SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree

In

Automobile Engineering

V & VI Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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PES College of Engineering

VISION

PESCE shall be a leading institution imparting quality engineering and management education, developing creative and socially responsible professionals

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching -learning practices
- Impart engineering and managerial skills through competent and committed faculty using Outcome Based Educational curriculum
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs
- Promote research, product development and industry-institution interaction.

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

DEPARTMENT OF AUTOMOBILE ENGINEERING

The discipline Automobile Engineering was established in the year 1980, and now it has gained expertise and contributing vitally to the Automobile Engineering community. The focus is to consistently pursue in providing innovative and quality training to the talented and dedicated students, to empower them in engineering the development of national economy, specialized in transport sector. We are the pioneers in Karnataka to introduce the Department of Automobile Engineering to impart sound automotive knowledge to the students with a passion towards Automobiles. We take honor in being recognized as a 'research centre' in Karnataka by VTU and Mysore University. In addition to these regular programmes, this department is also actively involved in conducting Faculty Development Programmes, Technical talks, Training programmes and technical visits to various industries & regular industrial trainings for the benefits of students. The department has well qualified and well experienced faculty members to meet the present day curriculum requirements both in theory and practical.

VISION

To be a distinguished centre for imparting quality education in automobile engineering to develop competent and socially responsible engineers and carryout research on continuous basis for the betterment of the society.

MISSION

AUM1: To give best learning experience through innovative teaching practices supported by excellent laboratory infrastructure and exposure to recent trends in the automotive industry.

AUM2: Provide in-depth knowledge in automobile engineering with equal emphasis on theoretical and practical aspects and interdisciplinary problem solving skills.

AUM3: Focus on Industry-institute interaction, for better understanding of the state of the art technologies, Promoting research and also to build the spirit of entrepreneurship.

AUM4: Inculcate societal responsibility and ethical values through personality development programs.

Programme Education Objectives (PEOs)

PEO1: To prepare Graduates to pursue a successful career in automotive and allied industries and/or to pursue higher education and/or to become entrepreneur.

PEO2: To develop expertise in the core area of automobile engineering such as design, manufacturing, and servicing with a focus on research and innovation for the benefit of the society.

PEO3: To enable graduates to apply interdisciplinary engineering knowledge to solve practical automobile engineering problems.

PEO4: To prepare graduates to demonstrate professionalism, team work, communication skills, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

Specific skills enhanced in this programme can enable the Graduates to

PSO1. Apply the basic and advanced knowledge of automobile, manufacturing, materials and thermal engineering to analyze and solve a realistic/practical problem.

PSO2. Design basic automotive systems and make use of advanced automotive systems to improve the performance, safety, maintenance and management of automobiles.

PSO3. Use modern tools and carry out research in automotive domain for providing solutions to automotive and societal issues.

Programme Outcomes (PO)

Engineering program must demonstrate that their students attain the following outcomes:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	Bachelor of Engineering (V –Semester)											
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21AU501	Industrial Management and Entrepreneurship	AU	3	-	-	-	3	50	50	100
2	P21AU502	Design of Machine Elements	AU	2	2	-	-	3	50	50	100
3	P21AU503X	**Professional Elective Course – I**	AU	3	-	-	-	3	50	50	100
4	P21AU504	Automotive Engines and Components [Integrated]	AU	3	-	2	-	4	50	50	100
5	P21AUO505X	**Open Elective – I**	AU	3	-	-	-	3	50	50	100
6	P21AUL506	Skill oriented Laboratory-I (Simulation Lab)	AU	-	-	2	-	1	50	50	100
7	P21INT507	Internship - II	AU	-	-	-	-	2	-	100	100
8	P21HSMC508	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV509	Social Connect and Responsibility	AU	1	-	-	-	1	100	-	100
	Total							**21**			

Professional Elective Course – I (P21XX503X)	
Course Code	**Course Title**
P21AU5031	Auxiliary system of automotive engines
P21AU5032	Advance Engine Technology
P21AU5033	Production of Automotive Components
P21AU5034	Non Traditional Machining

Open Elective – I(P21XXO505X)	
Course Code	**Course Title**
P21AUO5051	Automotive Engines and Systems

