S.I., Meaning; Nature of Support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only)</p>		
<b>UNIT-IV</b>		<b>10 Hrs.</b>
<p><b>INSTITUTIONAL SUPPORT:</b> Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.</p> <p><b>PREPARATION OF PROJECT:</b> Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study &amp; Social Feasibility Study.</p>		
<b>Reference Books *</b>		
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li><b>Principles of Management</b> - P.C. Tripathi, P.N. Reddy; Tata McGraw Hill,</li> <li><b>Dynamics of Entrepreneurial Development &amp; Management</b> - Vasant Desai Himalaya Publishing House</li> <li><b>Small Business Enterprises</b> - Poornima M Charantimath – Pearson Education - 2006 (2 &amp; 4)</li> </ol>		
<p><b>REFERENCE BOOKS:</b></p> <ol style="list-style-type: none"> <li><b>Management Fundamentals</b> - Concepts, Application, Skill Development Robert Lusier - Thomson</li> </ol>		

2. <b>Entrepreneurship Development</b> - S S Khanka - S Chand & Co
3. <b>Management</b> - Stephen Robbins - Pearson Education /PHI -17th Edition, 2003
<b>Course Outcomes**</b>
1. Assess the scope and significance of management and its principles
2. Illustrate the importance of planning and decision making
3. Demonstrate the communication skills to various Industrial fields
4. Develop entrepreneurial qualities to establish small scale Industry
5. Identify and develop the criterions for formulating project report
6. Evaluate the schemes to build business enterprise

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

UAU524C	AUXILIARY SYSTEMS FOR AUTOMOTIVE	Credits: 03
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0	ENGINE	CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
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**CARBURETION:** Carburetor principle, properties of air-petrol mixtures, mixture requirements for steady state and transient operation, mixture formation studies of volatile fuels, design of elementary carburetor, chokes, automatic chokes, effects of altitude on carburetion, carburetor for 2 - stroke and 4 - stroke engines, carburetor systems for emission control. Fuel flow systems for SI engines.

**GASOLINE INJECTION:** Petrol injection; advantages, disadvantages, Lucas petrol injection system, mechanical, pneumatic and electronic fuel injection systems, types. Performance and exhaust emissions of Gasoline Direct Injection (GDI) engine. Mixture and operation modes, fuel supply and engine management of GDI.

**AIRCRAFT FUEL SYSTEMS:** Basic fuel systems characteristics and functions, fuel properties and environment.

<b>UNIT-II</b>	<b>10 Hrs.</b>
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**DIESEL FUEL INJECTION:** Cleaning systems, transfer pumps, injection pumps, injectors and nozzles - types, functions and necessities, fuel injection pump principle, ratio of piston displacement to fuel charge volume, delivery characteristics, injection lag, pressure waves in fuel lines, fuel pump and governors - types, constructional features and operation, factors influencing fuel spray atomization, penetration and dispersion of diesel and heavy oils and their properties, rate and duration of injection, fuel line hydraulics.

CRDI injection: Operating concept, design, control and regulation for cars and CVs.

Diesel spray characteristics: Macroscopic; front penetration, cone angle, liquid length.

Microscopic characteristics; droplet size and distribution.

<b>UNIT-III</b>	<b>10 Hrs.</b>
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**MANIFOLDS AND MIXTURE DISTRIBUTION:** Intake system components: Air filter, intake manifold with mixture distribution, discharge coefficient, pressure drop, exhaust system components: exhaust manifold and exhaust pipe, spark arresters, waste heat recovery, exhaust mufflers, type of mufflers, exhaust manifold expansion.

**COOLING SYSTEM:** Necessity, variation of gas temperature, areas of heat flow, heat transfer, piston and cylinder temperature, heat rejected to coolant, quantity of water required. Cooling system: air cooling, water cooling, thermodynamics of forced circulation, water pumps, thermostats, pressurized water cooling, regenerative cooling. Comparison of air and water cooling. Radiators - types, cooling fan - power requirement, anti-freeze solution.

<b>UNIT-IV</b>	<b>10 Hrs.</b>
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**LUBRICATION SYSTEM:** Lubricants, lubricating systems - types, lubrication of piston rings, bearings, oil consumption, oil cooling. Heat transfer coefficients, liquid and air cooled engines, coolants, additives and lubricity improvers, concept of adiabatic engines, oil filters, pumps, crankcase ventilation - types.

**SUPERCHARGERS:** Introduction, purpose, thermodynamic cycle, effect on the performance, limits of supercharging for petrol and diesel engines, modifications of an engine for super charging; methods of super charging, compressor design, performance measures and mapping, engine matching.

**TURBOCHARGERS:** Introduction, merits of turbochargers in diesel and gasoline engines, basic structure and functionality, turbocharger performance, engine/turbochargers matching basics, advanced engine requirements and turbo technologies.

**Reference Books \***

**TEXT BOOKS:**

1. **A Course in Internal Combustion Engines** - Mathur, M.L., and Sharma, R.P., Dhanpat Rai Publications (P) Ltd., 1998.
2. **Automobile Engineering Vol I & II** - Kirpal singh, Standard Pub, New Delhi, 2004

3. **Internal Combustion Engine** - Ramalingam, K.K, ScitechPublication (India) Pvt.Ltd.2000.

**REFERENCES BOOKS:**

1. **A Course in Internal Combustion Engines** - Domkundwar, V.M, Dhanpat Rai and Co., 1999.

2. **Internal Combustion Engines** - Ganesan, V., Tata McGraw-Hill Book Co., 2002.

