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 2022-23

AU – Automobile Engineering

Fifth and Sixth Semester

Scheme and Syllabus

New Horizon College of Engineering
Department of Automobile Engineering
Fifth Semester B.E AY: 2022-2023

Sl.No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20AUT51	Theory of Machines	AU	3	1	0	0	4	5	50	50	100
2	20AUT52	Design of Automotive Engine Components	AU	2	1	0	0	3	4	50	50	100
3	20AUT53	Automotive Engines and Auxiliary Systems	AU	3	0	0	0	3	3	50	50	100
4	20AUT54	Automotive Electrical and Electronic systems	AU	3	0	0	0	3	3	50	50	100
5	20AUT55	Programming, Data Structures and Algorithms using Python	AU	2	0	0	0	2	2	25	25	50
6	20AUT56*	Professional Elective-I	AU	3	0	0	0	3	3	50	50	100
7	20AUL57	Automobile Lab - I	AU	0	0	1.5	0	1.5	3	25	25	50
8	20AUL58	Automotive Electrical and Electronics lab	AU	0	0	1.5	0	1.5	3	25	25	50
9	20AUT59	Mini Project-II	AU	-		2	0	2	4	25	25	50
Total								**23**	**30**	**350**	**350**	**700**

Professional Elective-I	
Course Code	**Course**
20AUT561	Total Quality Management
20AUT562	Vehicle Transport Management
20AUT563	Project Management
20AUT564	Statistical Quality Control

New Horizon College of Engineering

Department of Automobile Engineering

Sixth Semester B.E Program-Scheme AY: 2022-2023

Sl. No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20AUT61	Design of Machine Elements	AU	2	1	0	0	3	4	50	50	100
2	20AUT62	Finite Element Method	AU	2	1	0	0	3	4	50	50	100
3	20AUT63	Automotive Chassis	AU	3	0	0	0	3	3	50	50	100
4	20AUT64x	Professional Elective-II	AU	3	0	0	0	3	3	50	50	100
5	20AUT65x	Professional Elective-III	AU	3	0	0	0	3	3	50	50	100
6	20NHOPxx	Open Elective-I		3	0	0	0	3	3	50	50	100
7	20AUL66	Automobile Lab - II	AU	0	0	1.5	0	1.5	3	25	25	50
8	20AUL67	Computer Aided Modelling & Analysis Lab	AU	0	0	1.5	0	1.5	3	25	25	50
9	20AUT68	Mini Project-III	AU	-	2		0	2	4	25	25	50
Total								**23**	**30**	**375**	**375**	**750**

Professional Elective-II	
Course Code	**Course**
20AUT641	Non Destructive Testing
20AUT642	Composite Materials
20AUT643	Two and Three Wheeled Vehicles
20AUT644	Noise, Vibration and Harshness Control

Professional Elective-III	
Course Code	**Course**
20AUT651	Automotive Emissions and control
20AUT652	Nanotechnology
20AUT653	Earth Moving Equipments
20AUT654	Alternative fuels and Energy system

Open Elective-I	
Course Code	**Course**
20NHOP01	Big Data Analytics using HP Vertica-1
20NHOP02	VM Ware Virtualization Essentials-1
20NHOP04	Big Data Analytics using HP Vertica-2
NHOP05	VM Ware Virtualization Essentials-2
20NHOP07	SAP
20NHOP08	Schneider-Industrial Automation
20NHOP09	CISCO-Routing and Switching-1
NHOP10	Data Analytics
NHOP11	Machine learning
NHOP12	CISCO-Routing and switching - 2
NHOP13	IIOT – Embedded System
NHOP14	Block Chain
NHOP15	Product Life Cycle Management
20NHOP17A	Network security and cryptography
20NHOP18A	Physical Design
20NHOP19A	AI Data Analysis with python

FIFTH SEMESTER
(SYLLABUS)

THEORY OF MACHINES

Course Code : 20AUT51 **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	Understand the fundamentals of kinematics, primary and secondary mechanisms.
CO2	Analyse the velocity and acceleration of four bar chain and single slider crank mechanisms.
CO3	Analyse the cam profile for various displacements.
CO4	Evaluate spur gear profiles and various parameters of gear teeth. Determine the velocity ratios of simple, compound, epicyclic gear trains.
CO5	Understand the stability of an automobile using Gyroscope, various types of governors and to understand method of finding.
CO6	Determine the balancing of several rotating and reciprocating masses.

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	2	1	1	1	3	1
CO2	3	3	3	3	2	1	2	1	1	1	2	1
CO3	3	3	3	3	2	1	2	1	1	1	2	1
CO4	3	3	3	2	2	1	2	1	1	1	2	1
CO5	3	3	3	3	3	2	3	1	1	1	3	1
CO6	3	3	3	3	2	1	2	1	1	1	3	1

Module No.	Module Contents	Hrs	COs
1	**Introduction:** Mechanism and machines, kinematics links, kinematic pairs, kinematic chains, degrees of freedom, Grubler's criterion Inversions of Four bar chain; Single slider crank chain and Double slider crank chain, Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism, straight line motion mechanisms, Intermittent Motion mechanisms- Ratchet and Pawl mechanism, pantograph.	**9**	**CO1**
2	**Velocity and acceleration analysis of mechanisms:** Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles in a common link, relative velocity andaccelerations of coincident Particles on separate links **Cams:** Types of cams, Types of followers. Displacementcurves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller, Disc cam with oscillating roller follower. Follower	**9**	**CO2, CO3**

	motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.		
3	**Spur Gears:** Types of gears,Law of gearing, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding interference, Back lash, Comparison of involute and cycloidal teeth. **Gear Trains:** Simple gear trains, Compound gear trains for large speed reduction, Epicyclic gear trains tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains	**9**	**CO2**
4	**Gyroscope:** Vectorial representation of angular motion, gyroscopic couple. stability of a two wheeler and four wheeler taking a turn **Governors:** Introduction, Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, condition for stability, sensitiveness, iso-chronisms, hunting, effort and power of governor	**9**	**CO5**
5	**Balancing Of Rotating Masses:** Static and dynamic balancing, Balancing of single rotating and many rotating masses by another mass in one plane. Balancing of several rotating masses by balancing masses in different plane. **Balancing of reciprocating masses:** Introduction, primary balancing, secondary balancing, balancing of single cylinder engine, balancing of multi cylinder-inline engine, balancing of radial engines, balancing of V - engines.	**9**	**CO6**

Text Books:

1. Theory of Machines by "*Rattan S.S. Tata McGraw Hill Publishing Company Ltd*"., New Delhi, 4th Edition, 2014, **ISBN: 9789351343479**
2. Theory of Machines by "*V.P. Singh*", DhanpatRai& Co., 4th Edition, 2014, **ISBN: 9788177000665**
3. Theory of Machines by "*Sadhu Singh*", Pearson Publications, 2nd Edition, 2012, **ISBN: 9788177581270**

Reference Books:

1. Theory of Machines by "*R.S.Khurmi and J.K.Gupta*", S.Chand and Co., 33rd Edition, 2014, **ISBN: 9788121925242**
2. Theory of Machines by "*P.L. Ballaney*", Khanna Publishers,26th Edition, 2011,**ISBN: 9788174091222**
3. Theory of Machines by "*Dr. J.S. Brar and Dr. R.K. Bansal*", Laxmi Publications, 4th Edition, **ISBN: 9788131808054**

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		02
Apply	05	05	02
Analyse	05	05	02
Evaluate	05	05	02
Create			

SEE – Semester End Examination (50 Marks - Theory)

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

DESIGN OF AUTOMOTIVE ENGINE COMPONENTS

Course Code: 20AUT52 **Credits : 03**
L: T: P:S : 2:1:0:0 **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	Design cylinder block and cylinder head parts based on the engine specification.
CO2	Identify different piston failures and design piston, piston pin based on the engine specification.
CO3	Design connecting rod based on the engine specification.
CO4	Design crankshaft based on the engine specification.
CO5	Design clutch based on the engine specification.

CO6	Design valve mechanism based on the engine specification.