	Bachelor of Engineering (VI –Semester)											
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21AU601	Heat Transfer	AU	2	2	-	-	3	50	50	100
2	P21AU602X	**Professional Elective Course – II**	AU	3	-	-	-	3	50	50	100
3	P21AU603X	**Professional Elective Course – III**	AU	3	-	-	-	3	50	50	100
4	P21AU604	Automotive Chassis and Suspension [Integrated]	AU	3	-	2	-	4	50	50	100
5	P21AUO605X	**Open Elective – II**	AU	3	-	-	-	3	50	50	100
6	P21AUL606	Skill Oriented Laboratory	AU	-	-	2	-	1	50	50	100
7	P21AUMP607	Mini – Project	AU	-	-	2	2	2	50	50	100
8	P21HSMC608	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV609	Universal Human Values and Professional Ethics	AU	1	-	-	-	1	50	50	100
	Total							**21**			

Professional Elective Course – II (P21XX602X)	
Course Code	**Course Title**
P21AU6021	Automotive Fuels and Combustion
P21AU6022	Total Quality Management
P21AU6023	Operation Research
P21AU6024	Two and Three Wheeled Vehicles

Professional Elective Course – III (P21XX603X)	
Course Code	**Course Title**
P21AU6031	Automotive Transmission
P21AU6032	Transport Management and Motor Vehicle Act
P21AU6033	Finite Element Method
P21AU6034	Battery Technology and Charging Infrastructure

Open Elective – II(P21XXO605X)	
Course Code	**Course Title**
P21AUO6051	Automotive Chassis and Transmission
P21AUO6052	Electric Vehicles, Battery Technology and Charging Infrastructure

***Allot Tutorial as per the course requirement subjected to the credits allotted.**

Industrial Management and Entrepreneurship

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21AU501**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Describe** the ability to identify and evaluate business opportunities and trends.
2. **Relate** the concept of management and its importance and preparation of project report, and its significance of report.
3. **Develop** concepts and sources incisively and with sensitivity while organizing and decision making.
4. **Demonstrate** the ability to manage people process and resources within a diverse organization.
5. **Demonstrate** an ability to apply general management know-how in practical business situations.

UNIT – I	**8 Hours**

MANAGEMENT: Introduction - Meaning - Nature And Characteristics Of Management, Scope And Functional Areas Of Management, - Management As An Art Or Science, Art Or Profession, Management & Administration - Roles Of Management, Levels Of Management,

PLANNING: Nature, Importance And Purpose Of Planning Process, Importance Of Planning - Steps In Planning & Planning Premises.

Self-study component:	study of scientific management according to different authors

UNIT – II	**8 Hours**

ORGANISING AND STAFFING: Nature And Purpose Of Organization -Principles Of Organization - Types Of Organization – Departmentation - Committees - Centralization Vs Decentralization Of Authority And Responsibility - Span Of Control- MBO And MBE (Meaning 'Only) Nature And Importance Of Staffing - Process Of Selection &Recruitment (In Brief).

DIRECTING; Meaning And Nature Of Directing -Leadership Styles, Motivation Theories, Coordination, Meaning And Importance And Techniques Of Co -Ordination.

Self-study component:	Study of organizing structure of any one of existing unit**.**

UNIT – III	**8 Hours**

CONTROLLING: Meaning And Steps In Controlling - Essentials Of A Sound Control System - Methods Of Establishing Control.

ENTREPRENEUR: Meaning Of Entrepreneur; Evolution Of The Concept, Functions Of An Entrepreneur, Types Of Entrepreneur, Evolution Of Entrepreneurship, Development Of Entrepreneurship; Stages In Entrepreneurial Process; Role Of Entrepreneurs In Economic Development; Entrepreneurship In India; Barriers To Entrepreneurship.

Self-study component:	Identify in entrepreneur near by you & report in detail.

UNIT – IV	**8 Hours**

SMALL SCALE INDUSTRY: Definition; Characteristics, Need, Scope; Role Of SSI In Economic Development. Advantages Of SSI, Steps To Start An SSI - Government Policy Towards SSI; Different Policies Of S.S.L, Impact Of Liberalization, Privatization, Globalization On S.S.I., Effect Of WTO/GATT Supporting Agencies Of Government For S.S.L, Meaning; Nature Of Support; Objectives; Functions; Types Of Help; Ancillary Industry And Tiny Industry (Definition Only).