**Course Outcomes\*\***

1. Demonstrate the working of carburetors and petrol injections systems with its utility
2. Illustrate the types and characteristics of diesel injection systems
3. Elucidate the necessity and types of cooling systems
4. Enumerate manifolds and mixture distribution for intake and exhaust systems
5. Suggest lubricants and types of lubrication systems adopted in vehicles
6. Evaluate the scope and significance of turbo charging and its patterns

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

UAU532C	<b>Design of Power Train and Suspension System</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>CRITERIA FOR VEHICULAR SYSTEM DESIGN:</b> Vehicle load, Road, Wind and Gradient Resistance, Expectancy curves and Performance curves. Power and torque of propulsion, Driving Power and torque, Output Power and torque of the Propeller shaft, Output power and torque at fly wheels, Graphical representations of expectancy curves, Starting torque, Load-speed characteristics and performance curves (No derivation only problems).</p> <p><b>DESIGN AND DEVELOPMENT OF CLUTCH ASSEMBLY FOR DIFFERENT TYPES OF VEHICLE POWER TRAINS:-</b>Design and Development of clutch assembly using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of clutches: - single plate, multi plate and cone clutches, selection criteria for the clutches. Analyses of various stresses, forces acting on clutch assembly and components (No derivation only problems). Clutch assembly: clutch plates, pressure plates, springs, input and output shafts, rivets nuts and bolts, clutch plates, frictional materials and their selection criteria, materials used for various components.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>DESIGN AND DEVELOPMENT OF GEAR TRAINS AND GEAR BOXES FOR DIFFERENT TYPES OF VEHICLE POWER TRAINS:-</b>Design and Development of gear trains using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of gear boxes, gear trains and gears, selection criteria, transmission efficiency, criteria for selection of different gear ratios in gear boxes, calculations of gear train dimensions, gear ratios, diameter of the gear shafts and gears etc (No derivation only problems).</p> <p><b>LUBRICATION AND BEARINGS:</b> Lubricants and their properties, mechanisms of lubrication bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, heat dissipated, bearing materials design of journal bearing and thrust bearing (No derivation only problems).</p> <p><b>TYPES OF BRAKES:</b> Single block and simple band brakes.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>DESIGN AND DEVELOPMENT OF CONVENTIONAL TRANSMISSION SYSTEMS FOR DIFFERENT TYPES OF TWO WHEELER AND THREE WHEELERS:-</b>Design and Development of gear trains using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of conventional transmission systems:-belts ropes and chains force and stress analyses, calculations of dimensions for wire ropes. Belts:- types, Flat belts: length and cross section, selection of v-belts,wire ropes and chains for automotive and other applications (No derivation only problems).</p> <p><b>DESIGN AND DEVELOPMENT OF PROPELLER SHAFTS FOR DIFFERENT TYPES OF VEHICLE POWER TRAINS:-</b>Design and Development of propeller shaft using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, Types of propeller shaft, selection criteria, types of joints used (No derivation only problems).</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>SPRINGS:</b> Types of springs, stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, leaf Springs: stresses in leaf springs. Equalized stresses, energy stored in springs, torsion, Belleville and rubber springs.</p> <p><b>DESIGN AND DEVELOPMENT OF REAR AXEL GEAR TRAINS FOR DIFFERENT TYPES OF VEHICLE POWER TRAINS:-</b>Design and Development of rear axle gear trains using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, Types of gear trains, axle shaft design, gear train selection criteria, rear axle gear ratio calculations and selection criteria</p>	

**Reference Books \***

**DESIGN DATA HAND BOOKS:**

1. **Design Data Hand Book** – K. Lingaiah, McGraw Hill, 2nd Ed.2003.
2. **Design Data Hand Book** - K. Mahadevan and K.Balaveera Reddy CBS Publication
3. **Machine Design Data Hand Book** - H.G. Patil, ShriShashiPrakashan, Belgaum.

**TEXT BOOKS:**

1. **Mechanical Engineering Design** - Joseph E Shigley and Charles R.Mischke.  
McGraw Hill International edition.
2. **Introduction engineering system design method** – V. Gupta and P. Murthy
3. **Automotive Mechanics** – N. K. Giri
4. **Machine Design** – Trika

**Course Outcomes\*\***

1. Analyze the concept of engineering system design and formulate design aspects of curved beams
2. Recommend a suitable spring for various applications
3. Analyze the gear mechanisms and its applications to automobiles.
4. Evaluate the design criterion for clutches and brakes its applications
5. Formulate the materials to design and analyze the various types of bearings
6. Design and develop the belts, ropes and chains.

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

UAU541C	HEAT TRANSFER	Credits: 03
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>INTRODUCTORY CONCEPTS AND DEFINITIONS:</b> Modes of heat transfer; basic laws governing conduction, convection, and radiation heat transfer; thermal conductivity; convective heat transfer coefficient; radiation heat transfer coefficient; combined heat transfer mechanism.</p> <p><b>CONDUCTION:</b> Basic equations, general form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates. Boundary conditions of first, second and third kinds; illustrative problems on mathematical formulation of conduction problems.</p> <p><b>ONE-DIMENSIONAL STEADY STATE CONDUCTION :</b> Steady state conduction in a slab, in a cylinder and in a sphere without heat generation; overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>FINS:</b> Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency; conduction in solids with variable thermal conductivity.</p> <p><b>ONE-DIMENSIONAL TRANSIENT CONDUCTION:</b> Conduction in solids with negligible internal temperature gradients (lumped system analysis); use of transient temperature charts (Heisler 's charts) for transient conduction in slab, long cylinder and sphere.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS:</b> Flow over a body - velocity boundary layer; laminar and turbulent layers, critical Reynolds number; general expressions for drag coefficient and drag force, thermal boundary layer.</p> <p><b>FORCED AND FREE CONVECTION:</b> Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydrodynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and numericals. Application of dimensional analysis for free convection-physical significance of Grashoff number.</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>HEAT EXCHANGERS:</b> Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.</p> <p><b>RADIATION HEAT TRANSFER:</b> Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan - Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law, Lambert's Law; radiation heat exchange between two parallel infinite black surfaces.</p>	
<b>Reference Books *</b>	
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1) <b>Heat Transfer</b> by P.K. Nag Tata Mc Graw Hill 2002</li> <li>2) <b>Heat Transfer-</b> A Basic approach by M Necats Osisik Mc Graw Hill International ed 1988</li> </ol> <p><b>REFERENCE BOOKS:</b></p> <ol style="list-style-type: none"> <li>1) <b>Heat transfer</b> a practical approaches by Yunus A Cengel Tata Mc Graw Hill 2002.</li> <li>2) <b>Principles of Heat Transfer</b> by Kreith Thomas learning 200 1.</li> <li>3) <b>Fundamentals of Heat and Mass Transfer</b> by Frank. P. Incropera and David. P. Dewitt John Wiley and Sons 4<sup>th</sup> ed 1995.</li> <li>4) <b>Heat Transfer:</b> Sucec Jaieo Book house 2002.</li> <li>5) <b>Heat transfer:</b> Jojo Jaico Book house 2003</li> </ol>	

<b>Course Outcomes**</b>
1. Categorize the modes of heat transfer, boundary conditions, laws governing heat conduction and analyze conduction phenomenon.
2. Illustrate the solution to conductive heat transfer problems.
3. Analyze unsteady state heat conduction phenomenon and apply to solve numerical problems
4. Formulate the convective heat transfer phenomenon and its applications
5. Evaluate the utility of heat exchangers and its analysis to solve numerical problems
6. Describe radiation heat exchange phenomenon and its analysis

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



<b>UAU571E</b>	<b>AUTOMOTIVE EMISSIONS AND CONTROL</b> <b>( ELECTIVE)</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
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**INTRODUCTION:** Historical background, Euro norms, air quality standards. Effect of air pollution: effect on humans, animals and plants. Smog formation and its effects.