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	COs
1	**Design of Cylinder heads & Cylinder Block:** Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, Production of engine block, Design- Bore and length of cylinder, Thickness of cylinder wall, Stresses in cylinder wall, Thickness of cylinder head, Studs for cylinder head.	**9**	**CO1**
2	**Design of Piston:** Parts of IC engine piston, Piston materials, Piston slap, Compensation of thermal expansion in pistons, Piston Rings. Piston pin, locking of piston pins. Design- Thickness of piston head by strength basis and heat basis. Piston ribs and caps, piston rings groove width and thickness, piston pin, piston barrel and skirt.	**9**	**CO2**
3	**Design of Connecting rod:** Connecting rod materials, Cross section, Buckling, Drilled connecting rods, offset connecting rods, effects of whipping. Design- determining minimum length of connecting rod, small end and big end design, shank design, big end cap bolts.	**9**	**CO3**
4	**Design of Crankshaft:** Types of crankshaft, Balancing of I.C. Engines, significance of firing order, Material for crankshaft, Design- Crankshaft under bending and twisting, Balancing weight calculations. **Design of clutch:** Clutches, torque transmitting capacity, multi disk clutches, friction materials, cone clutches. Design problems	**9**	**CO4** **CO5**
5	**Design of Valves:** Number of valves per cylinder, operating temperatures, valve cooling, sodium cooled valves, valve rotators, valve seats, valve guides, valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Design- valve, rocker arm valve spring and push rod.	**9**	**CO6**

Text Books:

1. V.B. Bhandari, "Design of Machine elements", Tata McGraw Hill, 4th Edition, 2016.
2. R.S. Kurmi, J.K. Gupta, "A textbook of Machine Design", Eurasia Publishing House (Pvt.) Ltd., Updated edition, 2015.

3. J.B. Heywood, “Fundamentals of I.C Engines”, McGraw Hill, International Edition. 2011

Reference Books:

1. V.B. Bhandari, “Machine Design Data Book”, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. Giri. N.K, "Automobile Mechanics", Khanna Publishers, New Delhi, 2007.
3. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, Tata McGraw - Hill Publishing Company Pvt. Ltd., New Delhi, 2017.

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 ENGINES AND AUXILIARY SYSTEMS

Course Code : 20AUT53 **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 working of four stroke and two stroke engines.
CO2	Identify the properties of air- petrol mixture, mixture requirement
CO3	Explain various types of diesel injectors
CO4	Describe about the types of cooling and lubrication system, properties of lubricants, compare between water cooling and air cooling
CO5	Understand about air filters, fuel filters, exhaust muffler and manifold
CO6	Describe the super charger and turbocharger

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	COs
1	**Introduction:** Historical development of automobiles, Engine classification, Constructional details of four stroke spark ignition (SI) and compression ignition (CI) engines, Working principles. Comparison of SI and CI engines, theoretical and actual valve timing diagrams for engines, Comparison of Two Stroke & Four Stroke Engines. **Two stroke engines:** Principles of engine operation (SI & CI), Port timing diagrams. Scavenging systems, Theoretical Scavenging processes, Scavenging parameters, Scavenging pumps.	**9**	**CO1**

2	**Fuel System:** Air-fuel ratio requirements of SI engines, SI engine fuel systems, Simple and Solex Carburetors, Gasoline fuel injection systems- Multi Point Fuel Injection (MPFI), throttle body injection, Electronic fuel injection- Gasoline Direct Injection System (GDI) CI engine fuel injection systems- unit injector and Common Rail Direct Injection (CRDI) systems, inline plunger injection pump, distributor pump, Injection nozzles-types, Mechanical governor for fuel injection pumps.	**9**	**CO2, CO3**
3	**Cooling System:** Need for cooling, Effects of over cooling, variation of gas temperature, areas of heat flow, piston and cylinder temperature, Heat rejected to coolant, air and liquid cooling systems- thermo siphon, forced circulation and pressure cooling systems, components liquid cooling system, Requirements of coolants anti freezing agents, radiators – types **Lubrication System:** Requirements of lubrication system, Types- mist, pressure feed, dry and wet sump systems, oil filters, pumps, and crankcase ventilation – types.	**9**	**CO4**
4	**Intake And Exhaust Systems:** Intake system components - Air filter, intake manifold, Exhaust system components – Exhaust manifold and exhaust pipe - Spark arresters - Exhaust mufflers, Types, operation. Catalytic converter, Exhaust Gas Recirculation (EGR), NoX treatment	**9**	**CO5**
5	**Supercharging and Turbo charging:** 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.	**9**	**CO6**

Text Books:

1. Ganesan V, "*Internal combustion engines"*, 4th edition, Tata McGraw Hill Education, 2012. **ISBN: 1259006190**
2. Rajput R. K, *"A textbook of Internal Combustion Engines"*, 2nd edition, Laxmi Publications (P) Ltd.
3. Mathur,M.L., and Sharma,R.P., "*A Course in Internal Combustion Engines*", DhanpatRai Publications (P) Ltd.25th Edition, 2014 **ISBN: 9788189928469**

Reference Books:

1. Ramalingam K. K, *"Internal Combustion Engine"*, Scitech Publication (India) Pvt.Ltd. 2011. **ISBN: 9788188429486**
2. Duffy Smith, *"Auto Fuel Systems"*, The Good Heart Willcox Company Inc., Publishers, 1987.
3. Crouse W.H, Anglin D.L, *"Automotive Transmission and Power Trains construction",* McGraw Hill, 10th Edition, 2008, **ISBN: 9780070634350**

4. Dr.Kirpal Singh. "*Automobile Engineering Vol-2*" Standard Publications, 13th Edition, 2013, **ISBN: 9788180141966**

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 ELECTRICAL AND ELECTRONICS SYSTEMS

Course Code : 20AUT54 **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	Select the appropriate Battery from different types of Battery used in automobiles.
CO2	Analyse the Starting and Charging System with their performance used in automobiles.
CO3	Explain electrical systems and lighting accessories used in automotive vehicles.
CO4	Analyse the Ignition System with their performance parameter used in automobiles.

CO5	Choose appropriate automotive Sensors for modern automobile.
CO6	Know the safety features in vehicles.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**BATTERIES AND STARTING SYSTEM:** Different types of Batteries – principle, rating, testing and charging. Starter motors characteristics, capacity requirements. Drive mechanisms. Starter switches **CHARGING SYSTEM:** DC Generators and Alternators their characteristics. Control unit – cut out, electronic regulators.	**9**	**CO1, CO2**
2	**LIGHTING SYSTEM**: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods, anti-dazzling and dipper details, Smart lighting system, Dashboard instruments. Selection of Fuses, cables, connectors; multiplexing and de-multiplexing. Automotive wiring system	**9**	**CO3**
3	**IGNITION SYSTEM:** Introduction - Construction and working of magneto coil and battery coil ignition systems, spark plug types, spark advance mechanisms, electronic ignition systems - Transistorized ignition system, solid state ignition systems, capacitor discharge ignition system and distributor less ignition system.	**9**	**CO4**
4	**SENSORS:** Microprocessor architecture, open and closed loop control strategies, Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, fuel level, exhaust oxygen level, knock, engine temperature, manifold temperature and pressure sensors. Infrared sensors, Ultra sonic sensors, LIDAR, RADAR, voltage sensor	**9**	**CO5**
5	**SAFETY SYSTEMS**: ABS system-layout and working. Electronic control of suspension, Electric power steering, Supplementary Restraint System of air bag system-crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.	**9**	**CO6**

Text Books:

1. Judge. A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992
2. Tom Denton , “Automobile Electrical and Electronic systems” SAE publication,2000

Reference Books:

1. Young.A.P., &Griffiths.L., "Automobile Electrical Equipment", English Language Book Society & New Press, 1990
2. Robert Bosch, “Automotive Hand Book” SAE, 2000.
3. W. Bolton, “Mechatronics”, Longman, 2Ed, Pearson publications, 2007

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	10
Understand	10
Apply	20
Analyse	10
Evaluate	
Create	