Self-study component:	Salient features of Karnataka start up policy 2015-2020

UNIT – V		8 Hours

PREPARATION OF PROJECT: Meaning Of Project; Project Identification; Project Selection; Project Report; Need And Significance Of Report; Contents. Formulation; Errors Of Project Report; Project Appraisal.

INDUSTRIAL OWNERSHIP; Definition And Meaning Of Partnership, Characteristics Of Partnership, Kinds Of Partners, Partnership Agreement Or Partnership Deed, Registration Of Partnership Firm, Rights, Duties And Liabilities Of Partners, Advantages And Disadvantages Of Partnership, Sole Proprietorship, Features, Scope Advantages And Disadvantages Of Sole Proprietorship.

Self-study component:	Prepare project report, selecting your own components.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Describe** the ability to identify and evaluate business opportunities and trends.	Knowledge	L1
CO2	**Relate** the concept of management and its importance and preparation of project report, and its significance of report.	Understand	L2
CO3	**Develop** concepts and sources incisively and with sensitivity while organizing and decision making.	apply	L3
CO4	**Demonstrate** the ability to manage people, processes, and resources within a diverse organization.	Apply	L3
CO5	**Demonstrate** an ability to **apply** general management know-how in practical business situations.	apply	L3

Text Book(s):

1. P.C. Tripathi, P.N. Reddy "**Principles of Management**" -; Tata McGraw Hill, 4th Edition, 2012.
2. Vansant Desai "**Dynamics of Entrepreneurial Development & Management**" - Himalaya Publishing House -2009.
3. Poornima M Charantimath "**Small Business Enterprises**"-- Pearson Education – 2006.

Reference Book(s):

1. Robert Lusier - **Thomson Management Fundamentals** - Concepts, Application, Skill Development 2015.
2. S S Khanka, **Entrepreneurship Development** - - S Chand & Co, 2006
3. N.V.R.Naidu, T. KrishnaRao- **Management and Entrepreneurship**-, I.K.International Publishing House.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Describe** the ability to identify and evaluate business opportunities and trends.	2	2	2		-	-	-	-	-	-	-	-	2	-	-
2	**Relate** the concept of management and its importance and preparation of project report, and its significance of report.	3	2	2	-	-	-	-	-	-	-	-	2	2	-	-
3	**Develop** concepts and sources incisively and with sensitivity while organizing and decision making.	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
4	**Demonstrate** the ability to manage people, processes, and resources within a diverse organization.	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
5	**Demonstrate** an ability to **apply** general management know-how in practical business situations.	2	2	2	-	-	-	-	-	-	-	-	3	2	-	-

Design of Machine Elements [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P21AU502**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the use of Codes and Standards in design processes of various machine elements involved in a mechanical system
2. **Analyze** the behavior of machine components under static, impact, fatigue loading.
3. **Utilize** standard failure theories and fatigue analysis to **develop** safety factors for machine elements.
4. **Use** design parameters of Springs and joints during various loading application
5. **Analyze** the behavior of machine components under static, impact, fatigue loading.

UNIT – I	**8 Hours**

Design for static strength: Design considerations: Codes and Standards, Static strength; Static loads and factor of safety; Theories of failure -Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Maximum strain theory. Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. Combined Stress concentration factor. (Simple problems)

Self-study component:	Members subjected to Bi-axial stresses

UNIT – II	**8 Hours**

Design for fatigue strength: Introduction, S -N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors –size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Soderberg and Goodman, Stresses due to combined loading. (Simple problems)

Self-study component:	Impact load due to axial loading.

UNIT – III	**8 Hours**

Mechanical joints: **Riveted Joints** -Types, rivet materials, Failures of Riveted joints, Efficiency, riveted joint for boiler or pressure vessels. (Simple problems)

Welded Joints -Types, Strength of butt and fillet welds, welds subjected axial loads, Eccentric loading - welds subjected to bending moment, and torsional moments. (Simple problems)

Self-study component:	study on Riveted brackets.