**GENESIS AND FORMATION OF POLLUTANTS:** Vehicle emissions; sources- evaporative, blow-by and exhaust pipe. Unburnt hydrocarbons, carbon monoxide, oxides of nitrogen, particulate emission of both SI and CI engines. Diesel smoke; types and reasons of smoke, mechanism of smoke formation. Thermodynamics state of burned gases, flame quenching combustion chamber deposits, soot and particulate formation, characteristics and composition of particulates. Effect of engine design and operating variables. Emission test procedures and standards: test cycles for light and medium duty vehicles, USEPA emission test cycles, European emission test procedure, types of emission driving cycle, motor cycle emission standards.

<b>UNIT-II</b>	<b>10 Hrs.</b>
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**INFLUENCE OF GASOLINE AND DIESEL PROPERTIES ON EMISSION:** Properties like density, olefin and aromatic content, volatility, octane number, additives, viscosity, distillation interval, cetane number, sulphur content on emissions. Emission control methods: Evaporative emission control; charcoal canister. Positive Crankcase Ventilation (PCV).

**EXHAUST EMISSION CONTROL:** Design modifications: lean burn strategies, compression ratio, cylinder size and combustion chamber shape, variable valve timing and lift, variable swept volume, downsizing and pressure charging, faster warm-up, heated air systems. Exhaust Gas Recirculation(EGR); control and related systems.

<b>UNIT-III</b>	<b>10 Hrs.</b>
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**ADD-ON SYSTEMS FOR TREATMENT OF EMISSION WITHIN ENGINE:** Air injection, thermal reactor, catalytic converter. Catalytic converter: catalysts, substrate, converter housing, oxidation and reduction catalyst, two and three way converter. Catalyst technology for control of cold start, catalyst and poisoning. Gasoline direct injection stratified charge engines; air motion and mixture formation in the cylinder, fuel injection and air fuel ratio control, emissions of gasoline direct injection engines. OBD systems.

<b>UNIT-IV</b>	<b>10 Hrs.</b>
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**INSTRUMENTATION FOR POLLUTION MEASUREMENT:** NDIR analyzers, gas chromatograph, Orsat apparatus, flame ionization detectors, chemiluminescence, smoke measurement; principle, Hartridge and Bosch smoke meter.

**CI ENGINE EMISSION CONTROL TECHNOLOGY:** Fuel injection variables, high injection pressures, high pressure distributor pumps, electronic unit injectors, common rail fuel injection systems, EGR, turbo charging, catalytic treatment, Diesel Particulate Filters (DPF); material, substrates, diesel exhaust after treatment with metal substrates.

**Reference Books \***

**TEXT BOOKS:**

1. Theory of IC engines: Mathur and Sharma.
2. Automotive Mechanics: William H Crouse.
3. Engine Emissions: P.B.Pundir

**Course Outcomes\*\***

1. Assess the effect and conduct risk analysis of air pollution.

2. Analyze, interpret and compare the sources and formation of various emissions in gasoline engines.
3. Discuss and differentiate the influence of fuel properties on emissions.
4. Carry out the emission control measures for SI engines.
5. Evaluate the formation and controlling of emissions in CI engines.
6. Analyze and interpret the instrumentation utilized in measurement of emissions.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
<b>CO1</b>	3	2	1	2		2	3	1		2		1			
<b>CO2</b>	3	2	1	2		2	3	1		2		1			
<b>CO3</b>	3	2	1	2		2	3	1		2		1			
<b>CO4</b>	3	2	1	2		2	3	1		2		1			
<b>Co5</b>	3	2	1	2		2	2	1		2		1			
<b>Co6</b>	3	2	1	1	2	2	1	1		2		1			

<b>UAU572E</b>	<b>PRODUCT DESIGN AND DEVELOPMENT</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>INTRODUCTION:</b> Characteristics of successful product development, design and development of products, duration and cost of product development, the challenges of product development.</p> <p><b>DEVELOPMENT PROCESSES AND ORGANIZATIONS:</b> Generic development process, concept development: the front-end process, adopting the generic product development process, AMF development process, product development organizations, the AMF organization.</p> <p><b>PRODUCT PLANNING:</b> Product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.</p>	

<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>IDENTIFYING CUSTOMER NEEDS:</b> Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.</p> <p><b>PRODUCT SPECIFICATIONS:</b> What are specifications, when are specifications established, establishing target specifications, setting the final specifications.</p> <p><b>CONCEPT GENERATION:</b> Activity of concept generation, clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process.</p>	

<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>CONCEPT SELECTION:</b> Overview of methodology, concept screening, and concept scoring.</p> <p><b>CONCEPT TESTING:</b> Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect the results and the process.</p> <p><b>PRODUCT ARCHITECTURE:</b> What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.</p> <p><b>INDUSTRIAL DESIGN:</b> Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.</p>	

<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>DESIGN FOR MANUFACTURING:</b> Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.</p> <p><b>PROTOTYPING:</b> Prototyping basics, principles of prototyping, technologies, planning for prototypes.</p> <p><b>PRODUCT DEVELOPMENT ECONOMICS:</b> Elements of economic analysis, base case financial mode. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.</p> <p><b>MANAGING PROJECTS:</b> Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.</p>	

**Reference Books \***

**TEXT BOOK:**  
1.Product Design and Development - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

**REFERENCE BOOKS:**  
1. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3 rd Edition, 2003.  
2. New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997  
3. Product Design for Manufacture and Assembly - Geoffery Boothroyd, Peter Dewhurst and Winston Knight – 2002

<b>Course Outcomes**</b>
1. Understand the necessity of new product development and problems encountered in Developing new products.
2. Know the role of aesthetic in products.
3. Able to use different types of models designed by industrial engineer.
4. Able to select the different materials based on the functions of the product.
5. The ergonomic factors influencing the success of the product.
6. Know how to add value to the products.

