NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

The Trust is a Recipient of Prestigious Rajyotsava State Award 2012 Conferred by the Government of Karnataka
Awarded Outstanding Technical Education Institute in Karnataka-2016
Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA

Academic Year 2021-22

AU – Automobile Engineering

Seventh and Eight Semester

Scheme and Syllabus

New Horizon College of Engineering
Department of Automobile Engineering
Seventh Semester B.E Program-Scheme AY: 2021-2022

Sl. No.	Course Code	Course Name	Credit Distribution				Overall Credits	Contact Hrs Weekly	Marks		
			L	T	P	S			CIE	SEE	Total
1	20AUT71A	Mechanical Vibrations	3	1	0	0	4	5	50	50	100
2	20AUT72A	Management and Entrepreneurship	3	0	0	0	3	3	50	50	100
4	20AUT73XA	Professional Elective-IV	3	0	0	0	3	3	50	50	100
5	20AUT74XA	Professional Elective-V	3	0	0	0	3	3	50	50	100
6	20NHOPXX	Open Elective-II	3	0	0	0	3	3	50	50	100
7	20AUL75A	Automotive Simulation Lab	0	0	1.5	0	1.5	3	25	25	50
8	20AUL76A	Service and Recondition lab	0	0	1.5	0	1.5	3	25	25	50
9	20AUT77A	Mini Project- IV	--	--	4	0	4	8	50	50	100
Total							23	31	350	350	700

Professional Elective-IV	
Course Code	**Course Name**
20AUT731A	Control Engineering
20AUT732A	Electric and Hybrid Vehicle
20AUT733A	Computer Integrated Manufacturing
20AUT734A	Automotive Aerodynamics

Professional Elective-V	
Course Code	**Course Name**
20AUT741A	Engineering Economy
20AUT742A	Air Conditioning and Heat Transfer
20AUT743A	Operation Research
20AUT744A	Industrial Automation and Robotics

New Horizon College of Engineering
Department of Automobile Engineering
Eighth Semester B.E Program-Scheme AY: 2021-2022

Sl. No.	Course Code	Course Name	Credit Distribution				Overall Credits	Contact Hrs Weekly	Marks		
			L	T	P	S			CIE	SEE	Total
1	20AUT81XA	PE-VI	3	0	0	0	3	3	50	50	100
2	20AUT82XA	PE-VII	3	0	0	0	3	3	50	50	100
3	20AUT83A	Internship	--	--	4	0	4	8	50	50	100
4	20AUT84A	Project Work	--	--	10	0	10	20	150	150	300
Total							20	34	300	300	600

Professional Elective-VI	
Course Code	**Course Name**
20AUT811A	Supply Chain and Logistics management
20AUT812A	Product Life Cycle Management
20AUT813A	Advanced Manufacturing technology
20AUT814A	Vehicle Maintenance

Professional Elective-VII	
Course Code	**Course Name**
20AUT821A	Motorsport Technology
20AUT822A	Automotive testing and certification
20AUT823A	Advanced vehicle technology
20AUT824A	Vehicle Body Engineering and Safety

VII SEMESTER
SYLLABUS

MECHANICAL VIBRATIONS

Course Code: 20AUT71A **Credits: 04**
L: T: P:S : 3:1:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Calculate the natural frequency of the vibratory systems
CO2	Analyze undamped, damped and forced vibratory systems
CO3	Solve differential equations concerned to different vibratory systems
CO4	Identify vibration measuring techniques and also control of vibration
CO5	Formulate mathematical equations for different types of vibrations for single and multi-degree freedom systems.
CO6	Analyse vibration problems using modern tools

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2							1		1
CO2	3	2	2							1		1
CO3	3	2	2							1		1
CO4	3	2	2							1		1
CO5	3	2	2							1		1
CO6	3	2	2							1		1

Module No.	Module Contents	Hrs	CO's
1	I**ntroduction**: Introduction to Vibrations **Undamped free vibrations**: Single degree of freedom systems. Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring. Beat phenomena. Simple Harmonic Motion.	**9**	**CO1**
2	**Damped free vibrations**: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement	**9**	**CO5**
3	**Forced Vibration**: Single degree freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolation, transmissibility ratio -harmonic excitation and support motion. Whirling of shafts with and without damping. Discussion of speeds above and below critical speeds	**9**	**CO3,**
4	**Systems with two degrees of freedom**: Introduction, principle	**9**	**CO2, CO6**

	modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Forced Oscillations-Harmonic excitation. **Vibration Measurement and Applications:** Transducers, Vibration Pickups, Frequency measuring Instruments, Vibration exciters, Signal Analysis, Experimental Analysis, Machine Condition Monitoring and Diagnosis. Signal analysis		
5	**Vibration Control:** Vibration Nomograph and Vibration Criteria, Balancing of Rotating Machines, Whirling of Rotating shafts, Control of Natural Frequencies, Introduction to damping, Vibration Isolation, Vibration Absorbers. **Numerical methods for Multi degree Freedom systems**: Introduction, Influence coefficients, Maxwell reciprocal theorem, Matrix Method, Matrix iteration-Method. Holzer and Stodola method	**9**	**CO4**

Text Books:

1. **1. Mechanical Vibrations** (English) 8th Edition, G. K. Grover, Nem Chand and Brothers
2. **Mechanical Vibrations**: V.P. Singh, DhanpatRai& Company Pvt. Ltd., 3rd edition, 2006.

Reference Books:

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc., 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007
3. Theory & Practice of Mechanical vibrations: J.S. Rao& K. Gupta, New Age

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand			5
Apply	10	7.5	5
Analyse	10	7.5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	
Apply	
Analyse	20
Evaluate	20
Create	10

MANAGEMENT AND ENTREPRENEURSHIP

Course Code: 20AUT72A **Credits: 03**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the basic knowledge of management and staffing
CO2	Understand the importance and purpose of planning
CO3	Describe the organization and its types and controlling
CO4	Discuss the development of Entrepreneurship
CO5	Describe the importance of Small Scale Industries
CO6	Describe the significance of Institutional Support

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	1	3	2	3	2	2
CO2	1	1	1	1	1	3	1	2	3	2	1	3
CO3	1	1	1	1	1	2	1	3	3	3	2	2
CO4	1	1	1	1	1	2	1	3	3	2	1	2
CO5	1	1	1	1	1	3	1	3	3	2	1	2
CO6	1	1	1	1	1	2	1	3	2	3	2	2

Module No.	Module Contents	Hrs	CO's
1	**Management:** Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches. **Staffing:** Nature and importance of staffing, Process of Selection & Recruitment	9	CO1
2	**Planning:** Nature, importance and purpose of planning process	9	CO2,

	Objectives - Types of plans - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.		CO3
3	**Organizing:** 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 **Controlling:** Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control	9	CO4
4	**Entrepreneur:** Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Women Entrepreneurs; Entrepreneurship - its Barriers.	9	CO5
5	**Small Scale Industries:** Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions **Institutional Support:** Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.	9	CO6

Text Books:

1. P. C.Tripathi, P.N. Reddy, *"Principles of Management",* – Tata McGraw Hill
2. Vasant Desai,"*Dynamics of Entrepreneurial Development & Management*",Himalaya Publishing House
3. Poornima. M. Charantimath*,"Entrepreneurship Development",*Small Business Enterprises – Pearson Education - 2006