UNIT – IV	**8 Hours**

Design of gears: Introduction to Spur, Helical and bevel gears. Design of spur gears, stresses in gear tooth, Lewis equation, form factor, dynamic and wear load. (Simple problems)

Design of springs: Types of springs -stresses in Helical Coil springs of circular and non-circular cross sections. Tension and compression springs. Design in leaf spring. (Simple problems).

Self-study component:	Problems on helical gears

UNIT – V	**8 Hours**

Design of shafts: Torsion of shafts, design for strength & rigidity, with steady loading, ASME& BIS codes for design of transmission shafting, Design of shafts under different loads: Combined loads & Fluctuating loads. (Simple problems)

Lubrication and bearings: Mechanisms of Lubrication - Viscosity, bearing modulus, coefficient of friction, minimum oil film thickness-Heat Generated, Heat dissipated, bearing materials, lubricants and properties. Ball and Roller Bearings: Bearing life, equivalent bearing load, selection of bearings of different types (simple Problems only on Ball and Roller Bearings).

Self-study component:	problems on journal bearing

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the use of Codes and Standards in design processes of various machine elements involved in a mechanical system..	Understand	L2
CO2	**Analyze** the behavior of machine components under static, impact, fatigue loading.	Apply	L3
CO3	**Utilize** standard failure theories and fatigue analysis to **develop** safety factors for machine elements.	Apply	L3
CO4	**Use** design parameters of Springs and joints during various loading application.	Evaluate	L3
CO5	**Analyze** the behavior of machine components under static, impact, fatigue loading.	Evaluate	L4

Text Book(s):

1. Mechanical Engineering Design Joseph Edward Shigley's, Tata McGraw Hill, New Delhi 2014.
2. Machine Design VL. Maleev and Hartman, New Delhi, 2001.

DESIGN DATA HAND BOOK:

1. Design Data Hand Book-K. Mahadevan and Balaveera Reddy, CBS Publication fourth edition, 2013.

Reference Book(s):

1. Robert .L, Norton –Pearson, Machine Design - Education Asia, New Delhi, 2014.
2. V. B. Bahandri, Design of Machine Elements - -Tata McGraw Hill Publishing Co. Ltd., New – Delhi, 2000.
3. 3. R.S.Khurmi, J. K.Gupta. Machine Design – Eurasia publishing house private Ltd. New Delhi, 2005.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the use of Codes and Standards in design processes of various machine elements involved in a mechanical system..	2	2	-	-	-	-	-		-	-	-	-	2	-	-
2	**Analyze** the behavior of machine components under static, impact, fatigue loading.	2	2	-	-	-	-	-	-	-	-	-	2	2	-	-
3	**Utilize** standard failure theories and fatigue analysis to **develop** safety factors for machine elements.	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
4	**Use** design parameters of Springs and joints during various loading application.	2	3	-	2	-	-	-	-	-	-	2	2	2	-	-
5	**Analyze** the behavior of machine components under static, impact, fatigue loading.	2	2	-	-	-	-	-	-	-	-	2	3	2	-	-

Auxiliary Systems of Automotive Engines
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21AU5031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understanding** the different systems in and SI and CI engines and their working and its importance.
2. **Compare** the importance of cooling and lubrication systems and their types.
3. **Apply** various engineering concepts such as Thermodynamics and fluid mechanics in working Super charging systems.
4. **Use** the concepts of auxiliary systems and their importance in improving the engine performance.
5. **Relate** the different auxiliary systems used in SI and CI engines.

UNIT – I	**8 Hours**

Petrol Engine Fuel supply system : – Carburetor, principle, properties of A/F mixtures, Mixture requirements – steady state and transient, law of mixture preparation in simple carburetor, complete carburetor, , fuel feed systems, fuel pumps, filters, Petrol injection – Disadvantages of carburetor, advantages of petrol injection, different types, theory of mixture control, representative types of petrol injection ,principles-construction & performance (Bosch K-jetronic fuel injection system).

Self-study component:	Bosch L tetronic fuel injection system

UNIT – II	**8 Hours**

Diesel engine Fuel supply system: –Injection pumps (jerk pump, distributor type and CRDI system, EDC system), injectors (mechanical and electronic type) and nozzles. Factors influencing the fuel spray atomization, penetration and dispersion of diesel, rate and duration of injection, injection lag, pressure waves in fuel lines.