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

<b>UAU575E</b>	<b>COMPUTER GRAPHICS</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<b>SCAN CONVERSION AND CLIPPING REPRESENTATION:</b> Scan conversion and clipping representation of points, lines, line drawing algorithms: DDA algorithm, Bresenham's integer line algorithm, Bresenham's circle algorithm, mid point line and circle, polygon filling algorithms: scan conversion, seed filling, scan line algorithm. Viewing transformation, clipping points, lines, text, polygon, Cohen-Sutherland line clipping, Sutherland - Hodgmen algorithm.	

<b>UNIT-II</b>	<b>10 Hrs.</b>
<b>TWO DIMENSIONAL TRANSFORMATIONS:</b> Representation of points, transformations: rotation, reflection, scaling, combined transformations, translations and homogeneous coordinates, geometric interpretation of homogeneous coordinates, over all scaling, points at infinity, rotation about an arbitrary point, reflection through an arbitrary line.	

<b>UNIT-III</b>	<b>10 Hrs.</b>
<b>THREE DIMENSIONAL TRANSFORMATIONS:</b> Three dimensional transformations and projections 3D transformation matrix: general matrix, translation, scaling, shearing, rotation, reflection, multiple transformations, rotation about an axis parallel to coordinate axis, rotation about an arbitrary axis in space, reflection through an arbitrary plane, orthographic, parallel projection transformations, one, perspective projections - one point, two point and three point.	

<b>UNIT-IV</b>	<b>10 Hrs.</b>
<b>PLANE AND SPACE CURVES CURVE:</b> Plane and space curves curve representation, non-parametric curves, parametric curves, parametric representation and generation of line, circle, ellipse, parabola, hyperbola, generation of circle, ellipse, parabola, hyperbola, cubic spline, normalized cubic splines, Bezier curves: blending function, properties, generation, B-spline curves- Cox-de Boor recursive formula, properties, open uniform basis functions, non-uniform basis functions, periodic B-spline curve.	

**Reference Books \***

**TEXT BOOKS:**

1. Ibrahim Zeid, "CAD/CAM-Theory and Practice" McGraw Hill, 2006
2. Rogoer's Adams, "Mathematical Elements for Computer Graphics", McGraw Hill. 1990 **Reference**

**Reference Books:**

1. Xiang Z, Plastock, R. A, Computer Graphics, Schaums outlines, McGraw Hill. 2007.
2. Foley, Van- Damn, Finner and Hughes, "Computer Graphics", principles and practice, Addison Wesley. 2000
3. Sinha AN., Udai A D., Computer Graphics, Tata McGraw Hill, 2008.

**Course Outcomes\*\***

1. To understand the fundamental concepts of graphics with suitable commands
2. To apply comprehensive transformation techniques of computer graphics
3. To know and draw the creation of two and three dimensional transformations
4. To know and analyze plane and space curves

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

<b>UAU576E</b>	<b>VEHICLE TRANSPORT MANAGEMENT</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>INTRODUCTION:</b> Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988. Maintenance - preventive, breakdown, overhauling - major, minor, repair schedules and workshop, facilities, documentation, analysis and corrective maintenance schedules.</p> <p><b>ORGANIZATION AND MANAGEMENT:</b> Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering departments, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.</p>	

<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>ROUTE PLANNING:</b> Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency.</p> <p><b>TIMING, BUS WORKING AND SCHEDULES:</b> Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements.</p>	

<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>COLLECTIONS:</b> Need, principles of collection, tickets, the way bill, stage by stage, bell punch system, bell graphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter, one-man operation, two stream boarding, pre paid tickets, lenson parason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control.</p> <p><b>FARE STRUCTURE:</b> Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.</p>	

<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>OPERATING COST AND TYPES OF VEHICLES:</b> Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statutory procedure taxes and hire car.</p> <p><b>PUBLIC RELATIONS DIVISIONS:</b> Dissemination of information, maintaining goodwill handling complaints, traffic advisory committees, local contractors co-operation with the press news and articles - facilities for visitors- forms of publicity - importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity. prevention of accidents: Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.</p>	

<b>Reference Books *</b>
<b>TEXT BOOKS:</b>
1. Bus operation - L.D.Kitchen, Iliffe & Sons , London

2. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London

**REFERENCE BOOKS:**

1. Compendium of transport terms - Cirt,Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. The elements of transportation - R.J. Eaton
4. Goods vehicle operation - C.S. Dubbar

**Course Outcomes\*\***

1. Analyze public transport in India and different forms of ownership.
2. Define and analyze the vehicle maintenance and its types and selection and roles of crew.
3. Define route planning process and application bus scheduling methods of bus scheduling and implementation.
4. Analyze fare structure and collection systems, their principles and compare various fare collection systems.
5. Define different operating cost and analyze for optimized transport and functions of PRO in public transport.
6. Analyze the prevention of accidents and future of road transport.

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



<b>UAU527L</b>	<b>AUTOMOBIE ENGINE SERVICING LAB</b>	<b>Credits: 01</b>
L:T:P - N <sub>L</sub> :0 N <sub>T</sub> :0 N <sub>P</sub> 3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

1. Study of hand tools- sketching, materials used and their applications
2. Technical specifications of all types of automobile engines
3. Trouble shooting charts of all engine components
4. Note the specifications of given engines and component standard dimensions. Dismantle, inspect, clean and assemble of engine components of SI and CI engines(two and four stroke) of any commercial vehicles. Note procedure of dismantling and assembly; identify the major components, noting their functions and materials used. Measurement & comparison of major components dimension with standard specifications. Inspection for wear and tear, crack and brake down, identify the service requirements of engines such as decarbonizing, degreasing, spark plug cleaning and adjusting, fuel injector cleaning etc.
5. Compression and vacuum test on diesel and petrol and diesel engines.
6. Study(Dismantling and assembly): Carburetors, fuel injection pumps, fuel filters, fuel pumps, turbochargers, cooling systems and components, lubrication system and components. Identify the location of above components in a vehicle and note their functions

**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\*\***

1. Analyze the engine trouble shooting aspects and specifications of various vehicles
2. Able to demonstrate the dismantling and assembly of multi-cylinder of different engines with respective auxiliary systems.
3. Able to demonstrate the dismantling and assembly of two wheeler engines.
4. Conduct the testing of vacuum and compression test in engines and draw the inference.
5. Dismantle, assemble and analyze working and fault diagnosis of fuel system elements like carburetor and fuel injection pump.