Reference Books:

1.Robers Lusier – Thomson, "*Management Fundamentals",* Concepts, Application, Skill Development
2. S.S.Khanka, "*Entrepreneurship Development"*- S.Chand & Co.
3. Stephen Robbins "*Management"*, Pearson Education/PHI - 17th Edition, 2003

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	05		02
Understand	10	05	02
Apply	05	05	03

Analyse	05	05	03
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	15
Apply	10
Analyse	15
Evaluate	
Create	

AUTOMOTIVE SIMULATION LAB

Course Code:20AUL75A **Credits: 1.5**
L: T: P:S : 0:0:1.5:0 **CIE Marks: 25**
Exam Hours: 03 Hours **SEE Marks: 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the programming in MAT lab and solve problems
CO2	Solve engineering mechanics problems
CO3	Calculate the natural frequency of the vibratory systems.
CO4	Calculate the transmissibility ratio of the vibratory systems.
CO5	Analyse the automobile components
CO6	Analyse and understand the CNC machining

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	1	1	2	2	1	2
CO2	3	3	2	1	2	2	1	1	2	2	1	2
CO3	3	3	2	1	2	2	1	1	2	2	1	2
CO4	3	3	2	1	2	2	1	1	2	2	1	2
CO5	3	3	2	1	2	2	1	1	2	2	1	2
CO6	3	3	2	1	2	2	1	1	2	2	1	2

Sl No.	List of Experiments	Hrs	CO's
	Part A		
1	Introduction to matLab, Programming, Matrices,	3	CO1
2	Solution of Differential equations, Laplace transformation, Fourier series.	3	CO1
3	Problems on Engineering mechanics – Basic Problems	3	CO2
4	Trusses, Numerical methods, Gauss-elimination method.	3	CO2

5	Problems on Mechanical Vibration, SDOF, MDOF	3	CO3
6	Problems on Transmissibility	3	CO4
7	Case studies of Automobile engineering using Matlab/simulink	3	CO5
8	Case studies of Automobile engineering using Matlab/simulink CNC part programming on Turning and milling	3	CO6

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	Tests	Record	Quizzes/Viva
Marks (Out of 25)	**10**	**10**	**5**
Remember			
Understand		5	5
Apply	5	5	
Analyse	5		
Evaluate			
Create			

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	SEE (Theory)
Remember	
Understand	05
Apply	10
Analyse	10
Evaluate	
Create	

SERVICE AND RECONDITION LAB

Course Code: 20AUL76A **Credits: 1.5**
L: T: P:S 0:0:1.5:0 **CIE Marks: 25**
Exam Hours: 03 Hours **SEE Marks: 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Inspect vehicles and fault diagnosis
CO2	Demonstrate valve grinding, valve lapping, connecting rod alignment, cylinder re boring and spark plug cleaning
CO3	Demonstrate testing of two wheeler chassis dynamometer
CO4	Service the FIP and calibrate
CO5	Perform tyre vulcanizing, wheel balancing, wheel alignment and headlight focusing
CO6	Repair the vehicle body and paint it

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	2		2	2	2	1		2
CO2	3	2		1	2		2	2	2	1		2
CO3	3	2		1	2		2	2	2	1		2
CO4	3	2		1	2		2	2	2	1		2
CO5	3	2		1	2		2	2	2	1		2
CO6	3	2		1	2		2	2	2	1		2

Sl No.	List of Experiments	Hrs	CO's
	Part A		
1	Inspection of vehicle and preparation of test charts	3	CO1
2	Tuning of Engines: Check for ignition timing, valve tappet clearance, Radiator flushing and check for leaks etc.,	3	CO1
3	Perform Connecting rod alignment and Cylinder reboring machine	3	CO2
4	Perform valve grinding operation and valve lapping operation	3	CO2
5	Perform Spark plug cleaning and gap adjustments	3	CO2
	Part B		
1	Testing of Two wheeled vehicles on chassis dynamometer.	3	CO3
2	Servicing of FIP, Calibration and phasing of FIP	3	CO4
3	Perform wheel alignment for passenger vehicles	3	CO5
4	Perform wheel balancing for passenger vehicles	3	CO5
5	Study of tyre retreading and vulcanizing	3	CO5
6	Perform Head light focusing test and visibility test	3	CO5
7	Study and practice on body repairs – tinkering and painting.	3	CO6

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	Tests	Record	Quizzes/Viva
Marks (Out of 25)	**10**	**10**	**5**
Remember			
Understand		5	
Apply	5	5	2
Analyse	5		3
Evaluate			
Create			

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	SEE (Theory)
Remember	
Understand	
Apply	10
Analyse	10
Evaluate	05
Create	

PROFESSIONAL ELECTIVE-IV

CONTROL ENGINEERING

Course Code: 20AUT731 A **Credits: 03**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Identify the components of control systems given real life situation
CO2	Estimate the response characteristics and parameters related to stability of systems
CO3	Develop transfer function models and state-space models of single input single output, linear time invariant systems
CO4	Analyse the time response of first and second order systems
CO5	Evaluate the stability of systems using various methods
CO6	Design PID controllers

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	1	1	1	2	1	1
CO2	3	3	2	1	1	1	1	1	1	2	1	1
CO3	3	3	2	1	1	1	1	1	1	2	1	1
CO4	3	3	2	1	1	1	1	1	1	2	1	1
CO5	3	3	2	1	1	1	1	1	1	2	1	1
CO6	3	3	2	1	1	1	1	1	1	2	1	1

Module No.	Module Contents	Hrs	CO's
1	**INTRODUCTION TO CONTROL SYSTEMS & SYSTEM MODELLING**: Introduction, Basic Terminologies, Advantages of Control Systems, Open loop & Closed loop control systems, Real time applications, Analysis and design objectives, Properties of Feedback. Transfer Functions, models of mechanical systems (translational and rotational), Electrical Systems, Models of DC Motors, Block representation of control system elements, Modeling of mechanical & electrical systems in State Space.	9	CO1
2	**TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**: Types of standard test signals (inputs), poles and zeros. Analysis of first & second order system response to step input, poleplacement. Higher order system response, system response with zeros. Concept of stability: Rout-Hurwitz Criterion. Steady state errors, system type, static error constant	9	CO2
3	**ANALYSIS AND DESIGN USING ROOT LOCUS**: Definition of root loci, general rules for constructing root loci, Analysis using root locus	9	CO3

4	**FREQUENCY RESPONSE ANALYSIS:**Nyquist criterion, Sketching Nyquist Diagram, Stability, Gain Margin & Phase Margin via Nyquist plots. Sketching of Polar Plots.	**9**	**CO4**
5	**BODE PLOTS**: Introduction, Asymptotic Approximations: Bode Magnitude and Phase angle plots. Stability, Gain Margin & Phase Margin via Bode plot	**9**	**CO5, CO6**

Text Books:

1. Control Systems Engineering, 5th Edition, Norman S Nise, Wiley India -2009

Reference Books:

1. **Modern Control Engineering**, Katsuhiko Ogata, Pearson Education, 2004
2. Automatic Control Systems, B.C.Kuo, F.Golnaraghi, John Wiley & Sons, 2003.
3. Modern Control Systems, Richard C Dorf& Robert H Bishop, Prentice Hall, 2008