Self-study component:	Cummins diesel engine fuel injection system

UNIT – III	**8 Hours**

Cooling system – Necessity, variation of gas temperature, Areas of heat flow, heat transfer, piston and cylinder temperature, Heat rejected to coolant, quantity of water required, cooling systems, air cooling, water cooling, cooling and evaporative cooling and pressure cooling. Comparison of air and water cooling, antifreeze solution, fundamentals of radiator design, thermostats, cooling fan.

Self-study component:	Heavy duty cooling systems

UNIT – IV	**8 Hours**

Lubrication system – Principles of lubrication, mechanism of lubrication, elasto hydrodynamic lubrication journal bearing lubrication, functions of the lubricating systems, properties and classification of lubricating oils, oil additives, lubricating systems- splash, pressure feed lubrication, dry sump and wet sump lubrication systems

Self-study component:	Different types of oil filters

UNIT – V	**8 Hours**

Supercharging and Turbo charging: Purpose, types of superchargers, Thermodynamic cycle, effects of supercharging, limits of super charging for petrol and diesel engines. Modifications of an engine for supercharging.

Turbo charging: Methods of turbo charging (constant pressure, pulse and pulse converter) two stage turbo charging.

Self-study component:	Inter cooling systems

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the different systems in and SI and CI engines and their working and its importance.	Understanding	L2
CO2	**Compare** the importance of cooling and lubrication systems and their types.	Understanding	L2
CO3	**Apply** various engineering concepts such as Thermodynamics and fluid mechanics in working Super charging systems.	Apply	L3
CO4	**Use** the concepts of auxiliary systems and their importance in improving the engine performance.	Apply	L3
CO5	**Relate** the different auxiliary systems used in SI and CI engines.	Apply	L3

Text Book(s):

1. Heinz Heisler, **Advanced engine technology**, Butterworth Heinemann, 2002
2. Mathur,M.L., and Sharma,R.P., "A Course in **Internal Combustion Engines**", Dhanpat Rai Publications (P) Ltd., 2015.
3. Kirpal Singh, "**Automobile Engineering Vol I & II** ", Standard Pub, New Delhi, 2012, 2014

Reference Book(s):

1. Crouse W.H. "automotive transmissions and power trains", McGraw Hill Co. 5th edn, 1976
2. Newton K and Steeds. W. "motor Vehicle", Butter Worth's & Co., Publishers Ltd, 1997
3. Kirpal Singh, "Automobile engineering –. Vol.1, Standard Pub. 2011

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Understanding** the different systems in and SI and CI engines and their working and its importance.	2	2										2	2		
2	**Compare** the importance of cooling and lubrication systems and their types.	3											2	2		
3	**Apply** various engineering concepts such as Thermodynamics and fluid mechanics in working Super charging systems.	2	2										2	2		
4	**Use** the concepts of auxiliary systems and their importance in improving the engine performance.	2	2										2	2		
5	**Relate** the different auxiliary systems used in SI and CI engines.	2	2										2	2		

Advanced Engine Technology

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21AU5032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the fundamental principles and concepts behind internal combustion engines and Non-conventional engines
2. **Illustrate** to emerging trends and future developments in engine technology.
3. **Outline** the latest advancements in engine systems and technologies.
4. **Make use** of opportunities for hands-on experience with engine diagnostics and calibration tools.
5. **Develop** the ability to identify and address engine-related challenges

UNIT – I	**8 Hours**

Combustion in spark ignition engines: Stages of combustion in SI engines, essential features of process, thermodynamic analysis of SI engine combustion, flame structure & speed, cyclic variation in combustion, partial burning and misfire, causes of cycle-by-cycle and cylinder- cylinder variation, spark ignition fundamentals.

Self-study component:	Abnormal combustion: knock fundamentals & surface ignition.

UNIT – II	**8 Hours**

Combustion in compression ignition engines:

Introduction, stages of combustion in CI engines, methods of generating swirl in CI engines, DI and IDI engines, types of direct combustion systems, comparison of different combustion systems, combustion in direct injection multi spray systems, analysis of cylinder pressure data, ignition delay, brief introduction of auto-ignition fundamentals, mixing-controlled combustion.