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

Course Code : 20AUT55 **Credits : 02**
L: T: P:S : 2:0:0:0 **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	Know the basics of algorithmic problem solving.
CO2	Read and write simple Python programs.
CO3	Develop Python programs with conditionals and loops.
CO4	Define Python functions and call them.
CO5	Use Python data structures –- lists, tuples, dictionaries
CO6	Do input/output with files in Python.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**ALGORITHMIC PROBLEM SOLVING:** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	**7**	**CO1**
2	**DATA, EXPRESSIONS, STATEMENTS:** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	**7**	**CO2, CO4**
3	**CONTROL FLOW, FUNCTIONS:** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search	**7**	**CO3**

4	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.	**7**	**CO5**
5	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.	**7**	**CO6**

Text Books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2 nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books:

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (25 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (Out of 50)	**15**	**5**	**5**
Remember			
Understand	5		2.5
Apply	5	2.5	2.5
Analyse	5	2.5	
Evaluate			
Create			

SEE – Semester End Examination (25 Marks - Theory)

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

PROFESSIONAL ELECTIVE-I

TOTAL QUALITY MANAGEMENT

Course Code : 20AUT561 **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	Acquire the knowledge of basic concepts of TQM.
CO2	Describe the importance of TQM principles.
CO3	Gain the knowledge of TQM tools and Techniques.
CO4	Describe the concepts of Taguchi techniques.
CO5	Acquire the knowledge of Quality Management System.
CO6	Gain the knowledge of Environmental Management System.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction:** Introduction, Need for quality, Evolution of quality, Definition of quality, Dimensions of product and service quality, Definition of TQM, Basic concepts of TQM, Gurus of TQM (Brief introduction), TQM Framework Barriers to TQM, Benefits of TQM.	**9**	**CO1**
2	**TQM Principles:** Leadership, Characteristics of quality leaders, The Deming Philosophy, Quality council, Quality statements and Strategic planning, Customer Satisfaction, Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention, Employee involvement, Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal, Continuous process improvement, Juran Trilogy, PDSA cycle, 5s and Kaizen.	**9**	**CO2**
3	**TQM Tools & Techniques-I:** The seven traditional tools of quality, New management tool, Six-sigma Process Capability, Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning.	**9**	**CO3**
4	**TQM Tools & Techniques-II:** Quality circles, Quality Function Deployment (QFD), Taguchi quality loss function, TPM – Concepts,	**9**	**CO4**

	improvement needs, Performance measures, Cost of Quality, BPR.		
5	**Quality Management System**: Introduction, Benefits of ISO Registration, ISO 9000 Series of Standard, Sector-Specific Standards—AS 9100, TS16949 and TL 9000, ISO 9001 Requirements, Implementation, Documentation, Internal Audits, Registration. Environmental Management System: Introduction, ISO 14000 Series Standards, Concepts of ISO 14001, Requirements of ISO 14001, Benefits of EMS.	**9**	**CO5 CO6**

Text Books:

1. DaleH.Besterfiled,CarolB.Michna,GlenH.Besterfield,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management",PearsonEducation Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
2. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006

Reference Books:

1. R. Evans and William M. Lindsay, "The Management and Control of Quality", South Western (Thomson Learning) (6th Edition),2005.
2. Oakland, J.S."TQM – Text with Cases",Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Janakiraman,B and Gopal, R.K,"Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

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	5	5	
Apply	10	5	10
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 TRANSPORT MANAGEMENT

Course Code: 20AUT562 **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	Acquire the knowledge of basic concepts of Vehicle Transport Management
CO2	Describe the importance of organization and management of transport
CO3	Gain the knowledge of route planning
CO4	Describe the concepts fare collections and fare structure
CO5	Acquire the knowledge of public relation division
CO6	Describe the importance of prevention of accidents

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction:** Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988. **The Infrastructure:** Road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, ,location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.	**9**	**CO1**
2	**Organization and Management:** Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering departments, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.	**9**	**CO2**

3	**Route planning:** Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency Timing, Bus working and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements	**9**	**CO3**
4	**Fare collections & Fare structure:** Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bellgraphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter, one-man operation, two stream boarding, pre paid tickets, lensonparason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control. Fare structure: Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges. Case study on shared mobility like Ola, Uber, BlaBla Car etc.	**9**	**CO4**
5	**Public relations divisions:** Dissemination of information, maintaining goodwill- handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles- facilities for visitors- forms of publicity – importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity. **Prevention of accidents:** Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.	**9**	**CO5, CO6**

Text Books:

1. L.D.Kitchen, Iliffe&Sons,*"Bus operation"*, London
2. Rex W. Faulks,"Bus & coach operation Butterworth",Version Of 1987, London

Reference Books:

1. "*Compendium of transport terms"* - Cirt,Pune
2. *"M.V. Act 1988"* - Central Law Agency, Allahabad
3. "*The elements of transportation"* - R.J. Eaton
4. "*Goods vehicle operation"* - C.S. Dubbar
5. "*Road transport law*" - L.D. Kitchen
6. G B S Narang,"*Automobile engineering*", Khanna Publications
7. H B Keshwani ,"*Automobile engineering".*
8. R B Gupta, *"Automobile engineering*", satyaprakashan, New Delhi

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	

PROJECT MANAGEMENT

Course Code : 20AUT563 **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 selection, prioritization and initiation of individual projects and strategic role of project management.
CO2	Determine the work breakdown structure by integrating it with organization, scheduling and uncertainty in projects.
CO3	Understand the risk management planning using project quality tools.
CO4	Analyse the activities like purchasing, acquisitions, contracting, partnering and collaborations related to performing projects.
CO5	Determine project progress and results through balanced scorecard approach.
CO6	Draw the network diagram to calculate the duration of the project and reduce it using crashing.

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	COs
1	**Basics of Project Management:** Introduction, Definition of project, characteristics of projects, types of projects, need for project management, phases of project life cycle management, project management processes, impact of delays in project completions, roles and responsibilities of project leader, tools and techniques of project management. Project identification process, project initiation, and pre-feasibility study, prioritizing projects, securing and negotiating projects.	**9**	**CO1**
2	**Planning Projects:** Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organisation, coding the WBS for the information system. Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt chart.	**9**	**CO2, CO3**

3	**Resourcing Projects:** Abilities needed when resourcing projects, estimate resource needs, creating staffing management plant, project team composition issues, Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control. Project Risk Planning: Risk Management Planning, risk identification, risk analysis, risk response planning, Project Quality Planning and Project Kick off: Development of quality concepts, project quality management plan, project quality tools, kick off project, baseline and communicate project management plan, using Microsoft Project for project baselines.	**9**	**CO4**
4	**Performing Projects:** Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management. 28 Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure.	**9**	**CO5**
5	**Network Analysis:** Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method (CPM) to find the expected completion time of a project, floats; PERTfor finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	**9**	**CO6**

Text Books:

1. Contemporary **Project Management**, Timothy J Kloppenborg, Cengage Learning, 2nd Edition,**ISBN:97881315187.**
2. **Project Management a System approach to Planning Scheduling & Controlling,** Harold Kerzner, CBS Publishers and Distributors.2nd Ed., ISBN:9788123908670.

Reference Books:

1. **Project Management,** Benningston Lawrence, McGrawHill-1970
2. **Project Management,** A Moder Joseph and Phillips New Yark Van Nostrand,Reinhold
3. **ManagementFundamentals**-Concepts,Application,SkillDevelopment–RobersLusier–Thomson, **ISBN-13:**978-1506303277