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	5		
Understand	5		
Apply	5	5	
Analyse	5	5	10
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	15
Analyse	10
Evaluate	5
Create	

ELECTRIC AND HYBRID VEHICLES

Course Code: 20AUT732A **Credits: 03**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Differentiate hybrid and electric vehicles
CO2	Explain the current scenario of demand for fossil fuels, effects of automobile pollution and strategy of next generation vehicles.
CO3	Identify the requirements of Electric Drive train for hybrid and electric vehicles
CO4	Select appropriate electric motor and drive controls for EVs and HEVs
CO5	Analyse the performance of energy storage systems in electric and hybrid vehicles.
CO6	Select appropriate Fuel Cell Technology for EVs and HEVs.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					3				2	2
CO2	3	2					3				2	2
CO3	3	2					3				2	2
CO4	3	2					3				2	2
CO5	3	2					3				2	2
CO6	3	2					3				2	2

Module No.	Module Contents	Hrs	CO's
1	**INTRODUCTION**: Usage Pattern of Automobiles in cities and highways, Air Pollution: NOx, CO, HC, PM emission, Global Warming Health Impacts, Petroleum Resources, Induced Costs, Importance of Different Transportation Development, Strategies to Future Oil Supply, Strategies for Next Generation Vehicles.	9	CO2
2	**ELECTRIC AND HYBRID VEHICLES:** Configuration Layouts of early EVs and modern EVs, merits and demerits, Concept of Hybridization, Hybrid electric drive trains - types of hybrid drive train topologies, Speed & Torque Couplings, Types of HEVs, Regenerative braking strategies, Start/Stop in EVs and HEVs, Merits and demerits	9	CO1, CO3
3	**PROPULSION SYSTEM FOR EVS**: Basic concept of electric traction, Power-Torque Characteristic curves, Selection of Electric motors, Motors types: DC motor drives, induction motor drives, brushless DC PM motor drives, Switched Reluctance motor drives, starter/alternator, Electric Control Drives.	9	CO4
4	**ENERGY MANAGEMENT SYSTEM FOR EVS**: Energy storage requirements in HEVs and EVs, Energy storage techniques - battery based energy storage: Engine starter batteries, Traction Batteries, Super capacitor based energy storage and flywheel based energy	9	CO5

	storage, Hybridization of different energy storage devices.		
5	**FUEL CELL TECHNOLOGIES**: Fuel cell electric vehicles-operating principle, Fuel cell technologies- alkaline fuel cell- proton exchange Membrane, direct methanol fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, Fuel reformer, Hydrogen storage systems.	9	CO6

Text Books:

1. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2018.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, Boca Raton: CRC Press, 2011

Reference Books:

1. AuliceScibioh M. and Viswanathan B., Fuel Cells Principles and Applications, India: University Press, 2009
2. James Larminie and John Loury, Electric Vehicle Technology-Explained, New York: John Wiley & Sons Ltd., 2012.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	5		
Understand	5		5
Apply	10	5	5
Analyse	5	5	
Evaluate		5	
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	20
Analyse	20
Evaluate	
Create	

COMPUTER INTEGRATED MANUFACTURING

Course Code:20AUT733A **Credits: 3**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the concept of production system, automation, mathematical models in production, work part transfer mechanisms etc
CO2	Analyze the Flow lines and solve problems on line balancing for various manufacturing systems.
CO3	Understand the concept of Group Technology and Flexible Manufacturing System, its implementation and applications in industries.
CO4	Apply the concepts, principles and recommendations for Design and development of automated assembly systems and Automated Guided Vehicles.
CO5	Understand the concept of Computerized Manufacturing planning systems
CO6	Create the part programs for CNC Milling, Turning and drilling operations.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	3	3	3	2	1			2
CO2	2	1	2	1	3	3	3	2	1			2
CO3	2	1	2	1	3	3	3	2	1			2
CO4	2	1	2	1	3	3	3	2	1			2
CO5	2	1	2	1	3	3	3	2	1			2
CO6	2	1	2	1	3	3	3	2	1			2

Module No.	Module Contents	Hrs	CO's
1	**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.	**9**	**CO1**
2	**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. Automation for machining operation **Analysis of Automated Flow line & Line Balancing :** General terminology and analysis, Analysis of Transfer Line with Out	**9**	**CO1, CO2**

	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, Manual Assembly lines line balancing problem		
3	**Group Technology and Flexible Manufacturing System:** Part families, Part classification and coding, Production Flow Analysis, Cellular manufacturing, Flexible Manufacturing Systems (FMS), FMS components, FMS applications and benefits, FMS planning and Implementation issues. **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.	**9**	**CO3 CO6**
4	**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 Multi station Assembly system and numericals. **Automated Guided Vehicle System**: Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application.	**9**	**CO4**
5	**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	**9**	**CO5**

Text Books:

1. Automation, Production System & Computer Integrated Manufacturing, M. P. Groover, Person India, 2015, 3rd 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 by Zeid, Tata McGraw Hill.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes

Marks (Out of 50)	25	15	10
Remember	5		3
Understand	5	5	5
Apply	5	5	2
Analyse	5	5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	10
Analyse	10
Evaluate	10
Create	

AUTOMOTIVE AERODYNAMICS

Course Code: 20AUT734A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Evaluate basic fluid theory
CO2	Evaluate the fuel consumption of vehicle
CO3	Apply CFD to a range of problems.
CO4	Understand lift, drag and down force definitions and calculations.
CO5	Demonstrate a knowledge and understanding of aerodynamics in automotive field.
CO6	Explain the principles and functions of wind tunnel.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1				1	1	2
CO2	3	3	3	2	2	1				1	1	2
CO3	3	3	3	2	2	1				1	1	3
CO4	3	3	3	2	2	1				1	1	3

CO5	3	3	3	2	2	1				1	1	3
CO6	3	3	3	2	2	1				1	1	3

Module No.	Module Contents	Hrs	CO's
1	**INTRODUCTION :** Scope and historical development trends - Fundamental of fluid mechanics - Flow phenomenon related to vehicles - External & Internal flow problem - Resistance to vehicle motion - Performance - Fuel consumption and performance - Potential of vehicle aerodynamics.	9	CO1, CO2
2	**AERODYNAMIC DRAG OF CARS :** Cars as a bluff body - Flow field around car - drag force - types of drag force - analysis of aerodynamic drag -drag coefficient of cars - strategies for aerodynamic development - low drag profiles, Lift, Body styling	9	CO3
3	**SHAPE OPTIMIZATION OF CARS:** Front end modification - front and rear wind shield angle - Boat tailing - Hatch back, fast back and square back - Dust flow patterns at the rear - Effects of gap configuration - effect of fasteners. The origin of forces and moments on vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments	9	CO4
4	**VEHICLE HANDLING:** Characteristics of forces and moments - Dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles	9	CO5
5	**WIND TUNNELS FOR AUTOMOTIVE AERODYNAMIC:** Introduction – Principle of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.	9	CO6

Text Books:

1. Wolf – Heinrich Hucho, Aerodynamics of Road Vehicles, SAE, ISBN No: 978-0-7680- 0029-0, 2198.

2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002

Reference Books:

1. Pope. A., Wind Tunnel Testing, John Wiley & Sons, 2nd edition, New York, 2174.

2. Sumantran. V, Gino Sovran, Vehicle Aerodynamics, SAE, 2194

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	25	15	10

Remember			5
Understand	10	5	5
Apply	10	5	
Analyse	5	5	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	20
Analyse	10
Evaluate	
Create	

PROFESSIONAL ELECTIVE - V

ENGINEERING ECONOMY

Course Code: 20AUT741A **Credits: 03**
L: T: P:S :3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the basic concept and terminology used in engineering economics
CO2	Evaluate Depreciation based on different economic methods
CO3	Evaluate the cost and breakeven analysis on one or more economic alternatives.
CO4	Acquire knowledge of book keeping, Journal, Ledger, Balance sheet and theory of interest
CO5	Prepare a cost estimate for automotive components.
CO6	Estimate overhaul and service cost

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	3	1	2	1	3	2	2	1	3
CO2	2	1	1	3	1	2	1	3	2	2	1	3
CO3	2	1	1	3	1	2	1	3	2	2	1	3
CO4	2	1	1	3	1	2	1	3	2	2	1	3
CO5	2	1	1	3	1	2	1	3	2	2	1	3
CO6	2	1	1	3	1	2	1	3	2	2	1	3

Module No.	Module Contents	Hrs	CO's
1	**Introduction:** Definition of various economic terms such as economicgoods, utility, value, price, wealth, Attributes of wealth and its classification, wants and their characteristics, Classification of wants, standard of living, rent and profit, Factors of Production: Land,LabourCapital,Organization. **Demand and Supply:** Law of diminishing utility, marginal and total utility,Demand, Demand Schedule, Law of demand, Elasticity of demand, Factors governing the elasticity of demand, Law of substitution and its application, Supply, Law of supply, supply schedule, elasticity of supply, theory of value, equilibrium price, Laws of returns. **Wages:** Nominal and real wages, Factors affecting real wages, Wages, efficiency and standard of living, theory of wages, difference in wages, methods of wage payment.	**9**	**CO1**
2	**Depreciation:** Need for depreciation, Causes of depreciation, Life and salvage value, Methods of calculating depreciation and their merits and demerits, Numerical problems	**9**	**CO2**

3	**Costs and Cost Accounting:** Standard cost, estimated cost, First cost, Fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Breakeven, EOQ and minimum cost analysis. Objectives of cost accounting, Elements of cost: material cost, labour cost, and expenses, total cost, allocation of overheads by different methods, Numerical problems	**9**	**CO3**
4	**Book Keeping and accounts:** Introduction, Necessity of book keeping, single entry and double entry system, Classification of assets, Journal, Ledger, Trial balance, Final accounts, trading, profit and loss account, Balance sheet, Numerical problems. **Interest:** Introduction, theory of interest, interest rate, interest rate from lender's and borrower's view point, simple and compound interest, Cash Flow Diagram, Interest formulas (discrete compounding, discrete payments), Nominal and effective interest rates, Numerical problems	**9**	**CO4**
5	**Cost Estimation:** Introduction, importance, objectives and functions of estimating, principle factors in estimating, Functions and qualities of an estimator, estimating procedure. Estimation of material cost and manufacturing cost of simple automotive components, Estimation of cost of overhauling and servicing of automotive components-cylinder, valves, valve seats, crankshaft, FIP, Brake drum, body building, different types of repairs, Numerical problems	**9**	**CO5, CO6**

Text Books:

1. Tara Chand, Nem Chand and Brothers*,"Engineering Economics",* Roorkee, 14th Edition, 2012

2. Thuesen, G. J. and Fabrycky, W. J*,"Engineering Economy",* Prentice Hall of India Pvt. Ltd, 5th Edition, 2009

Reference Books:

1. T. R. Banga and S. C. Sharma,"*Industrial Organization and Engineering Economics",* Khanna Publishers, New Delhi- 2015.

2. O. P. Khanna, *."A Text Book of Mechanical Estimating and Costing",* DhanpatRai Publications Pvt. Ltd., New Delhi-2013

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	**10**		
Understand	**5**	**5**	**5**

Apply	**5**	**5**	**5**
Analyse	**5**	**5**	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	10
Analyse	20
Evaluate	10
Create	

AIR CONDITIONING AND HEAT TRANSFER

Course Code: 20AUT 742A **Credits: 03**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Choose appropriate system ventilation, heating and air conditioning systems in automobiles
CO2	Select appropriate refrigerants for Air-conditioning systems in automobiles.
CO3	Select suitable temperature control systems for HVAC
CO4	Apply the convection and radiation heat transfer principles to practical problems.
CO5	Design appropriate control valves and switches for automotive air-conditioning system.
CO6	Understand basic concepts and Mechanism of heat transfer

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1							1		2
CO2	3	2	1							1		2
CO3	3	2	1							1		2
CO4	3	2	1							1		2
CO5	3	2	1							1		2
CO6	3	2	1							1		2

Module No.	Module Contents	Hrs	CO's
1	**INTRODUCTION** Need for air conditioner in vehicles, Sources of heat, HVAC system	**9**	**CO1, CO3**

	operation-ventilating the passenger compartment- solar powered ventilation, heating system-parts and operation, Refrigeration and coolingvapour compression refrigeration system, basic air conditioning system, location of air conditioning components in a car, compressor components, defrost, expansion valve system, fixed orifice system.		
2	**AIR-CONDITIONING COMPONENTS AND REFRIGERANTS** Compressor, condenser, receiver-drier/accumulator, expansion valve/fixed orifice valve, evaporator, antifrosting devices, Refrigerants-requirements, types, R-134a vs R-12	**9**	**CO2**
3	**CONTROL VALVES AND SWITCHES** Expansion - thermostatic expansion valve, fixed orifice tubes, electronic expansion valves, controlling evaporator temperature, evaporator pressure controls-types, Compressor clutch controls- pressure cycling switches, thermostatic temperature cycling switches, pressure and temperature sensors, System protection switches and valves-pressure cutoff, temperature cutoff, thermal limiters.	**9**	**CO5**
4	**CONDUCTION** Basic concepts - Mechanism of heat transfer - Conduction, convection and radiation - General differential equation of heat conduction - Fourier law of conduction - One dimensional steady state heat conduction Conduction through plane wall, cylinders and spherical systems - Composite systems - Heat transfer from finned surfaces -Fins of uniform cross section- Fin efficiency and effectiveness-Unsteady heat conduction- Lumped analysis - Use of Heislers chart.	**9**	**CO6**
5	**CONVECTION AND RADIATION** Basic concepts - Convective heat transfer coefficients - Boundary layer concept - Forced convection, dimensional analysis, external flow, flow over plates, cylinders and spheres - Internal flow, laminar and turbulent flow- Flow over bank of tubes - Free convection, dimensional analysis, flow over vertical plate and horizontal plate. Shape factor-Radiation shields -Gas radiation.	**9**	**CO4**

Text Books:

1. J. D. Halderman, Automotive Heating and Air Conditioning, NY:Pearson Education, 2014.
2. J.P. Holman, Heat transfer, New Delhi: Tata McGraw- Hill Publishing Company, 2008.

