AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU71	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
Credits	04		

Course objectives: At the end of the course the student will be able to -

1. Explain the construction of battery used in automotive vehicles.
2. Describe the construction and working of D.C. generator, alternator, cranking motor, ignition systems along with trouble shooting.
3. Discuss the faults arising in automotive wiring and lighting system.
4. Explain various chassis electrical systems.
5. Describe transducers and sensors.
6. Understand various aspects of electrical and Hybrid vehicles.

Module-I	
Introduction: Earth return and insulated systems, 6volts and 12 volts system, fusing of circuits, low and high voltage automobile cables, cable specifications, diagram of typical wiring system, and symbols used in automobile electrical systems. **Storage Battery:** Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, effect of temperature on specific gravity of electrolyte, battery capacity and efficiency, battery rating, battery testing, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries,different types of batteries and their principles like alkaline, lithium and zinc air etc.,	10 Hours
Module-II	
Generator/ Alternator: Principle of generation of direct current, generator details, shunt dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout relay - construction, working and adjustment. Construction and working of alternator and output control. **Starter Motor & Drives:** Battery motor starting system, condition at starting, behavior of starter during starting, series motor and its characteristics, considerations affecting size of motor, types of drives, starting circuit.	10 Hours
Module-III	
Ignition systems: Ignition fundamentals, working of battery and magneto ignition systems, comparison of battery and magneto ignition system, advantages and disadvantages of conventional ignition systems, Types of solid state ignition systems, components, construction and working, high energy ignition distributors, Electronic spark timing	10 Hours

control. **Lighting system and Dashboard Instruments.** Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge, speedometer, odometer, etc. (Dash board instruments)	
Module-IV	
Engine management Systems: Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management. Hybrid vehicles and fuel cells. **Chassis Electrical systems:** Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners, seat heaters.	10 Hours
Module-V	
Electrical and hybrid vehicles Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. **Transduces and sensors** Definition and classification, principle of working and application of various light sensors, proximity sensors and Hall effect sensors.	10 Hours

Course outcomes: After completion of above course, students will be able to :

1. Explain the construction of battery used in automotive vehicles.
2. Describe the construction and working of cranking motor, D. C. generator, alternator, ignition systems along with trouble shooting.
3. Discuss the faults arising in automotive wiring and lighting system.
4. Explain various chassis electrical systems.
5. Describe transducers and sensors.
6. Explain various aspects of electrical and Hybrid vehicles.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Automobile Electrical and Electronic systems - Tom Denton,SAE publication, 2000.
2. Automotive Electrical Equipment - P.M. Kohli,Tata McGraw Hill, New Delhi.

3. Alternative Fuels- S .S. Thipse, JAICO Publishing House, New Delhi.
4. Mechatronics – W.Bolton, Longman, 2Ed, Pearson publications, 2007.

Reference Books:

1. Advanced Engine Technology - Heinz Heisler,SAE Publications, 1995.
2. Automotive Electronic Systems - Ulrich Adler, Robert Bosch, GMBH, 1995.
3 Bosch Technical Instruction Booklets.
4. Automobile Electrical Equipment - A.P. Young & Griffiths, ELBS &NewnesButterworths, London.

AUTOMOTIVE ENGINE COMPONENTS DESIGN AND AUXILIARY SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU72	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
Credits	04		

Course objectives: At the end of the course the student will be able to –

1. Calculate major dimensions of engine components like cylinder, piston, connecting rod, crankshaft, valve and valve operating mechanisms.
2. Analyze working of two stroke engine.
3. Select suitable scavenging process for two stroke engine.
4. Select suitable lubricant and lubrication system for given engine.
5. Calculateamount coolant required and select suitable cooling system for given engine. Explain need for supercharger and modifications required in engine for supercharging.