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	

STATISTICAL QUALITY CONTROL

Course Code : 20AUT564 **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 basic statistical concepts of SQC.
CO2	Understand the process improvement concepts.
CO3	Develop control charts for variables.
CO4	Develop control charts for attributes.
CO5	Select an appropriate sampling process for the quality control in particularly for manufacturing automotive components.
CO6	Evaluate the failure statistics and reliability of products.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction:** Basic concepts of Quality, Meaning, objectives of quality control, Quality Characteristics, Quality costs, Quality of Design, Quality of conformance, Concepts in quality management, quality planning, quality measurement. **Basic Statistical Concepts:** Concept of variation and its types, Variables and Attributes, Frequency distribution and its graphical representation, Central tendency and Measures of dispersion, Numerical Problems.	**9**	**CO1**
2	**Control Charts for Variables:** Theory and definition of control chart, Control charts for X - Bar and R charts, Type I and Type II errors, process capability **-** Methods of calculating process capability**,** natural Tolerance limits, Numerical problems. **Cumulative-Sum (CUSUM) & Exponentially Weighted Moving Average (EWMA)** : Control Charts: CUSUM Control Chart -basic principles, design of an EWMA control chart.	**9**	**CO3**
3	**Control Charts for Attributes:** Control charts for defects and defectives - p, np, c, and u charts andtheir applications, Numerical problems. **Process Improvement**: Quality improvement process, Quality tools for process improvement viz. Pareto Charts, C& E analysis, Scatter Diagrams.	**9**	**CO2, CO4**
4	**Acceptance Sampling:** Basis concepts, Sampling by attributes, single, double and multiple sampling plans, use of sampling table, Sequential sampling plan, construction and use of Operating Characteristic curves, Numerical problems.	**9**	**CO5**
5	**Failure statistics and Reliability:** Failure density, Failure rate, Mean failure rate, Mean time to failure, Mean time between failure, maintainability, Availability, Concepts of reliability, Reliability prediction, Bath tub curve, component and system reliability, interaction between reliability and maintenance, Numerical problems.	**9**	**CO6**

Text Books:

1. Statistical Quality Control, E. L. Grant and R.S.Leavenworth,Tata McGraw- Hill publishing Co.Ltd., New Delhi,7th edition,2014, ISBN: 9780070435551.
2. Statistical Quality Control, ManoharMahajan, DhanpatRai and Sons, New Delhi, 1st edition,2012,ISBN:9788177000399.
3. Concepts in Reliability Engineering, L.S. Srinath,East-west press pvt ltd, 2nd edition, 2007,ISBN:9788176710480.

Reference Books:

1. Introduction to Statistical Quality Control, Montgomery Douglas C , John Wiley and Sons, Inc,Hoboken,7th edition,2013,ISBN: 9781118146811.
2. Statistical Quality Control, R. C. Gupta,Khanna Publishers, Delhi,1st edition, 2013,ISBN:EBK0029239.
3. Statistical Process Control and Quality Improvement, Gerald M. Smith,Pearson Prentice Hall, 5th edition, 2013,ISBN:978013049036.
4. Fundamentals of quality control and improvement, AmitavMitra, Wiley 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		5
Apply	5		3
Analyse	5	5	2
Evaluate	5	5	
Create		5	

SEE – Semester End Examination (50 Marks - Theory)

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

AUTOMOBILE LAB I

Course Code : 20AUL57 **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	Measure gear tooth and screw thread parameters
CO2	Calibrate various transducers
CO3	Use various tools and measuring instruments
CO4	Dismantle and assembly carburettor and injection pumps
CO5	Dismantle and assembly petrol and diesel engines
CO6	Trouble shoot problems in petrol and diesel engines

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	COs
	Part A		
1	Measurement of gear tooth profile.	**3**	**CO1**
2	Determination of screw thread parameters using tool maker's microscope.	**3**	**CO1**
3	Determination of young's modulus using strain gauge.	**3**	**CO2**
4	Calibration of transducers (LVDT, load cell).	**3**	**CO2**
5	Vacuum and compression test of petrol and diesel engines.	**3**	**CO3**
6	Injection pressure test of fuel injector nozzle.	**3**	**CO3**
7	Angular measurement using Bevel protractor.	**3**	**CO3**
	Part B		
8	Study of hand tools used for dismantling and assemblies of automotive components.	**3**	**CO3**
9	Dismantling, study and assembly of simple carburettor and inline fuel injection pump.	**3**	**CO4**
10	Dismantling, study and assembly of single cylinder, two stroke and four stroke petrol engine.	**3**	**CO5 CO6**
11	Dismantling, study and assembly of four stroke multi cylinder petrol engine.	**3**	**CO5 CO6**
12	Dismantling, study and assembly of four stroke multi cylinder diesel engine.	**3**	**CO5 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	

AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB

Course Code : 20AUL58 **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	Rectify faults in electrical and electronics systems and maintain the same
CO2	Troubleshoot faults in battery and starter motor systems
CO3	Diagnosis faults in ignition system
CO4	Know about interfacing of various sensors
CO5	Know about interfacing of various Actuators
CO6	Diagnosis of various sensors

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		1	1		2
CO2	3	2		1	2		2		1	1		2
CO3	3	2		1	2		2		1	1		2
CO4	3	2		1	2		2		1	1		2
CO5	3	2		1	2		2		1	1		2
CO6	3	2		1	2		2		1	1		2

Sl No.	List of Experiments	Hrs	COs
1	Testing of Basic Electrical components like Switches, Relays, Resistors	**3**	**CO1**
2	Testing of batteries and battery maintenance	**3**	**CO2**
3	Study of starting motors and generators	**3**	**CO2**
4	Diagnosis of ignition system faults	**3**	**CO3**
5	Study of Automobile electrical wiring	**3**	**CO1**
6	Interfacing Sensors like RTD, LVDT, Load Cell etc	**3**	**CO4**
7	Interfacing A/D converter and simple data acquisition	**3**	**CO1**
8	Micro controller programming and interfacing	**3**	**CO1**
9	Interfacing Actuators	**3**	**CO5**
10	Fault Diagnosis of various sensors	**3**	**CO6**

Assessment Pattern:

CIE- Continuous Internal Evaluation for Lab (25 Marks)

Bloom's Category	Tests	Record	Quizzes/Viva
Marks (Out of 50)	**10**	**10**	**05**
Remember			
Understand		5	
Apply	5	5	2
Analyse	5		3
Evaluate			
Create			

SEE – Semester End Examination (25 Marks - Lab)

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

SIXTH SEMESTER
(SYLLABUS)

DESIGN OF MACHINE ELEMENTS

Course Code : 20AUT61 **Credits : 03**
L: T: P:S : 2:1:0:0 **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	Understand design concepts (strength consideration) and properties of engineering materials and theories.
CO2	Design shafts, knuckle joint, cotter joint.
CO3	Design rigid and flexible couplings.
CO4	Design springs and flywheels.
CO5	Design sliding contact and rolling contact bearings.
CO6	Design spur and helical gears.

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	COs
1	**STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS** Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties -- Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.	**9**	**CO1**
2	**DESIGN OF SHAFTS, JOINTS AND COUPLINGS** **Design of Shafts:**Design of solid and hollow shafts based on strength, rigidity and critical speed **Design of Joints &Couplings :**Knuckle joints - Cotter joints - Design of rigid and flexible couplings.	**9**	**CO2, CO3**
3	**DESIGN OF ENERGY STORING ELEMENTS** **Springs:**Design of various types of springs, optimization of helical springs -- rubber springs, Leaf springs **Flywheels:**Design of flywheels considering stresses in rims and arms, for engines and punching machines.	**9**	**CO4**

4	**DESIGN OF BEARINGS** Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings, McKee's Eqn. Sommerfield Number, Raimondi & Boyd graphs, -- Selection of RollingContact bearings .	**9**	**CO5**
5	**DESIGN OF SPUR & HELICAL GEARS** **Spur gear**: Introduction, spur gears, standard proportions of gear systems, stresses in gear tooth, Lewis equation and form factor, design for strength, dynamic load and wear load. **Helical gears:** Definitions, formative number of teeth, design based on strength, dynamic and wear loads.	**9**	**CO6**

Text Books:

1. R.S. Khurmi and J.K. Gupta "A text book of Machine Design", S. Chand & co, 25th Revised Edition, 2005.
2. V.B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publishing Company, 4th Edition, 2016.