Reference Books:

1. M. Prasad, Refrigeration and Air Conditioning, New Delhi: New Age Publishers, 2009.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	**5**		
Understand	**10**		**5**
Apply	**5**	**7.5**	**5**
Analyse	**5**	**7.5**	
Evaluate	**5**		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	
Apply	**20**
Analyse	**20**
Evaluate	**10**
Create	

OPERATIONS RESEARCH

Course Code: 20AUT743A **Credits: 03**
L: T: P:S: 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the scope of OR, and Solve Linear Programming Problems
CO2	Solve the Transportation Problems and assignment Problems
CO3	Do sequencing of number of jobs and machines
CO4	Formulate the Games and Finding the value of the game using Graphical and Dominance rule
CO5	Analyse the real world problems and convert it as mathematical models.
CO6	Construct the Network to Find the Critical Path, Duration for the Project and Prediction of date of completion

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	2	2	2	-	1	-	1
CO2	3	3	3	2	-	2	2	2	-	1	-	1
CO3	3	3	3	-	-	-	-	2	-	1	-	1
CO4	3	3	3	-	-	-	-	2	-	1	-	1
CO5	3	3	3	-	-	-	-	2	-	1	-	1
CO6	3	3	3	-	-	-	-	2	-	1	1	1

Module No.	Module Contents	Hrs	CO's
1	**Introduction:** Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution **Linear Programming Problems:** The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method, degeneracy, and procedure for resolving degenerate cases.	**09**	**CO1, CO5**
2	**Transportation Problem:** Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems. **Assignment Problem:** Formulation, unbalanced assignment problem, traveling problem	**09**	**CO2**
3	**Sequencing:** Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs n machines without passing sequence. 2 jobs n machines with passing. Graphical solutions	**09**	**CO3**
4	**Game Theory:** Formulation of games, two person -Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance principle.	**09**	**CO4**
5	**PERT-CPM Techniques:** Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks.	**09**	**CO6**

Text Books:

1.Taha H. A. - Operations Research and Introduction, Macmillan edition
2. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd, 2nd Edition 2007.

Reference Books:

1. AM Natarajan, P.Balasubramani ,ATamilaravari "Operation research" Pearson 2005
2. Hiller and Lieberman, Introduction to operation research. Mc Grew Hill. 5th edition 2001.
3. S. D. Sharma – Operations Research KedarnathRamnath& Co 2002.
4.Dr.Phaneesh, "Operations Research"SudhaPublictions, 5th edition, 2014
5. Prem Kumar Gupta "Operations Research" S Chand, 7th edition, 2014

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand			5
Apply	10	7.5	5
Analyse	10	7.5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	
Apply	20
Analyse	20
Evaluate	10
Create	

INDUSTRIAL AUTOMATION AND ROBOTICS

Course Code: 20AUT744A **Credits: 3**
L: T: P:S: 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the concept of production system, automation, mathematical models in production, work part transfer mechanisms etc
CO2	Analyze the industrial control systems
CO3	Understand the concept of Group Technology and Flexible Manufacturing System, its implementation and applications in industries.
CO4	Understand the basic concepts and configurations of robots.
CO5	Identify the functions of different types of controllers and actuators
CO6	Apply the knowledge of robot programming

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	3	3	3	2	1			2
CO2	2	3	2	1	3	3	3	2	1			2
CO3	2	3	2	1	3	3	3	2	1			2
CO4	2	3	2	1	3	3	3	2	1			2
CO5	2	3	2	1	3	3	3	2	1			2
CO6	2	3	2	1	3	3	3	2	1			2

Module No.	Module Contents	Hrs	CO's
1	**Automation**: History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies. **Industrial Control System**: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.	**9**	**CO1** **CO2**
2	**Automated Manufacturing Systems**: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS. **Group Technology & Flexible Manufacturing Systems:** Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues. Automated inspection	**9**	**CO3**

3	**Robotics:** Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and grippers.	**9**	**CO4**
4	**Controllers and Actuators:** Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis. Robot actuation and feedback components: Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems.	**9**	**CO5**
5	**Robot kinematics and robot programming :** Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.	**9**	**CO6**

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing M.P. Groover, Pearson Education.5th edition, 2009
2. Principles of CIM, Vajpayee, PHI, 2015
3. Fundamental Concepts and Analysis, Ghosal A., Robotics, Oxford, 2006

Reference Books:

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
3. Robotics Technology and Flexible Automation Deb S.R., Tata McGraw Hill Book Co., 2013.
4. Industrial Robotics, Technology, Programming and Applications by M.P. Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	5		3
Understand	5	5	5

Apply	5	5	2
Analyse	5	5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	10
Analyse	10
Evaluate	10
Create	

VIII SEMESTER
SYLLABUS

PROFESSIONAL ELECTIVE - VI

SUPPLY CHAIN AND LOGISTICS MANAGEMENT

Course Code: 20AUT811A **Credits: 3**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the objectives and framework of supply chain management(SCM)
CO2	Design a supply chain and transportation network
CO3	Apply the knowledge of sourcing and pricing of infrasturcture
CO4	Analyze the coordination in supply chain network
CO5	Evaluate demand management and customer service
CO6	Identify the emerging trends and role of technology in SCM

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1	1	2	1			2
CO2	2	1	2	1	1	1	1	2	1			2
CO3	2	1	2	1	1	1	1	2	1			2
CO4	2	1	2	1	1	1	1	2	1			2
CO5	2	1	2	1	1	1	1	2	1			2
CO6	2	1	2	1	1	1	1	2	1			2

Module No.	Module Contents	Hrs	CO's
1	**Introduction to Supply Chain Management** : Supply chain – objectives, importance , decision phases process view, competitive and supply chain strategies achieving strategic fit supply chain drivers , obstacles, framework, facilities, inventory, transportation, information, sourcing, pricing- pricing, Key issues and benefits of SCM	**9**	**CO1**
2	**Designing the Supply Chain Network:** Designing the distribution network, role of distribution, factors influencing distribution, design options, distribution networks in practice, network design in the supply chain, factors affecting the network design decisions. **Designing and Planning Transportation Networks**, role of transportation, modes and their performance, transportation Infrastructure and policies, design options and their trade-offs, tailored transportation.	**9**	**CO2**
3	**Sourcing and Pricing of infrastructure**: Sourcing – In-house or Outsource – 3rd and 4th PLs – supplier scoring and assessment, selection – design collaboration – procurement process – sourcing	**9**	**CO3, CO6**

	planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts. **Technology in the supply chain**: IT Framework – customer relationship management – internal supply chain management – supplier relationship management –transaction management, RFID, EDI – future of IT.		
4	**Coordination in a Supply Chain:** Lack of supply chain coordination and the Bullwhip effect – obstacle to coordination – managerial levers – building partnerships and trust – continuous replenishment and vendor-managed inventories (VMI) – collaborative planning, forecasting and replenishment, Role of computer/ IT in supply chain management.	**9**	**CO4**
5	**Demand Management and Customer Service**: Logistics costs, Logistics activities and elements, Outbound to customer logistics systems – Demand Management – Traditional Forecasting – Collaborative Planning Forecasting Replenishment Planning (CPFRP) – customer service – expected cost of stock outs – channels of distribution. **Emerging Concepts**: Reverse Logistics, Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains.	**9**	**CO5** **CO6**

Text Books:

1. Supply chain management, Chopra Sunil and Peter Meindl - 3rd edition, Pearson, 2007.
2. Supply Chain Logistics Management, Donald J Bowersox, Dand J Closs, M Bixby Coluper, 2nd Edition, TMH, 2008.