Module-I	
<u>Design of major dimensions of</u> **Cylinder heads & Cylinder Block** Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, and valve seats. Production of engine block – casting, cleaning, treatment, machining operations and transfer machines **Piston, piston rings and piston pin** 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.	10 Hours
Module-II	
<u>Design of major dimensions of</u> **Connecting rod** Length of rod, Cross section, Buckling, Drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials and lubrication. **Crank shaft** Balance weights, local balance, Crankshaft proportions, oil holes drilled in crank shafts, balancing, vibration dampers, firing order, bearings and lubrication Types of crank shafts, design of centre crank shaft, moments on crank shafts, centre crank shaft at tdc, centre crank shaft at angle of maximum torque. Design of side crankshaft (over hang), side crank shaft at tdc, side crank shaft at angle of maximum torque.	10 Hours
Module-III	
Valve and valve mechanism No. of Valves per cylinder, 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	10 Hours

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 & rocker Shaft. **Design of major dimensions** of valve and valve operating mechanisms. **Two stroke engines** Principles and working of two stroke engine (SI & CI), Port timing diagrams. Types - Three port engine, Separate pumps or blowers, Symmetrical & unsymmetrical timing, Cross flow, loop flow &uniflow type Scavenging systems. Scavenging Process – Pre blow down, Blow down, Scavenging, Additional Charging. Theoretical Scavenging processes, Scavenging parameters, Comparison of Different Scavenging Systems; port design, scavenging pumps.	
Module-IV	
Manifolds and Mixture Distribution Intake system components, Discharge coefficient, Pressure drop, Air filter, Intake manifold, Connecting pipe, 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, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators – types, cooling fan – power requirement, antifreeze solution, types of coolant	10 Hours
Module-V	
Lubrication System Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, additives and lubricity improvers, concept of adiabatic engines, oil filters, pumps, and crankcase ventilation – types. **Supercharging and Turbocharging** Purpose, thermodynamic cycle, effect on the performance, turbo charging, limits of supercharging for petrol and diesel engines. Modifications of an engine for super charging - methods of super charging – super charging and turbo charging of two stroke and four stroke engines.	10 Hours
Course outcomes: After completion of above course, students will be able to 1. Calculate major dimensions of engine components like cylinder, piston, connecting rod, crankshaft, valve and valve operating mechanisms. 2. Analyze working of two stroke engine. 3. Select suitable scavenging process for two stroke engine. 4. Select suitable lubricant and lubrication system for given engine. 5. Calculate amount coolant required and select suitable cooling system for given engine. 6. Explain need for supercharger and modifications required in engine for supercharging.	
Question paper pattern: 1. The question paper will have ten questions.	

2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. High Speed Engines - P.M.Heldt, Oxford & IBH, 1965
2. Machine design exercises - S. N. Trikha, Khanna publications, Delhi

Reference Books:

1. Auto Design – R.B. Gupta, SatyaPrakash, New Delhi 1999.
2. A course in I.C. Engine –Mathur& Sharma , DhanpatRai& Sons, Delhi, 1994.
3. Internal Combustion Engines-V.Ganesan, Tata McGraw Hill, Delhi, 2002.
4. Automobile Engineering Vol. II - Kirpal Singh, Standard publications, New Delhi, 2005
5. Modern Petrol Engine - A.W. Judge, B.I. Publications. 1983
6. Fundamentals of I. C. Engines - J.B.Heywood, McGraw Hill International Edition.
7. Machine design - P.C. Sharma & D.K. Aggarwal, S.K.Kataria& sons, Delhi.
8. I. C. Engine - Maleev&Litchy, McGraw Hill.

FINITE ELEMENT MODELING AND ANALYSIS
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU73	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
Credits	04		

Course objectives: At the end of the course the student will be able to

1. Describe the fundamentals of structural mechanics and finite element method.
2. Develop element stiffness matrix for different elements using various methods.
3. Illustrate different methods of deriving shape functions for various elements.
4. Analyze one dimensional structural and thermal problem.

Module-I	
Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. Boundary conditions, Matrix algebra, Gaussian elimination method, Eigen values and Eigen vectors, **Basic Procedure**: Euler - Lagrange equation for bar, beam (cantilever /simply supported fixed) Principle of virtual work, principle of minimumpotential energy, Raleigh's Ritz method.	10 Hours
Module-II	
Basic Procedure: Direct approach for stiffness matrix formulation of bar element. Galerkin's method. **Discretizationof Structure:** Steps in FEM**,** discritization process, element types-one, two, three and axisymmetric elements, Interpolation polynomials, shape functions: for one dimensional linear element, quadratic and cubic elements, shape functions in natural coordinates, Convergence requirements, selection of the order of the interpolation polynomial, Pascal triangle. Application and limitations of FEM.	10 Hours
Module-III	
Solution of 1D Bar: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique **Trusses:** Stiffness matrix of Truss element. Numerical problems.	10 Hours
Module-IV	
Higher order and Iso-parametric Elements: Lagrangian interpolation, Higher order one dimensional elements- quadratic, cubic elements and their shape functions, properties of shape functions, shape functions for 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions- linear, quadratic, shape function of beam	10 Hours