Reference Books:

1. Robert L. Norton, "Machine Design", Pearson Education India, 5th Edition, 2013.
2. Shigley, "Mechanical Engineering Design", McGraw Hill Education, 10th Edition, 2016.
3. J.B.K. Das, "Design of Machine Design-I", Sapna book house, 2nd Edition, 2015.
4. J.B.K. Das, "Design 0f Machine Design-II", Sapna book house, 3rd Edition, 2016

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	10
Apply	5	5	
Analyse	5		
Evaluate	-		
Create	5	5	

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	5
Apply	5
Analyse	5
Evaluate	5
Create	20

FINITE ELEMENT METHODS

Course Code : 20AUT62 **Credits : 03**
L: T: P:S : 2:1:0:0 **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	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso- parametric elements.
CO2	Develop element characteristic equation and generation of global equation.
CO3	Formulate and solve Axi-symmetric and heat transfer problems.
CO4	Apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts.
CO5	Solve problems on heat transfer, CFD and Vibration.
CO6	Solve dynamic problems.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction to Finite Element Method:** General steps of the finite element method. Engineering applications of finite element method. Advantages of the Finite Element Method. **Boundary conditions:** Homogeneous and non-homogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkins method, Displacement method of finite element formulation. Convergence criteria, Discretisation process, **Types of elements:** 1D, 2D and 3D, Node numbering, Location of nodes. **Strain-** displacement relations, Stress-strain relations, Plain stress and Plain strain conditions, temperature effects. **Interpolation models:** Simplex, complex and multiplex elements, linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements.	**9**	**CO1, CO6**
2	**Introduction to the stiffness (Displacement) method:** Introduction, Derivation of stiffness matrix, Derivation of stiffness matrix for a spring element, Assembly the total stiffness matrix by superposition. One-Dimensional Elements-Analysis of Bars and Trusses, Linear	**9**	**CO2, CO6**

	interpolation polynomials in terms of local coordinate‟s for1D, 2Delements. Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates, , , Constant strain triangle, Four-Nodded Tetrahedral Element (TET 4), Eight-Nodded Hexahedral Element (HEXA 3 8), 2D iso-parametric element, Lagrange interpolation functions. **Numerical integration:** Gaussian quadrature one point, two point formulae, 2D integrals. Force terms: Body force, traction force and point loads, Numerical Problems: Solution for displacement, stress and strain in 1D straight bars, stepped bars and tapered bars using elimination approach and penalty approach		
3	**Beams and Shafts:** Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped beams using direct stiffness method with concentrated and uniformly distributed load. **Torsion of Shafts:** Finite element formulation of shafts, determination of stress and twists in circular shafts	**9**	**CO3, CO6**
4	**Heat Transfer:** Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, 1D finite element formulation using vibration method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins. **Fluid Flow:** Flow through a porous medium, Flow through pipes of uniform and stepped sections, Flow through hydraulic networks.	**9**	**CO4, CO6**
5	**Axi-symmetric Solid Elements:** Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels. **Dynamic Considerations:** Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.	**9**	**CO5, CO6**

Text Books:

1. Chandrupatla T " Introduction to Finite Elements in Engineering" Pearson, Fourth edition, 2015.
2. S SRao, " The Finite Element Method in Engineering" Fifth edition, Reed Elsevier , 2011

Reference Books

1. P seshu, " Finite Element Analysis" PHI, 2016.
2. J N Redddy" Finite Element Method" Third edition, McGrawe Hill, 2016.

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		
Apply	5	5	
Analyse	5	5	5
Evaluate	5	5	
Create			

SEE – Semester End Examination (50 Marks - Theory)

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

AUTOMOTIVE CHASSIS

Course Code : 20AUT63 **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 different layouts of automobiles, frames, front axle, steering system.
CO2	Explain different types of braking systems and applications.
CO3	Classify different types of suspension system.
CO4	Describe the final drive and rear axle.
CO5	Classify the different types of tyres, wheels, factors affecting tyre life.
CO6	Understand the operation of sliding, constant, synchro mesh gear boxes, Explain Overdrive operations and gear shifting mechanism, fluid coupling and torque converter.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction:** layout of an automobile with reference to power plant, types of frames, frame materials, frame cross section, testing of frames, stresses acting on frames **Front Axle:** Axle parts and materials, loads and stresses, centre sections, section near steering head, front axle loads, types of stub axle **Steering System:** factors of wheel alignment, correct steering angle, Ackermann steering mechanism, cornering force, self righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting.	**9**	**CO1**
2	**Braking System:** Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, types of brakes- disc and drum brake, mechanical and hydraulic braking system, bleeding of brakes, brake linings, brake fluid, factors influencing operation of brakes Brake compensation, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting, ABS, EBD	**9**	**CO2**
3	**Suspension Systems:** Objective, basic considerations, Types of suspension springs, construction , operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, telescopic shock absorbers, front wheel independent suspension, rear wheel independent suspension **Final drive**: Differential-Principle, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, transaxle types. **Rear axle:** Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings	**9**	**CO3, CO4**

4	**Wheels and Tyres:** Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, tube and tubeless tyres, materials, tyre section & designation, factors affecting tyre life, run flat tyres,quick change wheels, special wheels	**9**	**CO5**
5	**Gear Box:** Objective of the Gear Box - Performance characteristics at different speeds - Construction and operations of Sliding-mesh gear box - Constant-mesh gear box, Synchro-mesh gear box. Wilson planetary transmission, Automatic transmission, Free wheel, Over drives, Transfer box. Gear shifting mechanisms **Fluid Coupling, Torque Converters:** Fluid coupling - Principle of operation - Construction details - Torque capacity - Performance characteristics - Torque converter - Principle of operation - Constructional details – Performance characteristics.	**9**	**CO6**

Text Books:

1. N.K Giri, "**Automotive Mechanics**", Khanna Publication, New Delhi, 2015, **ISBN:8184092161**
2. R.B.Gupta, "***Automobile Engineering***" Satya Publications, 9th Edition, 2015, **ISBN: 8176848581**

Reference Books:

1. Heldt P. M, *"**Torque converters**"*, Chilton Book Co., 1992.
2. SAE Transactions 900550 & 930910.
3. Crouse W.H, Anglin D.L, *"**Automotive Transmission and Power Trains construction**",* McGraw Hill, 10th Edition, 2008, **ISBN: 9780070634350**
4. Dr.Kirpal Singh. "***Automobile Engineering Vol-1***" Standard Publications, 13th Edition, 2013, **ISBN: 9788180141966**
5. G.B.S. Narang "**Automobile Engineering",**Khanna Publishers, 5th edition, 1995, **ISBN:8174092161** .
6. Joseph Heitner, **"Automotive Mechanics**", CBS Publishers, 1st edition, 2004, **ISBN: 81-239-0891-1**
7. *"**Automotive Transmissions: Fundamentals, Selection, Design and Application**"*, 2nd Edition, Springer, 2011.

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-II

NON DESTRUCTIVE TESTING

Course Code : 20AUT641 **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	Describe various NDT techniques, equipment, applications and limitations.
CO2	Understand Magnetic particle Inspection method.
CO3	Apply appropriate NDT method for various components using NDT standards and interpretation of defects.
CO4	Understand Eddy Current and Ultrasonic Inspection principles.
CO5	Apply the radiography principles in automobile manufacturing.
CO6	Analyse various limitations of Holography.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction to non destructive testing:** Selection of ND methods, visual inspection - Boroscopes, Image sensors, Magnifying Systems. Liquid penetration inspection, its advantages and limitation. Magnetic Particle Inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations	**9**	**CO1, CO2**
2	**Ultrasonic inspection:** Basic equipment, advantages and disadvantages, applicability, characteristics of ultrasonic waves, variables inspection, attenuation of ultrasonic beams, inspection methods:- pulse echo, A,B,C scans transmission. Transducer elements couplets, search units, contact types and immersion types, inspection standards-standard reference blocks, Indian standards for NDT.	**9**	**CO2, CO3**
3	**Eddy Current Inspection:** principles, operation variables, procedure, inspection coils, and detectable discounts by the method. **Leak and pressure testing:** Leak and pressure testing: Definition of	**9**	**CO4**

	leak and types, Principle, Various methods of pressure and leak testing, Application and limitation.		
4	**Radiography Inspection:** principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, **Thermal inspection Principles:** Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications equipment inspection methods applications	**9**	**CO5**
5	**Optical Holography:** Basics of Holography, recording and reconstruction - Acoustical Holography: systems, techniques, and applications. Microwave holography: Technique, applications and limitations.	**9**	**CO6**

Text Books:

1. Non Destructive Testing, McGonnagle JJ, Garden and reach New York
2. Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, ,Narosa Publishing House, 2009.
3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

Reference Books:

1. The Testing instruction of engineering materials, Davis H.E Troxel G.E wiskovil C.T, McGraw hill.
2. Introduction to Non-destructive testing: a training guide Paul E Mix, Wiley, 2nd Edition New Jersey, 2005
3. Handbook of Nondestructive evaluation, Charles, J. Hellier, McGraw Hill, New York 2001.
4. Non Destructive Evolution and Quality Control , Volume 17 of metals hand book 9 edition Asia internal 1989.