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	1	2	1	2	1
CO2	3	1							1	1	1	2	1	2	1
CO3	3	1							1	1	1	2	1	2	1
CO4	3	1		1	1				1	1	1	2	1	2	1
CO5	3	1							1	1	1	2	1	2	1

<b>UAU538L</b>	<b>AUTOMOTIVE SCANNING LABORATORY</b>	<b>Credits: 1.5</b>
L:T:P - N <sub>L</sub> :0 N <sub>T</sub> : 0 N <sub>p</sub> 3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

- Maintenance/service charts for different parts of chassis, suspension and transmission.
- Study of head light beam testing for two and four wheeler.
- Braking distance test for four wheeler.
- Study of tyre retreading, tubeless tyre puncture repairs, painting of vehicles.
- Sketch the layout of a service station and bus depot mentioning the various equipments required including the space needed.
- Study and practice on computerized wheel balancing machine, computerized wheel alignment machine, computerized engine analyzer.
- Study of two wheeler performance on two wheeler chassis dynamometer.
- 8.Study of electrical components like battery, alternator, regulator on electrical test bench
- Study and demo of wind tunnel testing I) testing for pressure distribution ii) testing for lift ,yaw ,drag

**Laboratory Assessment:**

- Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
- 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).
- Allocation of 50 marks for SEE

**Course Outcomes\*\***

- To study the head light beam testing for two and four wheeler and braking distance
- To know the process of tyre retreading, painting of vehicles and able to draw the layout of a service station and bus depot
- To study and practice on computerized wheel balancing machine, computerized wheel alignment machine, computerized engine analyzer.
- Study and demo of wind tunnel testing and know the various aspects

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

<b>UAU621C</b>	<b>AUTOMOTIVE ENGINE COMPONENT</b>	<b>Credits: 04</b>
L:T:P - N <sub>L</sub> :4 N <sub>T</sub> :0 N <sub>P</sub> 0	<b>DESIGN</b>	CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

<b>UNIT-I</b>	<b>13 Hrs.</b>
<p><b>ENGINE SELECTION CRITERIA:</b> Road, wind and gradient resistance, starting torque, load-speed characteristics, expectancy curves and performance curves.</p> <p><b>CARBURETION:</b> Air-fuel ratio, throat diameter, air and fuel flow rate, change in air-fuel ratio at altitude, velocity of air at venture throat, pressure drop, mass flow of fuel.</p> <p><b>INJECTION:</b> Injection in CI engines; volume of fuel injected, velocity and duration of injection, orifice area of injector, pressure difference.</p> <p><b>DESIGN OF CYLINDER BLOCK, CRANK CASE AND CYLINDER HEADS:</b> Cylinder heads, gaskets, cylinder wear, water jacket, cylinder liners, crank case, oil sumps and cooling features. Engine mountings, front and rear mountings, type of engine blocks, manifolds; types, inlet and exhaust manifolds, dual manifolds, design of manifolds, mufflers; types, design.</p>	
<b>UNIT-II</b>	<b>13 Hrs.</b>
<p><b>DESIGN OF CYLINDER BLOCK, CRANK CASE AND CYLINDER HEADS:</b> Cylinder heads, gaskets, cylinder wear, water jacket, cylinder liners, valve seats. Crank case - general form of crank case, oil sumps and cooling features, flywheel mountings, engine mountings, front and rear mountings. Production of engine blocks, manifolds and mufflers - inlet and exhaust manifolds, mixture distribution, heating by exhaust gas, dual manifolds, general design of manifolds, effect of firing order, mufflers, general design.</p> <p><b>DESIGN OF PISTON, PISTON RINGS, PISTON PIN:</b> Piston temperatures, piston slap, compensation of thermal expansion in pistons. Piston rings, forms of gap, stresses in piston rings, ring collapse, heat treatment, piston ring selection, shape. Piston pin, locking of piston pins, length of piston.</p>	
<b>UNIT-III</b>	<b>13 Hrs.</b>
<p><b>DESIGN OF CONNECTING ROD:</b> Length of rod, cross section, buckling, drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials, lubrication.</p> <p><b>DESIGN OF CRANK SHAFT:</b> Balance weights, local balance, crankshaft proportions, oil holes drilled in crank shafts, balancing and torsional vibration analysis, vibration dampers, firing order, bearings, lubrication.</p>	
<b>UNIT-IV</b>	<b>13 Hrs.</b>
<p><b>DESIGN OF FLYWHEEL:</b> Necessity, capacity, mounting of flywheels, coefficient of fluctuation of speed, fluctuation of energy, maximum fluctuation of energy, energy stored in a flywheel, stresses, construction.</p> <p><b>DESIGN OF VALVE AND VALVE MECHANISM:</b> Angle of seat, operating conditions, operating temperatures, valve cooling, sodium cooled valves, valve rotators, valve seats, valve guides, valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, camshaft, drives of cams, cam types, tappets, automatic zero clearance tappets, push rods, rocker arms and rocker shaft.</p>	
<b>Reference Books *</b>	
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. High Speed Engines - P.M.Heldt, Oxford &amp; IBH, 1965</li> <li>2. Auto Design – R.B Gupta, Satya Prakashan, New Delhi 2002</li> <li>3. Automotive mechanics- N.K. Giri</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. A course in I.C. Engine - Mathur &amp; Sharma, Dhanput Rai &amp; Sons, Delhi, 1994</li> <li>2. Internal Combustion Engines-V Ganesan, Tata McGraw Hill, Delhi, 2002</li> <li>3. Automobile Engineering Vol. II - Kirpal Singh, Standard publications, New Delhi, 2004</li> </ol>	

4. Modern Petrol Engine - A.W.Judge, B.I. Publications. 1983

**Course Outcomes\*\***

1. Correlate, analyze, and solve the vehicle design related problems.
2. Formulate, analyze and estimate the expectancy curves and compare with performance curves.
3. Analyze and solve the design problems of cylinder head, block and valves with live time approach.
4. Analyze and solve the design problems of piston assembly, connecting rod, crank shaft and flywheel with live time approach.
5. Design engine and their components used in automobiles, aeronautical, locomotive and marine engines.
6. Correlate, analyze, and solve the vehicle design related 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
<b>CO1</b>	3	3	3	1	1	1			2	1	1	1	2	3	2
<b>CO2</b>	3	3	3	1	1	1			1	1	1	1	2	2	2
<b>CO3</b>	3	3	3	1	1	1			2	1	1	1	2	3	2
<b>CO4</b>	3	3	3	1	1	1			1	1	1	1	2	3	2
<b>CO5</b>	3	3	3	1	1	1			2	1	1	1	2	2	2
<b>CO6</b>	3	3	3	1	1	1			2	1	1	1	2	2	2