element. Hermiteshape function of beam element.	
Module-V	
Beams: Hermite shape functions for beam element, Derivation of stiffnessmatrix. Numerical problems of beams carrying concentrated, UDL andlinearly varying loads. **Heat Transfer**: Steady state heat transfer, 1D heat conduction governingequations. Functional approach for heat conduction. Galerkin's approach forheat conduction. 1D heat transfer in thin fins.	10 Hours
Course outcomes: After completion of above course, students will be able to 1. Describe the fundamentals of structural mechanics and finite element method. 2. Develop element stiffness matrix for different elements using various methods. 3. Illustrate different methods of deriving shape functions for various elements. 4. Analyze one dimensional structural and thermal problem.	
Question paper pattern: 1. The question paper will have ten questions. 2. Each full question consists of 16 marks. 3. There will be 2full questions (with a maximum of four sub questions) from each module. 4. Each full question will have sub questions covering all the topics under a module. 5. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Finite Elements in Engineering - T.R.Chandrupatla, A.D Belegunde,3rd Ed PHI. 2. Finite Element Method in Engineering- S.S. Rao, 4th Edition,Elsevier, 2006.	
Reference Books: 1. Finite Element Methods for Engineers -U.S. Dixit, CengageLearning, 2009 2. Concepts and applications of Finite Element Analysis -R.D. Cook, D. S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009 3. Finite Element Methods - Daryl. L. Logon, Thomson Learning 3rdedition, 2001. 4. Finite Element Method - J.N.Reddy, McGraw -Hill InternationalEdition.	

EARTH MOVING EQUIPMENT & TRACTORS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU741	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Gain the knowledge about various basic operations and applications of earth moving equipment.
2. Acquire the knowledge of under carriage, hydraulics, steering of tractors.
3. Get the complete information about the earth moving equipment
4. Select suitable machine depending on type of land, haul distance, climate, etc.

Module-I	
Equipment and operation: Different types, working principles and applications of bull Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments.	08 Hours
Module-II	
Engine, under carriage and Suspension systems: All systems of engine and special features like Automatic injection timer, turbochargers, after coolers etc.,Tyre and tracked vehicles, advantages and disadvantages under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. Rubber spring suspension and air spring suspension.	08 Hours
Module-III	
Transmissions and Final drives: Basic types of transmissions, auxiliary transmission, compound transmission, twin triple countershaft, transmissions and planetary, transmission, constructional and working principles, hydro shift automatic Transmission and retarders. FINAL DRIVES: types of reductions like, single reduction, double reduction final drives and planetary final drives PTO shaft.	08 Hours
Module-IV	
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 & draft control systems.	08 Hours
Module-V	
Criterions for selection of equipment: Selection of machines based on type of soil, haul distance, weather condition, calculation Of Operating Capacity and calculation of productivity of a bull dozer **Earth Moving Equipment Maintenance & Safety:** Types of maintenance schedules, purpose and advantages, organization set ups, documentation. Safety methods for earth moving equipment.	08 Hours

Course outcomes: After completion of above course, students will be able to

1. Gain the knowledge about various basic operations and applications of earth moving equipment.
2. Acquire the knowledge of under carriage, hydraulics, steering of tractors.
3. Get the complete information about the earth moving equipment
4. Select suitable machine depending on type of land, haul distance, climate, etc.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

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

Reference Books:

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

COMPUTER INTEGRATED MANUFACTURING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU742	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Explain need for computer integrated manufacturing.
2. Calculate WIP, TIP ratios using mathematical modeling.
3. Explain various drives and mechanisms used in CIM.
4. AnalyzeAutomated Flow line & Line balancing.
5. Analyze AGV's.
6. Explain steps involved in development of part programming for milling and turning processes.
7. Programme the robots for given application.