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	5
Understand	10	5	5
Apply	5	5	
Analyse	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	

COMPOSITE MATERIALS

Course Code : 20AUT642 **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 basic concepts of composite materials.
CO2	Evaluate the structural and non-structural applications of composites.
CO3	Understand the properties and fabrication of Polymer matrix composites
CO4	Understand the fabrication techniques involved in metal and ceramic matrix composites.
CO5	Apply the mechanics of composite materials.
CO6	Analyze the advances in the field of composite materials.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction to composite Materials** Definition, classification of composite materials, classification based on matrix material, classification based on reinforcements, functions of reinforcement and matrix materials, Laminar composites, particulate composites, advantages & limitations of composites, Application of composites	9	CO1 CO2
2	**Mechanics of composites:**Macromechanics- lamina assumptions, generalized Hooke's law. Reduction to homogeneous orthotropic lamina , isotropic limit case, orthotropic stiffness matrix , rule of mixtures. Micromechanics: volume and mass fractions, density and void content, longitudinal and transverse Young's modulii, Simple problems.	9	CO5
3	**Polymer matrix composites** (PMC) Polymer matrix resins – Thermosetting resins, thermoplastic resins, Reinforcement fibres – rovings, woven fabrics, non woven random mats, layup and curing, fabricating process – open and closed mould process – hand layup , spray up process, bag molding, filament winding, pultrusion, pulforming, thermo – forming, injection moulding, resin transfer moulding (RTM), compression moulding.	9	CO3
4	**Metal Matrix Composites (MMC) and Ceramic Matrix Composites (CMC):** Reinforcement materials, types, characteristics, need for MMC's and its application, fabrication process for MMC's: Powder metallurgy technique, diffusion bonding, liquid metallurgy technique, stir casting, squeeze casting. Ceramic materials, properties, need for CMC, types of Ceramic Matrix composites-: Oxide ceramics, non oxide ceramics, aluminium oxide, silicon nitride, processing of CMCs: sintering, hot pressing, cold isostaticpressing, hot isostatic pressing.	9	CO5
5	**Advances in composite materials:** Joining of composites: adhesively bonded joints & mechanically fastened joints Carbon /carbon composites, advantages and limitations of carbon matrix, carbon fibre - chemical vapour deposition of carbon on carbon fibre preform, shape memory alloys. Environmental Effects of composites, recycling of composites	9	CO6

Text Books:

1. Composite materials, Krishan K. Chawla, Springer, 2012
2. Composite Materials, S C Sharma, Narosa Publishing House 2000
3. Mechanics of composites by Autar Kaw, CRC Press. 2005.

Reference Books:

1. Engineering Mechanics of Composite Materials, Issac M. Daniel and OriIshai, Oxford University Press-2006, First Indian Edition – 2007

2. FiberReinforced Composites: Materials, Manufacturing and Design, Mallick, P K, CRC Press, 2007.
3. Fundamentals of Composite Manufacturing, Brent Strong A, , Society of Manufacturing Engineers, 2008.
4. Mechanics of Composite Materials , Robert M. Jones, 2nd edition,CRC Press, 2015.
5. Composite Materials, S.C. Sharma Narosa publishing house, New Delhi 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	5		2
Understand	5	5	5
Apply	5	5	3
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	

TWO AND THREE WHEELED VEHICLES

Course Code : 20AUT643 **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 two wheelers and three wheelers and their layout.
CO2	Understand the different types of chassis, frames and ergonomic considerations for the body of the car.
CO3	Compare the power plant, lubrication, cooling system etc of two wheelers and three wheelers.
CO4	Compare the clutches, gears, final drive, differential and steering of two wheelers and three wheelers.
CO5	Understand the basics of braking system and suspension system of two and three wheelers.
CO6	Describe about the performance and maintenance of two and three wheelers.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction**: Development, Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three wheelers, applications & capacity – goods & passengers, study of technical specification of Two & Three wheelers. Frames & Body: Types of frame, construction, loads, design consideration, materials, Types of three wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics considerations for body work, side car.	**9**	**CO1, CO2**
2	**The Power unit:** Selection of engine for two wheeler & three wheeler, Design considerations for two wheeler & three wheeler power plants, special systems requirements for lubrication, cooling, starting. Recent engine developments.	**9**	**CO3**
3	**Transmission and steering system:** Transmission Systems : Clutch – special requirements, different types used in two & three wheelers,	**9**	**CO4**

	need of primary reduction, selection of transmission - gear transmission, gear shift mechanism, belt transmission, automatic transmission final drive & differential for three wheeler, wheel drive arrangement. Steering : Steering geometry, steering column construction, steering system for three wheelers		
4	**Brake and suspension system:** Brake, Wheel & Tyres: Design consideration of brake, types of brakes – disc, drum, braking mechanism – mechanical, hydraulic & servo, wheel types - spokes, disc, split, special tyre requirements for two & three wheelers. Suspension requirements, design considerations, trailing & leading link, swinging arm, springs & shock absorbers.	**9**	**CO5**
5	**Performance and maintenance: Road Performance**: Handling characteristics, driver & pillion seating arrangement, ergonomics & comfort, road holding & vehicle stability, riding characteristics, safety arrangements, Racing bikes – special requirements. Maintenance: Preventive & brake down maintenance, factors affecting fuel economy & emission.	**9**	**CO6**

Text Books:

1. Dhruv.U.Panchal, "Two and Three wheeler technology",PHI publishers,2015:ISBN13: 978-81-7317-792-7.
2. Gaetano Cocco, "Motorcycle Design and Technology", Giorgio Nada Editor (April 1, 2013).

Reference Books:

1. Mick Walker, "Motorcycle: Evolution, design and Passion", Johns Hopkins, 2006.
2. Marshall Cavensih, "Encyclopaedia of Motor cycling, 20 volumes", New York and London, 1989.
3. John Robinson, "Motorcycle Tuning: Chassis", Butterworth-Heinemann, 2001.

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	10		5
Apply		5	5
Analyse		5	
Evaluate	5	5	
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	20
Understand	20
Apply	
Analyse	5
Evaluate	5
Create	

NOISE, VIBRATION AND HARSHNESS CONTROL

Course Code : 20AUT644 **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 basic concept of vibration, sources of vibration and noises in automobiles.
CO2	Analyse the effect of noise and vibration on human beings and nature.
CO3	Analyse the various methods to predict and control the noise and vibration in different components of automobiles.
CO4	Find out the suitable transducers to reduce the noise and vibration in automobiles.
CO5	Explain the different NVH controlling techniques in an interior transportation and safety precautions.
CO6	Solve some real life problems in automotive domain.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**INTRODUCTION TO NOISE, VIBRATION AND HARSHNESS** Definition of Noise, Vibrations & Harshness in reference to Vehicular application - Noise - Definition, basic attributes of sound and units (wavelength, period, frequency velocity, speed, pressure, power and sound intensity - sound wave -properties, sound sources, sound propagation in the atmosphere, sound radiation from Structures - General Introduction to Vibration, free and forced vibration, undamped and damped vibration, linear and non -linear vibration	9	CO1
2	**EFFECTS OF NOISE AND VIBRATION ON PEOPLE** Effects on people and hearing conservation, sleep disturbance due to transportation noise exposure, noise induced annoyance, effects of infrasound, low-frequency noise and ultrasound on people, auditory hazards of impulse and impact noise, effects of intense noise on people and hearing loss, effects of vibration on people, rating measures, and procedures for determining human response to noise and vibration	9	CO2
3	**TRANSPORTATION NOISE AND VIBRATION ,SOURCES AND CONTROL** Internal Combustion Engine Noise - Prediction and Control, Diesel exhaust and intake noise and acoustical design of mufflers - Tire/Road Noise - Generation, Measurement, and Abatement - Aerodynamic Sound Sources in Vehicles - Prediction and Control, Transmission, Gearbox Noise, Vibration, prediction and control, Brake Noise Prediction and Control.	9	CO3
4	**TRANSDUCERS AND MEASUREMENT TECHNIQUES** Transducers and exciters - Sound pressure, intensity and power measurement. Sound level meters, noise dosimeters, analyzers and signal generators, equipment for data acquisition and digital signal processing -Calibration of measurement microphones, calibration of shock and vibration transducers, metrology and traceability of vibration and shock measurements.	9	CO4
5	**NOISE AND VIBRATION IN INTERIOR TRANSPORTATION AND SAFETY** Interior Transportation Noise and Vibration - Introduction - Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors- Prediction and Control - Study of NVH - Legislations applicable for vehicles in India-Safety - Passive safety Active safety. Study of Safety Regulations for vehicular application	9	CO5, CO6