Self-study component:	Fuel spray behaviour, atomization, spray penetration, droplet size, spray evaporation

UNIT – III	**8 Hours**

Advances in air and fuel supply system:

Introduction to valve operating mechanism, valve rotators, variable valve timing technologies, VTEC technology, cam less engines, hydraulic operated tappets, turbo compound turbochargers, single stage injector, two stage injector and electronically controlled fuel injection system.

Self-study component:	Electronically controlled fuel injection system

UNIT – IV	**8 Hours**

Advances in cooling, lubrication and ignition system: introduction, thermostats, fan blade drive and shutter control, smart coolant pump, speed sensitive type fan blades, heat exchangers in lubrication system, dry sump lubrication system, principle of distributor type inductive electronic ignition,

Self-study component:	Capacitor discharge system, laser ignition system

UNIT – V	**8 Hours**

Non-conventional engines: Free piston engine, homogeneous charge compression ignition engine, lean burn engines, sterling engine, stratified charge engine, variable compression ratio engine.

Self-study component:	Wankel engine and gas turbine engine

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the fundamental principles and concepts behind internal combustion engines and Non-conventional engines	Understand	L2
CO2	**Illustrate** to emerging trends and future developments in engine technology.	Understand	L2
CO3	**Outline** the latest advancements in engine systems and technologies.	Understand	L2
CO4	**Make use of** opportunities for hands-on experience with engine diagnostics and calibration tools.	Apply	L3
CO5	**Develop** the ability to identify and address engine-related challenges.	Apply	L3

Text Book(s):

1. John. B Heywood, Internal combustion engines & fundamentals, MC Grew hill, 2014.
2. V. Ganesan, IC Engine, Tata MC Graw Hill, 2014.
3. Heinz Heisler, Advanced engine technology, SAE edition, 1995.

Reference Book(s):

1. Mathur R.B and R.P Sharma, "internal combustion engines", SciTech publications,2015

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs)

CO	**Course Outcome**	**BL**	**Programme Outcomes**												**Programme Specific outcomes**		
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Understand** the fundamental principles and concepts behind internal combustion engines and Non-conventional engines	L2	2	2										2	2	2	2
2	**Illustrate** to emerging trends and future developments in engine technology.	L2	2	2										2	2	2	2
3	**Outline** the latest advancements in engine systems and technologies.	L2	2	2										2	3	3	3
4	**Make use of** opportunities for hands-on experience with engine diagnostics and calibration tools.	L3	2	2										2	3	3	3
5	**Develop** the ability to identify and address engine-related challenges.	L3	2	2										2	3	3	3

Production of Automotive Components
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21AU5033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the different production methods of automotive components used in vehicles, including engines, transmissions, chassis components and electrical systems.
2. **Illustrate** about different materials used in automotive component manufacturing, including metals, polymers, composites, and their properties.
3. **Extend** a thorough understanding of various manufacturing processes employed in the automotive industry, such as casting, forging, machining, welding, moulding, and assembly.
4. **Outline** the quality control methods and quality standards used in automotive component production.
5. **Develop** an awareness of environmental regulations and safety protocols related to automotive component manufacturing.

UNIT – I	**8 Hours**

Introduction and materials: Components of automobiles and its functions. Requirements of materials in automotive, current materials in use and their future. Advances in manufacturing and joining techniques. Design data/ Test methodologies. Renewable materials, Bio composites, Thermoplastic, composite processing. Materials and technology for automobiles, use of aluminum in automobiles, and uses of plastics in automobiles. [Text Book 1: chapter 1 to 5]

Self-study component:	Advanced materials used application of technologies in automobiles

UNIT – II	**8 Hours**

Manufacturing of engine parts: Introduction, methodologies, material selection, manufacturing process of auto pistons, pins for automobiles, piston ring, lead storage battery, technical aspects. Manufacturing of valve and valve seat, silencer, technical aspects. Manufacturing of chain, cylinder block, cylinder liner, technical aspects. Manufacturing of control cable, engine mounting pad and auto locks. [Text Book 1: Chapter 6]

Self-study component:	Manufacturing methods for crank shaft, connecting rod, cam shaft, piston pin, push rodrocker arm and tappets, technical aspects.