Module-I	
Computer Integrated Manufacturing Systems : Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. **High Volume Production System:** Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Rachet& Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality.	08 Hours
Module-II	
Analysis of Automated Flow line & Line Balancing : General terminology and analysis, Analysis of Transfer Line with Out storage-upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with example problem, Partial automation-with numerical problem example, flow lines with more than two stage, Manual Assembly lines balancing numerical problems.	08 Hours
Module-III	
Automated Assembly Systems: Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feedback, escapement and placement analysis of Multistation Assembly machine analysis of single station assembly.	08 Hours

Automated Guided Vehicle System: Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's withnumerical problems and application.	
Module-IV	
Minimum rational work element: Work station process time, Cycle time, precedence constraints. Precedence diagram, balance delay methods of line balancing-largest candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering above methods and computerized line balancing. **Computerized Manufacturing Planning system :** Introduction, Computer Aided process planning, Retrieval types of process planning , Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.	08 Hours
Module-V	
CNC Machining Centers: Introduction to CNC, elements of CNC, CNC machining centers, part programming, and fundamental steps involved in development of part programming for milling and turning. **Robotics:** Introduction to Robot configuration, Robot motion, and programming of Robots end effectors, Robot sensors and Robot applications.	08 Hours
Course outcomes: After completion of above course, students will be able to 1. Explain need for computer integrated manufacturing. 2. Calculate WIP, TIP ratios using mathematical modeling. 3. Explain various drives and mechanisms used in CIM. 4. Analyze Automated Flow line & Line balancing. 5. Analyze AGV's. 6. Explain steps involved in development of part programming for milling and turning processes. 7. Programme the robots for given application.	
Question paper pattern: The question paper will have ten questions. 1. Each full question consists of 16 marks. 2. There will be 2full questions (with a maximum of four sub questions) from each module. 3. Each full question will have sub questions covering all the topics under a module. 4. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Automation, Production system & Computer Integrated manufacturing-M. P. Grover PersonIndia, 2007, 2nd edition. 2. Principles of Computer Integrated Manufacturing-S. Kant Vajpayee, Prentice Hall India	
Reference Books: 1. Computer Integrated Manufacturing- J.A.Rehg& Henry.W. Kraebber. 2. CAD/CAM -Zeid, Tata McGraw Hill. 3. Introduction to Robotics -Mechanica and Control, Craig, J. J., 2nd Edition, Addison-Welsey,	

1989.
4. Fundamentals of Robotics - Analysis and Control, Schilling R. J., PHI, 2006.

TRIBOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU743	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Calculate viscous force developed in oil between parallel plates.
2. Develop mathematical models for tribological processes
3. Design journal bearings.
4. Design hydrostatic bearings for optimal performance.
5. Select bearing materials
6. Explain different aspects of tribological properties.

Module-I	
Introduction: Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubricationprinciples, classification of lubricants.	08 Hours
Module-II	
Hydrodynamic Lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, mechanism of pressure development in an oil film, Reynold's investigation and Reynold's equation in 2D, numerical problems.	08 Hours
Module-III	
Idealized Journal Bearing: Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, end leakages in journal bearing, numerical problems.	08 Hours
Module-IV	
Oil Flow and Thermal Equilibrium of Journal Bearing: Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings. **Hydrostatic Lubrication:** Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.	08 Hours
Module-V	
Bearing Materials: Commonly used bearings materials, properties of typical bearing materials, advantages and disadvantages of bearing materials.	08 Hours

Behavior of Tribological Components: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering	

Course outcomes: After completion of above course, students will be able to

1. Calculate viscous force developed in oil between parallel plates.
2. Develop mathematical models for tribological processes
3. Design journal bearings.
4. Design hydrostatic bearings for optimal performance.
5. Select bearing materials
6. Explain different aspects of tribological properties.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Fundamentals of Tribology -Basu S. K., Sengupta A N., Ahuja B.B., PHI 2006.
2. Introduction to Tribology Bearings -Mujumdar B. C., S. Chandcompany Pvt. Ltd. 2008.

Reference Books:

1. Theory and Practice of Lubrication for Engineers -Fuller, D.,New York company 1998
2. Principles and Applications of Tribology -Moore, Pergamaonpress 1998
3. Tribology in Industries - Srivastava S., S Chand and Companylimited, Delhi 2002.
4. Lubrication of bearings – Theoretical Principles and Design - Redzimovskay E I., Oxford press company 2000.

ENGINEERING SYSTEM DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU744	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Develop an understanding of the Systems Engineering Process and the range of factors that influence the design, planning, production, evaluation and use of a system.
2. Understand the concepts of and develop skills in the design, construction, fault-finding, diagnosis, performance analysis, maintenance, modification, and control of technological systems.
3. Acquire knowledge of new developments and innovations in technological systems.
4. Develop an understanding of how technologies have transformed people's lives and can be used to solve challenges associated with climate change, efficient energy use, security, health, education and transport.
5. Gain an awareness of quality and standards, including systems reliability, safety and fitness for the intended purpose.