Text Books:

1. David A.Bies and Colin H.Hansen, Engineering Noise Control: Theory and Practice, SponPress,London, 2009.
2. Xu Wang, Vehicle Noise and Vibration Refinement, Sawston, Cambridge: Woodhead Publishing Ltd, 2010.
3. M.Harrison, Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Oxford:Butterworth-Heinemann Elsevier Ltd, 2004.
4. C.W. de Silva, Vibration Monitoring, Testing, and Instrumentation, Boca Raton: CRC Press, 2007.

Reference Books:

1. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill , New Delhi, 2010

2. Colin H Hansen "Understanding Active Noise Cancellation" ,Spon Press , London 2003

3. Matthew Harrison"VehicleRefinement:Controlling Noise and Vibration in Road Vehicles, ",Elsevier Butterworth-Heinemann, Burlington, 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	5		5
Understand	10		
Apply	5	5	
Analyse	5	5	5
Evaluate	5	5	
Create			

SEE – Semester End Examination (50 Marks - Theory)

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

PROFESSIONAL ELECTIVE – III

AUTOMOTIVE EMISSIONS AND CONTROL

Course Code : 20AUT651 **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 various emission norms, standards.
CO2	Understand the formation of various pollutants like HC, CO, CO2, NOx.
CO3	Analyze control techniques, design changes for minimizing pollution.
CO4	Understand the influence of fuel properties on emissions and various post combustion treatments in automobile.
CO5	Identify the effect of air pollution on humans, animals and plants
CO6	Evaluate the sampling methods and test procedures.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction:** Historical background, regulatory test procedure (European cycles), Exhaust gas pollutants, European rail road limits, particulate pollutants, European statutory values, BS stages, inspection of vehicle in circulation- influence of actual traffic conditions and influence of vehicle maintenance **Effect of Air Pollution:**Effect of air pollution on Human Health, Effect of air pollution on animals,Effect of air pollution on plants	**9**	**CO1, CO5**
2	**Pollutant formation in Engines** Nitrogen Oxides: Formation of nitrogen oxides in spark ignition engines, NOx formation in compression ignition engines, factors. Carbon monoxide: Formation, CO emissions in SI engine, CI engine. Unburned Hydrocarbon Emissions: Factors affecting HC emission, HC emissions in spark ignition engines, HC emission in diesel engines Particulate Emissions: Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation. Non-exhaust emissions.	**9**	**CO2**

3	**Pollution control techniques**: Pollution control measures inside SI Engines & lean burn strategies, measures in engines to control Diesel Emissions. Pollution control in SI & CI Engines, Design changes, Exhaust gas recirculation, fuel additives to reduce smoke & particulates. Road draught crankcase ventilation system, positive crankcase ventilation system, fuel evaporation control	**9**	**CO3**
4	**Influence of Fuel Properties:** Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions. **Post combustion Treatments**: Exhaust gas compositions before treatment, Catalytic mechanism, Thermal Reactions, Installation of catalyst in exhaust lines, catalyst poisoning, catalyst light-off, particulate traps, and Diesel Trap oxidizer.	**9**	**CO4**
5	**Sampling and Testing:** Combustion gas sampling, Particulate sampling: soot particles in a cylinder, soot in exhaust tube, Sampling Methods sedimentations, and filtration, and impinge methods, electrostatic precipitation, thermal precipitation, centrifugal methods, determination of mass concentration, analytical methods-volumetric, gravimetric, calorimetric. **Testing**: NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NOx, Orsat apparatus, Smoke measurement, obscuration method, Continuous filter type smoke meter, Bosch smoke meter, Hart ridge smoke meter	**9**	**CO6**

Text Books:

1. Automobiles and pollution - Paul degobert (SAE), 1995.
2. Internal combustion engine fundamentals – John B. Heywood, McGraw Hill Education; 1 edition, 2011.
3. Engine Emissions: Pollutant Formation and Advances in Control Technology ,Pundir B P, Narosa Publishing House Pvt. Ltd., Delhi, 2007.

Reference Books:

1. Automotive Fuel and Emissions Control Systems, James D. Halderman, Prentice Hall, Pearson Education, 2012.
2. Internal combustion engines: V. Ganesan, Mcgraw Hill Education , 4th Edition, 2012.
3. Automotive Emission Control, Crouse William, McGraw-Hill. 3rd revised edition, 1983.
4. Engine Emission, Springer and Patterson, Plenum Press, 1990.

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	

NANOTECHNOLOGY

Course Code : 20AUT652 **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 basic concepts of Nanotechnology and nano science.
CO2	Evaluate the various nano materials and manufacturing methods.
CO3	Understand the importance and application of fullerenes and CNTs.
CO4	Understand the applications of nanotechnology.
CO5	Understand the different microfabrication techniques.
CO6	Analyze the various characterization methods.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	**Introduction**: Nanoscale Science and Nano Technology, Historical background – nature, scope. Implications for Physics, Chemistry, Biology and Engineering. multidisciplinary aspects - industrial, economic and societal implications. Applications of nanotechnology.	**9**	**CO1**
2	**Nano materials** Classifications of nanostructured materials- Nano particles, quantum dots, nanowires, nano films. effect of nano scale on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Synthesis Methods: Bottom-up and Top-down Approach: Wet chemical synthesis (Precipitation and sol gel), Mechanical Milling, Colloidal routes, Self-assembly, Vapour deposition (PVD and CVD), Molecular Beam Epitaxy.	**9**	**CO2**
3	**Nano particles, fullerines and Carbon Nano Tubes(CNTs):** Metal Nanoparticles- Method of preparation , functionalized metal nanoparticles, applications Core-shell Nanoparticles –types, properties , applications. Nanoshells– types, properties, applications Fullerenes- Discovery, synthesis, properties and applications. Carbon Nanotubes – synthesis and purification , mechanism of growth mechanical and physical properties, applications.	**9**	**CO2, CO3**
4	**Microfabrication:** Introduction to optical / UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, dip pen lithography and applications. Preparation Environments: specifications and design, requirements for particular processes, Vibration free environments, working practices, safety issues - flammable and toxic hazards, biohazards.	**9**	**CO5**
5	**Characterization Techniques:** X-ray diffraction technique, Scanning Electron Microscopy, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, Raman spectroscopy.	**9**	**CO6**

Text Books:

1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep, Tata McGraw-Hill India, 2007.
2. Nanomaterials: Synthesis, Properties and Applications ,A.S. Edelstein and R.C. Cammearata, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
3. Nanotechnology: Richard Booker & Earl Boysen, Wiley,2005.

Reference Books:

1. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science andTechnology]: Di Ventra, Springer, 2004.
2. Nanotechnology Demystified: Linda Williams & Wade Adams; McGraw-Hill, 2007.
3. N John Dinardo, "Nanoscalecharecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 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	5		5
Understand	5	5	5
Apply	5	5	
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	

EARTH MOVING EQUIPMENTS

Course Code : 20AUT653 **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 hydraulic and pneumatic components such as DCV, PCV, single and double actuating cylinder.
CO2	Understand control components in hydraulic and pneumatic systems.
CO3	Compare the different types, construction and working of different earthmovers.
CO4	Analyze the articulation and steering of tracked vehicles.
CO5	Understand the method of selection of earthmovers.
CO6	Describe about the Corrective maintenance and Condition monitoring.