Reference Books:

1. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems - Robert B Handfield, Ernest L Nichols, Jr. - Pearson Education Inc - ISBN: 81-297-0113-8. - 2002.
2. Modelling the Supply Chain -Jeremy F Shapiro, Duxbury - Thomson Learning – ISBN 0-534-37363. -2002.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	5		3
Understand	5	5	5
Apply	5	5	2
Analyse	5	5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	10
Analyse	10
Evaluate	10
Create	

PRODUCT LIFE CYCLE MANAGEMENT

Course Code: 20AUT 812 A **Credits: 03**
L: T: P:S : 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Analyse the various stages of PLM into engineering product ranges and portfolios that will evaluate into commercial success.
CO2	Evaluate data and information and/or communicate information to the supply chain and valuable supplier chain quotation to ensure sustainable solution.
CO3	Apply life cycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in engineering environment
CO4	Understand the legal, environmental and international regulatory frame works into product design, development and manufacturing requirements
CO5	Develop the system for corrective and preventive action to track production quality issues
CO6	Understand the preventive approaches concentrating on minimizing waste, hazard and risk associated with product design, development, manufacturing.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2				1	1		1		2
CO2	3	3	2				1	1		1		2
CO3	3	3	2				1	1		1		2
CO4	3	3	2				1	1		1		2
CO5	3	3	2				1	1		1		2
CO6	3	3	2				1	1		1		2

Module No.	Module Contents	Hrs	CO's
1	**Introduction to Product Life Cycle Management(PLM):** Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM,Opportunities and Benefits of PLM, Views, Components and Phases ofPLM, PLM feasibility Study, PLM Visioning.	**9**	**CO1**

2	**PLM Concepts, Processes and Workflow:** Characteristics of PLM, Environment Driving PLM, PLM Elements,Drivers of PLM, Conceptualization, Design, Development, Validation,Production, Support of PLM	**9**	**CO1, CO2**
3	**Collaborative Product Development:** Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Bill of Materials and Process Consistency, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral	**9**	**CO2, CO3**
4	**Digital Manufacturing – PLM:** Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.	**9**	**CO4, CO5**
5	**Developing a PLM Strategy and Conducting a PLM Assessment:** Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.	**9**	**CO5, CO6**

Text Books:

1. Product Lifecycle Management : Grieves, Michael, McGraw-Hil, Edition 2006.ISBN 0071452303

Reference Books:

1. Fabio Guidice, Guido La Rosa, **Product Design for the environment -A life cycle approach**, Taylor and Francis 2006

2. Stark, John, **"Product Life cycle Management: Paradigm for 21st Century Product Realization**", Springer-Verlag, 2004. ISBN 1852338105

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand	10	10	5
Apply	10	5	5
Analyse	5		
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)

Remember	
Understand	20
Apply	20
Analyse	10
Evaluate	
Create	

ADVANCED MANUFACTURING TECHNOLOGY

Course Code: 20AUT813A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Become conversant with the non- traditional machining process and to appreciate the effect of process parameters on the surface integrity aspects during the non- traditional machining process
CO2	Understand the powder metallurgy Process
CO3	Appreciate the use of an EDM,USM etc, as a non-traditional method of machining complex and hard materials
CO4	Appreciate the use of an LBM, AJM etc. as a non-traditional method of machining complex and hard materials
CO5	Understand the various forming Process
CO6	Understand the additive manufacturing process

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	1	1	2	1	1	1	2	1
CO2	3	1	1	2	1	1	2	1	1	1	2	1
CO3	3	1	1	2	1	1	2	1	1	1	2	1
CO4	3	1	1	2	1	1	2	1	1	1	2	1
CO5	3	1	1	2	1	1	2	1	1	1	2	1
CO6	3	1	1	2	1	1	2	1	1	1	2	1

Module No.	Module Contents	Hrs	CO's
1	**Introduction:** Need and comparison between traditional, nontraditional and micro & nano machining process. Powder Metallurgy: Need of P/M - Powder Production methods:- Atomization, electrolysıs, Reduction of oxides, Carbonyls (Process parameters, characteristics of powder produced in each method).	9	CO1, CO2

2	**Machining Processes –I** Electric Discharge Machining (EDM):- Mechanism of metal removal, dielectric fluid, spark generation, recast layer and attributes of process characteristics on MRR, accuracy, HAZ etc, Wire EDM, applications and accessories. Ultrasonic Machining (USM):-mechanics of cutting, effects of parameters on amplitude, frequency of vibration, grain diameter, slurry, tool material attributes and hardness of work material, applications Electro chemical machining (ECM):- Mechanism of metal removal attributes of process characteristics on MRR, accuracy, surface roughness etc, application and limitations.	9	CO3
3	**Machining Processes -II** Laser Beam Machining (LBM), Electron Beam Machining (EBM), Plasma arc Machining (PAM), Ion beam Machining(IBM) - Mechanism of metal removal, attributes of process characteristics on MRR, accuracy etc and structure of HAZ compared with conventional process; application, comparative study of advantages and limitations of each process. Abrasive Jet Machining (AJM), Abrasive Water Jet Machining (AWJM) - Working principle, Mechanism of metal removal, Influence of process parameters, Applications, Advantages & disadvantages	9	CO4
4	**High velocity forming of metals:-**effects of high speeds on the stress strain relationship steel, aluminum, Copper – comparison of conventional and high velocity forming methods- deformation velocity, material behavior, stain distribution. **Sheet metal forming:** - explosive forming:-process variable, properties of explosively formed parts, etc **Electro hydraulic forming:** - theory, process variables, etc, comparison with explosive forming.	9	CO5
5	**Micromachining:** Diamond turn mechanism, material removal mechanism, applications. Magneto rheological Abrasive Flow Finishing, Magnetic Float Polishing, Elastic Emission Machining. **Material addition process:-** stereo-lithography, selective laser sintering, 3D Printing, fused deposition modeling, laminated object manufacturing, , laser engineered net-shaping, laser welding, LIGA process.	9	CO6

Text Books:

1. Davies K and Austin E.R, Developments in high speed metal forming, the machinery publishing Co, 2170.

2. ASTME, High velocity forming of metals, PHI, 2168

Reference Books:

1. Jain V.K., Introduction to Micromachining, Narosa publishers,2014

2. M.P. Groover, E.M. Zimmers, Jr. CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall of India, 2187

3. Ibrahim Zeid, R Sivasubrahmanian CAD/CAM: Theory & Practice, McGraw Hill Education, 2009

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	**5**	**5**	
Understand	**10**	**5**	**10**
Apply	**5**	**5**	
Analyse	**5**		
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	**10**
Understand	**20**
Apply	**10**
Analyse	**10**
Evaluate	
Create	