Module-I	
Introduction Definition of designing, Man as a designer: Design by evolution, inadequacies of traditional design method: System approach of engineering problems: Need models: design history of large scale existing system. **Morphology of design:** The three phases of design projects, the structure of design process, decision making and iteration.	08 Hours
Module-II	
Identification and analysis of Need: Preliminary need statement, analysis of need, specifications, and standards of performance and constrains. **Origination of Design Concept:** Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brainstorming etc	08 Hours
Module-III	
Preliminary Design: Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. **Reliability Considerations in Design:** Bath tub curve, exponential reliability function, system reliability concept. (Numerical).	08 Hours

Module-IV	
Evaluation of Alternatives and Design decisions: Physical realisability, Design Tree: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical). **Economics and Optimization in Engineering Design:** Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical).	08 Hours
Module-V	
Optimization: Introduction to LPP, formulation and graphical solutions. **Man- Machine Interaction:** Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. Factors influencing displays and controls.	08 Hours

Course outcomes: After completion of above course, students will be able to

1. Develop an understanding of the Systems Engineering Process and the range of factors that influence the design, planning, production, evaluation and use of a system.
2. Understand the concepts of and develop skills in the design, construction, fault-finding, diagnosis, performance analysis, maintenance, modification, and control of technological systems.
3. Acquire knowledge of new developments and innovations in technological systems.
4. Develop an understanding of how technologies have transformed people's lives and can be used to solve challenges associated with climate change, efficient energy use, security, health, education and transport.
5. Gain an awareness of quality and standards, including systems reliability, safety and fitness for the intended purpose.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. An Introduction to Engineering Design Method - by V. Gupta and P. Murthy, Tata McGraw Hill. 2000
2. Introduction of Engineering Design by T. Woodson, McGraw Hil1.2001

Reference Books:

1. Design & Planning of Engineering systems - D.D. Meredith, K.W. Wong, R.W. Wood head & K.K. Worthman. 2000.
2. Introduction to Design - by M.A. Asimov-Prentice Hall. 1996.
3. Design Methods - Seeds of Human Futures-Wiley Inter Science.1970.

CONTROL ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU751	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Differentiate between open loop and closed loop control systems with practical examples.
2. Solve a complex control system to simple form using block diagrams and signal flow graph.
3. Evaluate the response of a control system for step & ramp inputs using differential equations.
4. Analyze stability of a given system by using polar, Nyquist, bode plots and root locus concepts.
5. Explain need for system compensations.

Module-I	
Introduction: Classifications of control systems open and closed loop systems, concepts of feedback and feed forward control systems, requirement of an ideal control system, types of controllers. **Mathematical models:** Transfer function models, models of mechanical systems, models of electrical circuits, models of thermal systems, models of hydraulic systems, Pneumatic system, DC and AC servomotors in control systems. Error detectors	08 Hours
Module-II	
Block diagrams and signal flow graphs: Transfer Functions definition, blocks representation of system elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.	08 Hours
Module-III	
Transient and steady state response analysis Introduction, Analysis of first order and second order system response to step, ramp and impulse inputs, Transient response and time domain specifications. System stability: Routh's-Hurwitz Criterion.	08 Hours
Module-IV	
Frequency Response Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin. Bode attenuation diagrams, Stability analysis using Bode plots, Simplified Bode Diagrams.	08 Hours
Module-V	

Root Locus Plots: Definition of root loci, General rules for constructing rootloci, Analysis using root locus plots. **System Compensation and State Variable Characteristics of Linear Systems:** Series and feedback compensation, Introduction to state concepts,state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test**.**	08 Hours

Course outcomes: After completion of above course, students will be able to

1. Differentiate between open loop and closed loop control systems with practical examples.
2. Solve a complex control system to simple form using block diagrams and signal flow graph.
3. Evaluate the response of a control system for step & ramp inputs using differential equations.
4. Analyze stability of a given system by using polar, Nyquist, bode plots and root locus concepts.
5. Explain need for system compensations.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Modern Control Engineering -Katsuhiko Ogatta, PearsonEducation,2004.
2. Control Systems Principles and Design -M.Gopal, 3rd Ed.,TMH,2000.