<b>UAU622H</b>	<b>ENGINEERING ECONOMICS</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>INTRODUCTION:</b> Definition of various economic terms such as economic goods, utility, value, price, wealth, wants capital, rent and profit, laws of returns.</p> <p><b>DEMAND AND SUPPLY:</b> Law of diminishing utility and total utility. Demand schedule. Law of demand. Elasticity of demand, law of substitution, law of supply, supply schedule, elasticity of supply.</p> <p><b>WAGES:</b> Nominal and real wages, factors affecting real wages, theory of wages, difference in wages, methods of wage payment.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>MONEY AND EXCHANGE:</b> Theory of exchange, barter, stock exchange, speculation money qualities of a good money, function of a money, classification of money, value of money, index number, appreciation and depreciation of money value, Gresham's law and its limitations.</p> <p><b>TAXATION AND INSURANCE:</b> Principle of taxation, characteristics of a good taxation system, kinds of taxes, and their merits and demerits, vehicle insurance, loss assessment.</p> <p><b>INTEREST AND DEPRECIATION:</b> Introduction, theory of interest, interest rate, interest from lender's and borrower's view point, simple and compound interest. Nominal and effective interest rates, interest formulae. Annual compounding, annual payments and continuous compounding annual payment, simple numerical problems. Need for depreciation causes of depreciation life and salvage value methods of depreciation, simple numerical problems.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>COSTS:</b> Standard costs estimated cost, first cost, fixed cost, variable costs, incremental cost, differential cost, sunk and marginal cost, breakeven and minimum cost analysis, simple numerical problems.</p> <p><b>COST ACCOUNTING:</b> Introduction, objectives of cost accounting, elements of cost material cost, labour cost, and expenses, allocation of overheads by different methods, simple numerical problems.</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>BASIS FOR COMPARISON OF ALTERNATIVES:</b> Present worth methods, capital recovery methods, and rate of return method, simple numerical problems.</p> <p><b>BOOK KEEPING AND ACCOUNTS:</b> Introduction, necessity for book keeping, single entry and double entry, ledger, trial balance, final accounts, trading accounts, profit and loss accounts, balance sheet, simple problems.</p>	
<b>Reference Books *</b>	
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Engineering Economy - TARACHAND, 2000</li> <li>2. Engineering Economy - RIGGS J.L., McGraw Hill, 2002</li> <li>3. Engineering Economy - THUWSEN H.G., PHI, 2002</li> </ol> <p><b>REFERENCE BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Industrial Engineering and Management - O.P KHANNA, Dhanpat Rai &amp; Sons.</li> <li>2. Financial Management -I.M PANDAY, Vikas Publishing House</li> <li>3. Engineering Economy - Paul Dearmo, Macmillan Pub, Co., 2001</li> <li>4. Mechanical Estimation and Costing - D. Kannappan.</li> </ol>	

**Course Outcomes\*\***

1. Define various economic terms and analyze the basic concepts of price, product and market and correlate them.
2. Know how of banking, stock exchange, insurance, wages, their role in economics of business.
3. Classify taxes and depreciation and monetary system their role in economics and methods to evaluate them.
4. Define various costs, cost accounting procedure and its implementation in business enterprises for assessment.
5. Concept of interest its significance, analysis of cash flow methods and apply them to evaluate investment options.
6. Define book keeping approaches, their role and implementation in assessments.

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

<b>UAU623C</b>	<b>AUTOMOTIVE ELECTRICAL SYSTEMS</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>STORAGE BATTERY:</b> Introduction, principle of lead acid cells, construction and elements, electrolyte and their preparation, specific gravity, capacity and efficiency, battery tests, battery ratings, chemical action in cell, direction of current flow, recharging batteries, temperature effect on battery characteristics, methods of charging. Working principles of Alkaline, Nickel - Cadmium, silver - zinc battery, Lithium batteries. Battery trouble shooting.</p> <p>Networks and multiplexing. Other electric and electronic devices.</p> <p>Vehicle security systems: seat belts, air bags.</p> <p><b>INDICATING AND WARNING DEVICES AND DASH BOARD INSTRUMENTS:</b> Fuel gauge, oil-pressure gauge; balancing coil, thermostatic, electronic and digital gauges, water temperature gauge, speedometers; mechanical, electrical, digital. Warning lights; oil pressure, water temperature, horn, windscreen-wipers, signaling devices. Trouble shooting.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>GENERATOR / ALTERNATOR:</b> Principle of generation of direct current, generator constructional details; commutators, principle of commutation, armature, field magnets, windings, brushes, wiring circuit of generators, types of generators, generator drives, cutout relay, ammeter. Construction of alternator, rectification, voltage regulation, testing of alternator. Alternator terminals, cooling, instrument panel. Charge indicators, charging system test, charging system service and fault diagnosis.</p> <p><b>STARTER MOTOR AND DRIVES:</b> Introduction, starting motor principle, torque and power requirements, starting motors and its characteristics. Starting motor drives. Starting system tests. Servicing starting motors. Starting motor trouble shooting.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>IGNITION SYSTEM:</b> Ignition fundamentals, types of ignition systems and related components. Spark plugs; general considerations, characteristics, materials. Ignition timing; advance mechanism; centrifugal and vacuum. Ignition system tests, oscilloscope pattern. Setting ignition timing; types.</p> <p><b>ELECTRONIC IGNITION:</b> Pickup coil voltage pulse, high energy ignition system, electronic spark advance, optical photo diode distributor, distributors less ignition system, multiple coil ignitions, direct capacitor charge ignition. Distributor less ignition system, C.D.I, systems. Artificial intelligence.</p> <p>Ignition system trouble shooting and trouble codes.</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>LIGHTING AND ELECTRICAL ACCESSORIES:</b> Introduction, principle of automobile illumination, lightings, control of head light beam, head light dazzle, fog lamps, side and taillight, brake warning light, instrument and indicator lights, ignition warning light, direction indicators, parking light, fluorescent lighting. Automatic head lamp controls, fiber optic lighting, computer control lighting, distributed lighting, head lamp aiming. Lighting system trouble shooting and recent developments; L.E.D.</p> <p><b>VENTILATION, HEATING AND AIR CONDITIONING:</b> Passenger compartment heater, heater controls, heated air distribution, basic refrigeration cycle: refrigerant flow control valves, refrigerants, refrigerant oil. Types of air conditioner: manually controlled, automatically controlled and electronic automatic temperature control.</p>	
<b>Reference Books *</b>	
<p><b>TEXT BOOKS:</b></p> <p>1. Automobile Engineering: Kirpal Singh</p>	