VEHICLE MAINTENANCE

Course Code: 20AUT814A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the concept of maintenance, practices in workshop and tools used
CO2	Identify the Engine repairing and components
CO3	Explain the various auxiliary system maintenance
CO4	Describe the transmission and driveline maintenance
CO5	Understand Steering, Brake, Suspension, Wheel Maintenance
CO6	Describe the Auto Electrical And Air Conditioning Maintenance

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2			1	1	1	2	1
CO2	2	3	3	3	2			1	1	1	2	1
CO3	2	3	3	3	2			1	1	1	2	1
CO4	2	3	3	3	3			1	1	1	2	1
CO5	2	3	3	3	3			1	1	1	2	1
CO6	3	3	3	3	2			1	1	1	2	1

Module No.	Module Contents	Hrs	CO's
1	**Maintenance, Workshop Practices, Safety And Tools:** Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.	9	CO1
2	**Engine And Engine Subsystem Maintenance:** General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls	9	CO2, CO3
3	**Transmission And Driveline Maintenance**: Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings servicing differential assemblies- fault diagnosis.	9	CO4
4	**Steering, Brake, Suspension, Wheel Maintenance:** Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system	9	CO5
5	**Auto Electrical And Air Conditioning Maintenance:** Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.	9	CO6

Text Books:

1. Ed May, "Automotive Mechanics Volume One and Two" , Mc Graw Hill Publications, 2003

2. Vehicle Service Manuals of reputed manufacturers

Reference Books:

1. Bosch Automotive Handbook, Sixth Edition, 2004

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	05		02
Understand	10	05	02
Apply	05	05	03
Analyse	05	05	03
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	15
Apply	10
Analyse	15
Evaluate	
Create	

PROFESSIONAL ELECTIVE - VII

MOTORSPORT TECHNOLOGY

Course Code: 20AUT821A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Analyse the racing vehicle characteristics
CO2	Apply the aerodynamics in racing vehicles
CO3	Explain the concept of chassis behavior of racing vehicles
CO4	Analyse the suspension characteristics of racing vehicles
CO5	Analyse the problems faced in drives in motor sports
CO6	Analyse the problems faced in braking systems in motor sports

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	1	3	1	1	2	2	1
CO2	3	3	3	3	1	1	3	1	1	2	2	1
CO3	3	3	3	3	1	1	3	1	1	2	2	1
CO4	3	3	3	3	1	1	3	1	1	2	2	1
CO5	3	3	3	3	1	1	3	1	1	2	2	1
CO6	3	3	3	3	1	1	3	1	1	2	2	1

Module No.	Module Contents	Hrs	CO's
1	**Race car design and development:** Problems Imposed By Racing, Racing Objective, ''g-g'' Diagram. Constraints And Specifications-Performance, Handling, Structure. Driver Accommodation And Safety, Tires. Adjustable Features, Preliminary Design And Analysis. Driver-Vehicle Relationship. Desirable Vehicle Characteristics, Fundamentals Of Testing. Track Test Program Planning And Test Methodology. General Notes On Development-Circular Skid Pad Testing.	9	CO1
2	**Race car aerodynamics:** Aerodynamic Force And Moment, Race Car Drag Components, Drag Improvement And Estimation. Ground Effects And Ground-Plane Simulation In Race Car Applications. Spoilers, Dams, Wings Effectiveness Of Wings In Steady State Cornering. High Lift Devices-Flaps And Slats. Flow Control Devices Dams, Fences, Vanes, Skirts, Spoilers. Vortex Creating Devices- Ledges, Edges, Cusps, Lips. Pressure Change Creation Devices- Perforations, Vents, Bleeds, Scoops, Seals. Air-Foil Devices- Slats, Flaps, End Plates, Cuffs, Fillets, Trips. Active Flow Control Devices- Internal Airflow, RAM Air Ducted	9	CO2

	Radiator, Air Entrance Scoop.		
3	**Race car chassis:** Conditions For Traversing a 90° Corner, Principle Chassis Tuning Items. Effects of High Speed Braking, Cornering, Combined Braking Cornering. Steady State Cornering, Acceleration out of a Corner, Straight Line Acceleration. Throttle Behaviour, Steering Wheel Force And Kick Back. Moving CG Position, Roll Center Position Changing AntiPitch Geometry. Chassis Steering Axis Geometry, Changing Camber. Chassis Ride Roll Characteristics, Chassis Track Width. Chassis Ride Spring Rate, Tires And Rims, Adjusting Roll Stiffness And Roll Stiffness Distribution.	9	CO3
4	**Race car suspension system:** Front Suspension- General Design Issues, Camber Effects. SLA Suspension, McPherson Struts. Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept. SLA Rear Suspension, Beam Axle Rear Suspensions. Torque Tube And Torque Arm Suspension, Decoupled Rear Axle Suspension. Suspension Springs- Torsion Springs, Coil Springs, Progressive Rate Coil Springs. Leaf Springs, Types, Installation Consideration, Inter Leaf Friction, Spring Fatigue. Damping In Racing- Ride/Handling Compromise, Steering Activity, And Transient Maneuvering, Bump Damping And Rebound Damping.	9	CO4
5	**Race cardrives and braking systems:** Merits Of Front, Rear And Four-Wheel Drive In Racing. Differentials Used In Racing- Open Differentials, Locked (Spool), Limited Slip Differentials. Traction Control And Other Electronic Improvements In Racing. Mechanical Components In Braking System. Limitations And Considerations Of Braking In Racing. Brake Boost, Effects Of ''g'' Force On Brake Fluids. Brake Hydraulics, Ventilation. Brake Distribution, ABS In Racing. Carbon-Carbon discs.	9	CO5 CO6

Text Books:

1. William F.Milliken and Douglas L.Milliken, Race car vehicle dynamics, 11th edition,
2. Thomas D. Gillespie, Fundamental of Vehicle Dynamics, Society of Automotive Engineers, USA, 2194.

Reference Books:

1. Peter Wright, Formula 1 Technology, 2001.
2. Wolf-Heinrich Hucho, Aerodynamics of road vehicles, 4th edition, 2000.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand	5		5
Apply	10	5	5
Analyse	10	10	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	15
Analyse	25
Evaluate	
Create	

AUTOMOTIVE TESTING AND CERTIFICATION

Course Code: 20AUT822 A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Classify the vehicle and identify the regulations governing for each vehicle type
CO2	Understand the various tests to be performed on the subsystems of a vehicle
CO3	Analyze the performance characteristics of the emission subsystems of a vehicle
CO4	Analyze the performance characteristics of the safety subsystems of a vehicle
CO5	Analyze the braking, wheels, tires and windshield characteristics of a vehicle
CO6	Analyze the characteristics of the lighting systems of a vehicle

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	1	3	1	1	2	2	1
CO2	3	3	3	3	1	1	3	1	1	2	2	1
CO3	3	3	3	3	1	1	3	1	1	2	2	1
CO4	3	3	3	3	1	1	3	1	1	2	2	1
CO5	3	3	3	3	1	1	3	1	1	2	2	1
CO6	3	3	3	3	1	1	3	1	1	2	2	1