Reference Books:

1**.** Modern Control Systems - Richard.C.Dorf and Robert.H.Bishop,Addison Wesley,1999
2. System Dynamics &Control -Eronini, Umez, Thomson Asia Pvt. Ltd. Singapore, 2002.
3. Feedback Control System - Schaum's series. 2001.

ENGINEERING ECONOMY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU752	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Solve the problem related to decision making regarding supply and demand.
2. Understand the concept of interest and time value of money.
3. Make the decision based on present worth, future worth of the alternatives.
4. Understand the financial statements for making suitable decisions.

Module-I	
Introduction: Engineering Decision-Makers, Engineering and Economics,Problem solving and Decision making, Intuition and Analysis, Tactics andStrategy. Engineering Economic Decision Maize, Law of demand andsupply, Law of returns, Interest and Interest factors: Interest rate, Simpleinterest, Compound interest, Cash - flow diagrams, Personal loans and EMIPayment, Exercises and Discussion.	08 Hours
Module-II	
Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Presentworth, Assets with unequal lives, infinite lives, Future-worth comparison,Pay-back comparison, Exercises, Discussions and problems.	08 Hours
Module-III	
Rate-of-Return Calculations And Depreciation: Rate of return, Minimumacceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts, Causes of Depreciation, Basic methods of computing depreciation charges,Tax concepts, and corporate income tax.	08 Hours
Module-IV	
Rate-Of-Return Calculations And Depreciation: Rate of return, Minimum, acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts, Causes of Depreciation, Basic methods of computing depreciation charges,Tax concepts, corporate income tax. **Estimating and Costing:** Components of costs such as Direct MaterialCosts, Direct Labor Costs, Fixed Over-Heads, and Factory cost, AdministrativeOver-Heads, First cost, Marginal cost, Selling price, Estimation for simplecomponents.	08 Hours
Module-V	

Introduction, Scope of Finance, Finance Functions: Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numerical. **Financial and Profit Planning:** Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting (No numericals).	08 Hours
Course outcomes: After completion of above course, students will be able to 1. Solve the problem related to decision making regarding supply and demand. 2. Understand the concept of interest and time value of money. 3. Make the decision based on present worth, future worth of the alternatives. 4. Understand the financial statements for making suitable decisions.	
Question paper pattern: 1. The question paper will have ten questions. 2. Each full question consists of 16 marks. 3. There will be 2full questions (with a maximum of four sub questions) from each module. 4. Each full question will have sub questions covering all the topics under a module. 5. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Engineering Economy - Riggs J.L., 4TH ed. , McGraw Hill, 2002 2. Engineering Economy - Thuesen H.G. PHI , 2002.	
Reference Books: 1. Engineering Economy - Tarachand, TMH, 2000. 2. Industrial Engineering and Management – O.P. Khanna, DhanpatRai& Sons. 2000. 3. Financial Mangement- Prasanna Chandra, 7th Ed., TMH, 2004. 4. Finacial Management – I. M. Pandey, Vikas Pub. House, 2002.	

OPERATIONS RESEARCH

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU753	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to

1. Formulate a problem as LPP.
2. Solve LPP of different models using suitable method.
3. Plan and execute the projects using CPM and PERT techniques.
4. Decide the optimum sequence of the processes/ machines.

Module-I	
Introduction: Evolution of OR, definition of OR, scope of OR, applicationareas of OR, steps (phases) in OR study, characteristics and limitations ofOR, models used in OR, linear programming (LP) problem-formulation andsolution by graphical method. **Solution of Linear Programming Problems**: The simplex methodcanonicaland standard form of an LP problem, slack, surplus and artificialvariables, big M method and concept of duality, dual simplex method.	08 Hours
Module-II	
Transportation Problem: Formulation of transportation problem, types,initial basic feasible solution using different methods, optimal solution byMODI method, degeneracy in transportation problems, application oftransportation problem concept for maximization cases. **AssignmentProblem:** Formulation, types, application to maximization cases and travellingsalesman problem	08 Hours
Module-III	
Integer Programming: Pure and mixed integer programming problems,solution of Integer programming problems-Gomory's all integer cuttingplane method and mixed integer method, branch and bound method, Zero- One programming. **Queuing Theory:** Queuing systems and their characteristics, Pure-birth andPure-death models (only equations), empirical queuing models – M/M/1 andM/M/C models and their steady state performance analysis.	08 Hours
Module-IV	