2. Automobile Mechanics : William H Crouse  
 3. Automotive Electrical equipments: P.L.Kohli

**Course Outcomes\*\***

1. Elucidate the construction, working and elements of different batteries, electrical accessories and dashboard instruments.
2. To know and analyze the construction and working of starting motors with different types of drives and its trouble shooting.
3. Expound the theory of the working of various ignition systems and their components, its trouble shooting with update of latest systems.
4. Able to illustrate the construction and working of charging system and its fault diagnosing methods and remedial techniques.
5. Analyze the principle of automobile illumination and different types lighting systems and allied electrical systems.
6. Able to construe the utility, scope and significance of automobile ventilating, safety and air condition 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
<b>CO1</b>	3	2	2	1	2	1				1	1	1	1	2	2
<b>CO2</b>	3	2	1	1	2	1				1	1	1	1	2	2
<b>CO3</b>	3	2	2	2	2	1				1	1	1	2	2	2
<b>CO4</b>	3	2	1	1	2	1				1	1	1	1	2	2
<b>CO5</b>	3	2	1	2	2	1				1	1	1	1	2	2
<b>CO6</b>	3	2	1	1	2	1				1	1	1	2	2	2

<b>UAU651E</b>	<b>CAD/CAM</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>INTRODUCTION:</b> Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.</p> <p><b>HARDWARE FOR CAD:</b> Basic hardware structure, working principles, usage and types of hardware for CAD - Input devices, output devices, memory, CPU, hardcopy and storage devices.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>COMPUTER GRAPHICS:</b> Software configuration of a graphic system, function of graphics package, construction of geometry, wire frame and solid modeling, geometry transformation - two dimensional and three dimensional transformation, translation, scaling, reflection, rotation, CAD/CAM integration. Desirable modeling facilities. Introduction to exchange of modeling data - basic features of IGES, STEP, DXF, DMIS</p> <p><b>INTRODUCTION TO ROBOTICS:</b> Introduction, robot configuration, robot motion, programming of robots, end effectors work cell, control and interlock, robot sensor, robot applications.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>NC, CNC, DNC TECHNOLOGIES:</b> NC, CNC, DNC, modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.</p> <p><b>CNC TOOLING:</b> Turning tool geometry, milling tooling system, tool presetting, ATC, work holding.</p> <p><b>CAM PROGRAMMING:</b> Overview of different CNC machining centers, CNC turning centers, high speed machine tools.</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>CNC PROGRAMMING:</b> Part program fundamentals, steps involved in development of a part program. Manual part programming, milling, turning, turning center programming.</p> <p><b>INTRODUCTION TO FINITE ELEMENT ANALYSIS:</b> Introduction, basic concepts, discretization, element types, nodes and degrees of freedom mesh generation, constraints, loads, preprocessing, application to static analysis.</p>	
<b>Reference Books *</b>	
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. CAD/CAM Principles and Application - by P.N. Rao, Tata McGraw Hill.</li> <li>2. CAD/CAM - by Groover, Tata McGraw Hill.</li> </ol> <p><b>REFERENCE BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Introduction to the Design and Analysis of Algorithms – S.E. Goodman, S.T. Headetmiemi, McGraw Hill Book Company – 1988.</li> <li>2. Principles of Interactive Computer Graphics - by Newman and Sproull, Tata McGraw Hill, 1995.</li> <li>3. NC Machine Programming and Software Design – Chno- Hwachang, Michel. A. Melkanoff, Prentice Hall, 1989.</li> <li>4. Numetical Control and CAM - Pressman RS and Williams JE, Johnwiley.</li> <li>5. Computer Graphics by Steven Harrington, McGraw Hill Book Co.</li> <li>6. CAD-CAM - by Chris McMahan &amp; Jimmie Browne – Pearson education Asia 2001.</li> <li>7. CAD/CAM – Ibrahim Zeid, Tat McGraw Hill, 1999.</li> <li>8. Computer Aided Manufacturing - by P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 1999.</li> <li>9. Introduction to FEM - T Chandra patta Ashok D Bebgundu.</li> </ol>	
<b>Course Outcomes**</b>	
<ol style="list-style-type: none"> <li>1. List role of computers in design and manufacturing area and realize their significance.</li> </ol>	

2. Define various devices used in CAD/CAM, their role in CAD/CAM activities.
3. Classify cad model and know-how of developing models using different approaches.
4. Develop programs to generate the drawings on computers and manufacture products on NC machines.
5. Classify the different types of robots and manufacturing systems, their features and application.
6. Define the stages in Finite Element Analysis and their need and significance.

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

<b>UAU653E</b>	<b>AUTOMOTIVE AIR CONDITIONING</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<p><b>AIR CONDITIONING FUNDAMENTALS:</b> History of automotive air conditioning systems. Introduction to heating and ventilation. Basic theory of cooling, vapour compression refrigeration, alternative cycles, expansion valve system, fixed orifice valve system, dual air-conditioning.</p> <p>Refrigeration and cooling; refrigeration, evaporation, condensation, heat transfer, refrigeration cycle, refrigerant and flow control valves.</p>	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<p><b>AIR CONDITIONING COMPONENTS:</b> Compressor, compressor clutch, types of air conditioning compressors, cycling and non cycling compressor, electrically driven compressor, condenser, receiver-drier/accumulator, expansion valve, fixed orifice valve, evaporator, anti-frosting devices, basic control switches.</p>	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<p><b>AIR CONDITIONING CONTROLS:</b> Electrical and electronic control, electrical principles, sensors and actuators, testing of sensors and actuators, oscilloscope waveform sampling, multiplex wiring systems, OBD and EOBD, ready wiring diagrams, automotive A/C manual control systems - case studies.</p> <p>Diagnostics and troubleshooting: initial vehicle inspection, temperature measurement, pressure gauge, cycle testing, A/C system leak testing.</p>	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<p><b>SERVICE AND REPAIR:</b> Precaution, refrigerant, recovery, recycle and charging, system oil, system flushing, odour removal, retrofitting, replacement and adjustment of components, fixed orifice valve replace.</p> <p><b>ENVIRONMENT AND LEGISLATION:</b> Global warming, ozone layer, legislation.</p> <p>Ventilating the passenger compartment, heater controls, heated air distribution, heated wind shield. Solar powered ventilation, electronic automatic temperature control.</p>	
<b>Reference Books *</b>	
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Automotive air conditioning and climate control: <b>Steven Daley</b> (Butterworth Heinmann, Elsevier)</li> <li>2. Automotive mechanics – <b>William Crouse</b>.</li> </ol>	
<b>Course Outcomes**</b>	
1. To understand the basic concepts of refrigeration and air - conditioning.	
2. Know-how on components vehicle air- conditioning system.	
3. To study the control systems in air - conditioning and trouble shooting.	
4. To study refrigerants, their environmental impact and legislation.	