Module No.	Module Contents	Hrs	CO's
1	**Regulations:** Specification & Classification of Vehicles (including M, N and O layout), Regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle Specifications, Two Wheeler certification	9	CO1
2	**Vehicle testing:** Vehicle Testing - Photographs, CMVR physical verification, Vehicle weightment, Coast down test, Brake test, ABS, Turning circle diameter test, Steering effort test, Speedometer calibration, Pass by noise test, External projection test, Gradability test, Acceleration control system, Horn installation, Rear view mirror installation, Installation requirement for lighting & signaling devices, Wind screen wiping system	9	CO2
3	**Emission testing:** Steering Impact test (GVW<1500 kg), Body block test, Head form test, Fixtures charges, Crash test with dummies, OBD I/ii, Bumper testing, Documentation SHL, Certification charges, Engine power test(petrol & diesel), Indian driving cycle, Vehicle mass emission, Evaporative emission (petrol vehicles), Broad band / Narrow band EMI test.	9	CO3
4	**Auxiliary systems testing:** Size and Ply rating of tyres, Safety Glasses: Windscreen laminated safety glass, Side window / door glass, Back light / Rear toughened glass, Wind screen wiping system, Wiper Blade, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention	9	CO4 CO5
5	**Head, tail and side lamp testing:** Performance requirement for lighting & signaling devices - Vertical orientation of dipped beam- head lamp, driveR"s field of vision, Head lamp assembly (glass lens & plastic lens), Head lamp + Front position lamp / Front indicator lamp / front fog lamp, Rear combinational lamp (each additional function), Independent front position lamp / Front direction indicator lamp / Front fog lamp, Rear combination lamp (single function), Warning triangles, Fuel tank: Metallic & Plastic (excluding fire resistance test).	9	CO6

Text Books:

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

Reference Books:

1. SAE Hand book, Vol. 3, SAE Publications, 2000.
2. Jain R K. "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 2199.
3. Tim Gilles, "Automotive Service"‟ Delmar Publishers, 2198.
4. Beckwith TG. and Buck N L., "Mechanical Measurements", Addition Wesley Publishing Company Limited, 2195.

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand	5		5
Apply	10	5	5
Analyse	10	10	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	15
Analyse	25
Evaluate	
Create	

ADVANCED VEHICLE TECHNOLOGY

Course Code: 20AUT823A **Credits: 03**
L: T: P:S 3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Explain the various trends in automotive power plants
CO2	Understand about various modern suspension and braking systems.
CO3	Compare various emissions and noise pollution techniques
CO4	Select the suitable modern sensors, actuators for various application in automobiles
CO5	Compare various ignition and injection systems
CO6	Analyse the feasibility of automated tracks for safe and fast travel

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	1	3	1	1	2	2	1
CO2	3	3	3	3	1	1	3	1	1	2	2	1
CO3	3	3	3	3	1	1	3	1	1	2	2	1
CO4	3	3	3	3	1	1	3	1	1	2	2	1
CO5	3	3	3	3	1	1	3	1	1	2	2	1
CO6	3	3	3	3	1	1	3	1	1	2	2	1

Module No.	Module Contents	Hrs	CO's
1	**Trends in automotive power plants:** Hybrid Vehicles-Stratified Charged / Lean Burn Engines, Hydrogen Engines. Battery Vehicles-Electric Propulsion With Cables. Magnetic Track Vehicles.	9	CO1
2	**Suspension brakes and safety:** Interconnected Air And Liquid Suspensions. Hydro Elastic Suspension System, Hydro Gas Suspension, Closed Loop Suspension, Modern Rear Wheel Brake, Indirect Floating Caliper Disc Brake, Self Energizing Disc Brake, Brake Limiting Device, Anti-Skid System, Regenerative Braking, Passenger Comfort.	9	CO2
3	**Emission and noise pollution control:** Engine Emissions, Types of Catalytic Conversion. Open Loop and Closed Loop Operation to the Oxidizing Catalytic Converter. Evaporative Emissions, Internal And External Noise, Identification of Noise Sources, Noise Control Techniques	9	CO3
4	**Vehicle operation and control:** Fundamentals of Automotive Electronics - sensors, Actuators, Processors. Computer Control for pollution, noise and for fuel economy, Electronic Fuel Injection, Electronic Ignition system, Transducers and Operation of The Vehicle Like Optimum Speed and Direction.	9	CO4 CO5
5	**Vehicle automated tracks:** Preparation And Maintenance of Proper Road Network. National Highway Network With Automated Roads And Vehicles. Satellite Control of Vehicle Operation For Safe And Fast Traveltest).	9	CO6

Text Books:

1. Crouse W.H.and Anglin D.L., "Automotive Mechanics"‟ Tata McGraw Hill Publishing Company, 2004.
2. Dr. N.K. Giri, Automobile Mechanic, Khanna Publishers, 2006.
3. Heinz Heisler, Advanced vehicle technology, elsevier Store.2002.

Reference Books:

1. SAE Hand book, Vol. 3, SAE Publications, 2000.
2. T. K. Garrett, The Motor Vechicle, 13th edition 2009.

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Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember			
Understand	5		5
Apply	10	5	5
Analyse	10	10	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	15
Analyse	25
Evaluate	
Create	

VEHICLE BODY ENGINEERING AND SAFETY

Course Code: 20AUT824A **Credits: 03**
L: T: P:S :3:0:0:0 **CIE Marks: 50**
Exam Hours: 03 Hours **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Explain the different types of construction of vehicle body of cars, buses, commercial vehicles.
CO2	Describe the various materials used for the construction of vehicle bodies.
CO3	Analyse the various forces and moments acting on the vehicle body.
CO4	Discuss the interior ergonomics of various vehicle body types.
CO5	Describe the driver's visibility, methods of improving visibility and various seating dimensions.
CO6	Understand the safety features to be included during the construction of vehicle.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	1	-	-	3	-	1
CO2	3	-	-	-	-	1	2	-	-	1	-	1
CO3	3	2	1	-	1	2	2	3	1	2	-	1
CO4	3	2	2	-	-	3	1	-	1	2	-	1

CO5	3	-	1	-	-	1	1	3	1	1	-	1
CO6	3	-	2	-	-	2	3	3	2	3	-	1

Module No.	Module Contents	Hrs	CO's
1	**Introduction:** Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pickups.	**09**	**CO1**
2	**Vehicle Body Materials:** Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.	**09**	**CO2**
3	**Aerodynamics:** Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.	**09**	**CO3**
4	**Interior Ergonomics**: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.	**09**	**CO4, CO5**
5	**Safety:** Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.	**09**	**CO6**

Text Books:

1. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 2156
2. "Giles J Pawlowski", Vehicle body engineering Business books limited, 2189
3. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.

Reference Books:

1. Hand book on vehicle body design – SAE publication
2. Automotive chassis by P.M. Heldt, Chilton & Co, 2170
3. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.
4. Redesign of bus bodies – part I & part II – CIRT pune (Report), 2183
5. Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 2187
6. Scibor-Rylski A.J, Road Vehicle Aerodynamics, Pentech press, London 2nd Edition 2184
7. Rae W.H & Pope A, Low Speed Wind Tunnel Testing Wiley & Sons, USA 2184 out of print

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**25**	**15**	**10**
Remember	5		5
Understand	10	5	5
Apply	5		
Analyse	5	5	
Evaluate			
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	20
Apply	10
Analyse	10
Evaluate	
Create	