PERT-CPM Techniques: Introduction, network construction – rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Criticalpath method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining theprobability of completing a project, predicting the completion time of project;crashing of simple projects.	08 Hours
Module-V	
Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **Sequencing:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method	08 Hours

Course outcomes: After completion of above course, students will be able to

1. Formulate a problem as LPP.
2. Solve LPP of different models using suitable method.
3. Plan and execute the projects using CPM and PERT techniques.
4. Decide the optimum sequence of the processes/ machines.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Operations Research–P. K. Gupta and D S Hira, ChandPublications, New Delhi – 2007.
2. Operations Research - Taha H A, Pearson Education.
3. Operations Research -S.D. Sharma, LedarnathRamanath& Co,2002.

Reference Books:

1. Operations Research- A. P.Verma, S K Kataria&Sons, 2008.
2. Operations Research -Paneerselvan, PHI.
3. Operations Research –A. M.Natarajan, P Balasubramani, PearsonEducation, 2005.
4. Introduction to Operations Research -Hillier and Liberman,8thEd., McGraw Hill.

TWO AND THREE WHEELED VEHICLE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	15AU754	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
Credits	03		

Course objectives: At the end of the course the student will be able to:

1. Describe construction and working of different type of internal combustion engines for two and three wheeled vehicles.
2. Laydown wiring diagram for two wheeler and three wheeled vehicles.
3. Explain types of clutches, transmission and final drives used for two and three wheeled vehicles.
4. Describe types of frames, brakes and tyres used for two and three wheeled vehicles.
5. Laydown maintenance schedule for two and three wheeled vehicles.

Module-I	
The Power Unit: Types of engines for two wheelers, advantages and disadvantages of two stroke and four stroke engines, engine components, constructional details, materials, symmetrical and unsymmetrical port timing diagrams, valve actuating mechanisms, valve timing diagrams. Rotary valve engine, Advantages and disadvantages of diesel engines for two wheelers, power plant for electric bikes, exhaust systems.	08 Hours
Module-II	
Fuel, Lubrication and Cooling system: Layout of fuel supply system, fuel tank construction, carburetor types, construction, working and adjustments. Types of cooling systems, advantages of air cooling system. Lubrication types, Lubrication of parts, grades of lubricating oils. **Electrical system**: Types of ignition system, their working principles, wiring diagram for Indian vehicles, spark plug construction, indicators and gauges used in two wheelers, lighting systems.	08 Hours
Module-III	
Transmission system: **Primary drive and Clutch:** Motor cycle power train, Primary drives, Types of primary drives, Chain drive, Gear drive, Construction and operation of motorcycle clutches, Clutch release mechanism. Gear boxes and **Transmission:** Introduction to motorcycle transmission, Sprockets and chain, Gears and Dogs in motor cycle transmission, Gear and Gear ratios, Sliding gear transmissions, Shifting fork mechanisms, Constant mesh transmissions, lubrication, **Final drive:**	08 Hours

Introduction to motorcycle final drives, Fundamentals of chain drive, Chain lubrication and lubricators, Shaft drives, Drive shaft couplings, Final drive gear case,	
Module-IV	
Frames and suspension: Types and constructional details of frames, advantages and limitations, frame materials, frame stresses, frame building problems, frame components, Front and Rear suspension systems, shock absorber construction and working, Panel meters and controls on handle bar, body manufacture and painting. **Brakes and Wheels**: Front and rear braking systems, disc and drum brakes, merits and demerits, Types of wheels, loads on wheels, construction and materials for wheels, wheels designation,tyre designation, inflation, types of tyres, construction details.	08 Hours
Module-V	
Two wheelers and Three wheelers: Case study of major Indian models of major motor cycles, scooters, scooteretts and mopeds. Case study of Indian models of three wheelers, Front mounted engine and rear mounted engine types, Auto rickshaws, pick up van, delivery van and trailer, Bijlielectric vehicles. **Maintenance:** Importance of maintenance, Decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules, trouble diagnosis charts, safety precautions, Lubrication charts.	08 Hours

Course outcomes: After completion of above course, students will be able to

1. Describe construction and working of different type of internal combustion engines for two and three wheeled vehicles.
2. Laydown wiring diagram for two wheeler and three wheeled vehicles.
3. Explain types of clutches, transmission and final drives used for two and three wheeled vehicles.
4. Describe types of frames, brakes and tyres used for two and three wheeled vehicles.
5. Laydown maintenance schedule for two and three wheeled vehicles.