Mapping of Course Outcomes to Program Outcomes:

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

Module No.	Module Contents	Hrs	COs
1	I**ntroduction to Hydraulics and Pneumatic:** Basics hydraulics system-principle, components, advantages and disadvantages, Hydraulic Pumps, Motors and Actuators - Construction, working principle and operation of rotary & reciprocating pumps like Gear, Vane, Axial Piston, and Linear Actuators. Pneumatic Actuators - Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Linear cylinders – Types, end position cushioning, seals, mounting arrangements applications. Rod less cylinders.	**9**	**CO1**
2	**Control Components in Hydraulic systems:** Directional Control Valves – Symbolic representation, Constructional features, pressure control valves and flow control valves, Series hydraulic circuit, parallel hydraulic circuit, electro hydraulic circuits. **Control Components in Pneumatic Systems:** Direct and indirect actuation pneumatic cylinders, Flow control valves, Directional Control Valves, Pressure control valves.	**9**	**CO2**
3	**Different types of earth moving equipment and their applications:** Classification of earth moving equipments,Crawler Dozers, Under carriage components like track frame, sprockets, track rollers, track	**9**	**CO3**

	chains assembly and track shoes. Wheel loaders, Power shovels, Hydraulic excavators, Scraper, Motor graders, vibratory compaction equipments.		
4	**Steering of tracked vehicles and heavy equipment operations :** Skid steering, articulated steering, clutch /brake steering system, controlled differential steering system,Excavator hydraulic system, hydraulic retarder, Scrapers articulation and tractors articulation mechanism.	**9**	**CO4**
5	**Earth Moving Equipment Management** - Objectives of maintenance, Earth moving equipment maintenance- Type of maintenance, Functions and advantages of maintenance, Corrective maintenance, Condition monitoring. **Method of selection of equipment**- selection of machine, basic rules of matching machine, selection of equipment including the nature of operation, selection based on type of soil, based on haul distance, based on weather condition.	**9**	**CO5 CO6**

Text Books:

1. Anthony Esposito “Fluid Power with applications”, pearson education, 5th edition.
2. Andrew Parr “Pneumatics and Hydraulics”. Jaico Publishing Co. 2000.
3. Construction equipment and its management By S.C. Sharma
4. Diesel equipment- volume I and II by Erich J.schulz

Reference Books:

1. Majumdar,” Oil Hydraulic Systems – Principles and Maintenance”. 2002, Tata McGraw Hillpublishing company Ltd. 2001.
2. S.R.Majumdar “Pneumatic systems “, Tata McGraw Hill publishing Co., 1995
3. Farm machinery and mechanism by Donald R. hunt and L. W.garner
4. Theory of ground vehicles by J.Y.Wong john Wiley and sons
5. Moving the earth by Herbert Nicholas

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	5	5	
Apply	10	5	10
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	

ALTERNATIVE FUELS AND ENERGY SYSTEM

Course Code : 20AUT654 **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 properties of alcohol and understand the performance, combustion and emission characteristics.
CO2	Describe properties of hydrogen and understand the performance, combustion and emission characteristics.
CO3	Understand properties of vegetable oil and its performance, combustion and emission characteristics.
CO4	Explain properties of gaseous fuels and its performance, combustion and emission characteristics.
CO5	Describe the concept of reformulated Conventional Fuels.
CO6	Analyze the concept of future Alternative Fuels.

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	3	1	1	1	1	1
CO2	2	1	2	1	1	1	3	1	1	1	1	1
CO3	2	1	2	1	1	1	3	1	1	1	1	1
CO4	2	1	2	1	1	1	3	1	1	1	1	1
CO5	2	1	2	1	1	1	3	1	1	1	1	1
CO6	2	1	2	1	1	1	3	1	1	1	1	1

Module No.	Module Contents	Hrs	COs
1	**Alcohols as Fuels:** Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.	9	CO1
2	**Hydrogen as an Alternate Fuel:** Hydrogen, properties and production of hydrogen. Storage, Advantages and disadvantages of hydrogen. Hydrogen used in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Emission from hydrogen	9	CO2
3	**Vegetable Oils as Fuels:** Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.	9	CO3
4	**Biogas, Natural Gas and LPG As Fuels:** Production methods of Biogas, Natural gas and LPG. Properties studies. Modification required using in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.	9	CO4
5	**Reformulated Conventional Fuels:** Introduction. Production of coal water slurry, properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. **Future Alternative Fuels:** Production, properties, Engine performance, advantages and disadvantages of PMF, Ammonia, Liquid-Nitrogen, Boron, Compressed Air, Water as fuel for Internal combustion Engine	9	CO5 CO6

Text Books:

1. AyhanDemirbas, “Biodiesel A Realistic Fuel Alternative for Diesel Engines”, Springer-Verlag London Limited 2008, ISBN-13: 9781846289941
2. Richard L Bechtold P.E., “Alternative Fuels Guide book”, Society of Automotive Engineers, 1997, ISBN 0-76-80-0052-1.

Reference Books:

1. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, “The Biodiesel Handbook”, AOCS Press Champaign, Illinois 2005.
2. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
3. Nagpal, “Power Plant Engineering”, Khanna Publishers
4. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 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	5	5	
Understand	5	5	
Apply	10	5	10
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	

AUTOMOBILE ENGINEERING LAB-II

Course Code : 20AUL66 **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	Write technical specifications of different types of engines.
CO2	Explain the procedure for dismantling and assemble of clutch.
CO3	Select the suitable gear box and determine the gear ratio for automobile vehicles.
CO4	Determine the gear ratio for differential.
CO5	Describe the procedure for dismantling and assemble of front and rear axles.
CO6	Describe the procedure for dismantling and assemble of suspension and steering systems.

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		1	1		2
CO2	3	2		1	2		2		1	1		2
CO3	3	2		1	2		2		1	1		2
CO4	3	2		1	2		2		1	1		2
CO5	3	2		1	2		2		1	1		2
CO6	3	2		1	2		2		1	1		2

Sl.No.	List of Experiments	Hrs	COs
1	Writing Technical specifications and description of all types of vehicles	3	CO1
2	Exercise on dismantling and assembling of single plate clutch	3	CO2
3	Exercise on dismantling and assembling of multi plate clutch	3	CO2
4	Exercise on dismantling and measuring the gear ratio of constant mesh gear box	3	CO3
5	Exercise on dismantling and measuring the gear ratio of synchro mesh gear box	3	CO3
6	Exercise on dismantling and measuring the gear ratio of automatic transmission	3	CO3
7	Exercise on dismantling and measuring the gear ratio of differential	3	CO4
8	Exercise on dismantling and assembling of front axle	3	CO5
9	Exercise on dismantling and assembling of rear axle	3	CO5
10	Exercise on dismantling and assembling of steering system	3	CO6
11	Exercise on dismantling and assembling of suspension	3	CO6

Assessment Pattern:

CIE- Continuous Internal Evaluation for Lab (25 Marks)

Bloom's Category	Test	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 (Lab)
Remember	
Understand	5
Apply	10
Analyse	10
Evaluate	
Create	

COMPUTER AIDED MODELLING AND ANALYSIS LAB

Course Code : 20AUL67 **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	Analyse the bar problems.
CO2	Analyse the truss problems.
CO3	Analyse the heat transfer problems.
CO4	Analyse the dynamic problems, modal analysis.
CO5	Analyse the case studies problems.
CO6	Analyse the real time problems in automobile engineering.

Mapping of Course Outcomes to Program Outcomes:

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

Sl No.	List of experiments	Hrs	COs
1	Modelling and stress analysis of Bracket	3	CO1
2	Modelling and stress analysis of 1-d Bar element	3	CO2
3	Modelling and stress analysis of Truss	3	CO3
4	Modelling and stress analysis of Beams	3	CO4
5	Modelling and stress analysis of plate with a hole	3	CO5
6	Thermal analysis of composite wall, fins	3	CO6
7	Dynamic analysis to find , Natural frequency of bars, beams .	3	CO6
8.	Case studies using ansys workbench	3	CO6
9.	Crash analysis of cars.	3	CO6
10.	To write program and run for fem problems.	3	CO6

CIE- Continuous Internal Evaluation for Lab (25 Marks)

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

SEE – Semester End Examination (25 Marks - Lab)

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