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	1	1	1	1			1		1			
CO2	2	1	1	1	1	1	1			1		1			
CO3	2	1	1	1	1	1	1			1		1			
CO4	2	1	1	1	1	1	1			1		1			

<b>UAU654E</b>	<b>ADVANCED AUTOMOTIVE MATERIALS</b>	<b>Credits: 03</b>
L:T:P - N <sub>L</sub> :3 N <sub>T</sub> :0 N <sub>P</sub> 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

<b>UNIT-I</b>	<b>10 Hrs.</b>
<b>INTRODUCTION TO ADVANCED MATERIALS:</b> Composites and hybrids Sandwich materials, Metal matrix composites: automotive applications. Ceramic and glasses; automotive glazing, sustainable materials. Advanced composites.	
<b>UNIT-II</b>	<b>10 Hrs.</b>
<b>POLYMERS:</b> Processing of polymers, components for noise and vibration isolation and control on automotive industry. Recycling of polymers and biopolymers and steel processing: formability of steel sheets and tailor welded blanks for automotive application. Thermoplastics, thermosets.	
<b>UNIT-III</b>	<b>10 Hrs.</b>
<b>CARBON FIBERS:</b> Carbon-fibers-reinforced silicon carbide. Magnesium: Properties and automotive application for magnesium. New brake disc material - Elements of ceramic brake disc, material behaviour, material properties, advantages. Titanium and Nickel: Properties and their automotive applications	
<b>UNIT-IV</b>	<b>10 Hrs.</b>
<b>BODY MATERIALS:</b> Future trends in body materials; objectives and contents. Mechanical and physical properties of materials. Material selection for automotive body components. Trimming of plastics. Insulating materials and sealing compounds. Factors influencing material change in future, emission control and fuel systems.	
<b>Reference Books *</b>	
BOOKS: 1. Encyclopedia of automobile engineering (vol. 6) 1. Materials for automotive bodies – Geoff Davis (B/H) 2. Encyclopedia of automobile engineering (vol. 4) 3. Automotive Hand book(9 <sup>th</sup> Edition) – Bosch( Wiley)	
<b>Course Outcomes**</b>	
1. To understand the basic knowledge and use of advanced materials and composites in automotive engineering.	
2. Know-how on polymers and its application in automotives.	
3. To study the use and significance of carbon polymers.	
4. To understand the future trends in body materials.	

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

<b>UAU627L</b>	<b>AUTOMOTIVE CAD LABORATORY</b>	<b>Credits: 1.5</b>
L:T:P - N <sub>L</sub> :0 N <sub>T</sub> :0 N <sub>P</sub> 3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

1. Modeling – Introduction. Development of 2D and 3D geometric modeling using anyone parametric software. Exercises on automotive components - 3D modeling ( 1 – 4 components) Softwares – Pro-E, CATIA, UNIGRPHICS etc.
2. Analysis – FEA ( Preprocessor, solver, post processor)
  - a) Exercise involving simple structures.
  - b) Validation of result with analytical solution.
3. Introduction to CNC programming(G codes & M codes) a)Turning b) Milling Simple Exercises (2 – 4 Nos.) using CNC Simulator.

**Laboratory Assessment:**

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

**Allocation of 50 marks for SEE**

**Course Outcomes\*\***

1. Utilize the CATIA software commands to generate geometrical primitives and sketcher
2. Utilize the CATIA software commands to generate 2D and 3D models.
3. Able to convert, modify and develop solid and surface models for FEM solutions.
4. Develop program for generating component profile using NC programming for milling and turning jobs.

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

<b>UAU638L</b>	<b>AUTOMOTIVE POWER TRAIN AND ELECTRICAL SERVICING LAB</b>	<b>Credits: 1.5</b>
L:T:P - N <sub>L</sub> :0 N <sub>T</sub> :0 N <sub>P</sub> 3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

1. Writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors (two wheeler, four wheeler and heavy vehicle – one each)
2. Trouble shooting charts for major parts like clutch, gear box, differential, brakes, wheels with tyres, steering system and suspension.
3. Testing and servicing of electrical components like battery, starting system, ignition system, central locking system, lighting system, and alternator. Experiments on microprocessors related to automobiles
4. Dismantle and assemble of major systems (clutch system, Gear boxes, Propeller shaft, Differential, Front and Rear axles, brake system, steering system and suspension system) and identifying remedies (like backlash adjustment, brakes adjustment, bleeding of brakes) for the possible problems based on trouble shooting charts.
5. Draw sketch of seating arrangements, seats for commercial vehicle and study the comfort levels provided for driver and passengers.
6. Draw sketches of different mechanisms of door, seat adjustments mechanisms.

**Laboratory Assessment:**

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

**Allocation of 50 marks for SEE**

**Course Outcomes\*\***

1. To know the electrical and power train trouble shooting aspects and specifications of various vehicles
2. Able to demonstrate the dismantling of various transmission elements like clutch, gear box etc. and study its details
3. Able to demonstrate the dismantling of electrical elements and study its details
4. To be able to know the seat adjustments and door mechanisms



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			1			2	1	1	1	1	2	1
CO2	2	1	1			1			2	1	1	1	1	2	1
CO3	2	1	1			1			2	1	1	1	1	2	1
CO4	2	1	1			1			2	1	1	1	2	2	1