Question paper pattern:

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2full questions (with a maximum of four sub questions) from each module.
4. Each full question will have sub questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Motor cycle engines - P.E.Irving, Temple Press Book, London, 1992
2. Motor cycles -Michel M. Griffin
3. Motor cycle Mechanics - William H. Crouse and Donald L. Anglin, TMH

Reference Books:

1. The cycle Motor manual - Temple Press Ltd, 1990
2. Vespa maintenance and repair series - Bryaut R. V.
3. Encyclopedia of Motor Cycling 20 volumes - Marshall Cavendish, New York., 1989

AUTOMOBILE SCANNING AND RE-CONDITIONING LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –VII

Subject Code	15AUL76	IA Marks	20
Number of Lecture Hours/Week	01I + 02P	Exam Marks	80
Total Number of Lecture Hours	39	Exam Hours	03
Credits	02		

Course objectives:At the end of the course the student will be able to:

1. Check and adjust ignition timing and tappet clearance
2. Align the given connecting rod
3. Rebore the given engine cylinders
4. Service the FIP and calibrate
5. Repair the vehicle body and paint it

PART – A

1. Inspection of vehicles and preparation of test charts.
2. Tuning of Engines: Check for ignition timing, valve tappet clearance, Radiator flushing and check for leaks etc.,
3. Study and practice on
   a. Connecting rod alignment
   b. Cylinder reboring machine
   c. Valve refacing machine
   d. Nozzle grinding machine
   e. Brake drum skimming machine

PART-B

1. Servicing of FIP, Calibration and phasing of FIP.
2. Study and practice of wheel balancing and wheel alignment.
3. Testing of Two wheeled vehicles on chassis dynamometer.
4. Study of tyre retreading and vulcanizing.
5. Study and practice on body repairs – tinkering and painting.
6. Head light focusing test and visibility test.

Course outcome: At the end of this laboratory, students will be able to:

1. Check and adjust ignition timing and tappet clearance
2. Align the given connecting rod
3. Rebore the given engine cylinders
4. Service the FIP and calibrate
5. Repair the vehicle body and paint it

Scheme of Examination:

One Question from Part – A	30 marks
One Question from Part – B	40 marks
Viva – Voce	10 marks
Total:	**80 marks**

MODELING AND ANALYSIS LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –VII

Subject Code	15AUL77	IA Marks	20
Number of Lecture Hours/Week	01I + 02P	Exam Marks	80
Total Number of Lecture Hours	39	Exam Hours	03
Credits	02		

Course objectives: At the end of the course the student will be able to:

1. Describe procedure for FEA
2. Model and analyze bar, beam and trusses subjected to various types of loads
3. Analyze heat transfer and flow processes

PART – A

Study of FEA packages, Modeling, Static and Dynamic analysis

STATIC ANALYSIS

1. Bars subjected to axial loads for constant cross section, tapered cross section and stepped bar.
2. Trusses – Simple trusses
3. Beams – Cantilever and simply supported beams subjected to point load,UDL, UVL and moments.

PART-B

1. Beams subjected to axial and bending loads.
2. Thermal analysis – 2D problems with conduction and convection.
3. Fluid flow analysis- simple and 2 D problems.

Course outcome: At the end of this laboratory, students will be able to:

1. Describe procedure for FEA
2. Model and analyze bar, beam and trusses subjected to various types of loads
3. Analyze heat transfer and flow processes

Scheme of Examination:

One Question from Part – A 30 marks

One Question from Part – B 40 marks

Viva – Voce 10 marks

Total: 80 marks

Project Phase- I + Project seminar [As per Choice Based Credit System (CBCS) scheme] SEMESTER –VII			
Subject Code	15AUP78	IA Marks	100
Number of Lecture Hours/Week	03	Exam Marks	
Total Number of Lecture Hours		Exam Hours	03
Credits	02		

During project Phase – I , students are expected to

1. Identify the project domain and topic
2. Carryout necessary literature survey
3. Define the problem for consideration
4. Finalizing the methodology to carry out the project work in Phase- II.
5. Present seminar on topic selected for project