UNIT – III	**8 Hours**

Manufacturing of automotive chassis: Introduction, methodologies, material selection, manufacturing process of automobile body, disc brake, brake drum, technical aspects. Manufacturing of gear blank, gear, gear box housing, technical aspects. Manufacturing processof leaf spring, shock absorbers, and technical aspects. Manufacturing process of tires, tubes and flaps, technical aspects. [Text Book 1: Chapter 7]

Self-study component:	Manufacturing methods for chassis, dead axle, wheel housing & steering system.

UNIT – IV	**8 Hours**

Heat treatment of automotive components: Introduction, types of heat treatment. Processing technology in heat treatment. Emerging technologies in materials, heat treatment and surface engineering. Furnaces for heat treatment of fasteners and automobile parts. Forging technologyof automobile parts: Introduction, types of forging processes. Steps for the design of forged part, and forging equipment's. [Text Book 1: Chapter 8 and 9]

Self-study component:	Heat treatment procedures for engine and chassis components

UNIT – V		8 Hours

Painting technology of automobiles: Introduction, performance and pretreatment. Priming, different priming systems, ultra filtration, surfacers, pigmentation, prime pigments. Anti-chip coatings, general properties. Basecoat/clear technology, undercoats, solid colours and painting problems. Paint processes and products, automatic spray. [Text Book 1: Chapter 10]

Self-study component:	Oven technology, performance and testing and future developments.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the different production methods of automotive components used in vehicles, including engines, transmissions, chassis components and electrical systems.	Understand	L2
CO2	**Illustrate** about different materials used in automotive component manufacturing, including metals, polymers, composites, and their properties.	Understand	L2
CO3	**Extend** a thorough understanding of various manufacturing processes employed in the automotive industry, such as casting, forging, machining, welding, molding, and assembly.	Understand	L2
CO4	**Outline** the quality control methods and quality standards used in automotive component production	Understand	L2
CO5	**Develop** an awareness of environmental regulations and safety protocols related to automotive component manufacturing.	Apply	L3

Text Book(s):

1. Production of Automobile Components & Allied products by B.S. Bharadwaj, NPCSpublishers, Delhi-35
2. Manufacturing processes and systems by Philip F. Steward& Jairo Munuz, John wiley&sons.

Reference Book(s):

1. Manufacturing and engineering technology by kalpakjian, Addison wesloy PublishingCompany.
2. Materials and process in manufacturing by Degarmo E. P., Macmillan publishing Co.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs)

CO	Course Outcome	BL	Programme Outcomes												Programme Specific outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the different production methods of automotive components used in vehicles, including engines, transmissions, chassis components and electrical systems.	L2	2	2	-	-	-	-	-	-	-	-	-	2	2	2	2
2	**Illustrate** about different materials used in automotive component manufacturing, including metals, polymers, composites, and their properties.	L2	2	2	-	-	-	-	-	-	-	-	-	2	2	2	2
3	**Extend** a thorough understanding of various manufacturing processes employed in the automotive industry, such as casting, forging, machining, welding, molding, and assembly.	L2	2	2	-	-	-	-	-	-	-	-	-	2	2	2	2
4	**Outline** the quality control methods and quality standards used in automotive component production.	L2	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2
5	**Develop** an awareness of environmental regulations and safety protocols related to automotive component manufacturing.	L3	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2

Non Traditional Machining [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21AU5034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the fundamentals of non -machining processes to describe their Constructional feature and working.
2. **Interpret** the process parameters affecting the functioning of various non-traditional machining processes.
3. **Utilize** the concepts of NTM to identify the process characteristics.
4. **Apply** the knowledge of NTM to infer the advantages, disadvantages and applications of various non-traditional machining processes.
5. **Analyze** the mechanism of metal removal in various non-traditional machining processes.

UNIT – I	**8 Hours**

Introduction to Mechanical Process: Need for non traditional machining processes, Process selection-classification on-comparative study of different processes, comparison between conventional and Non-conventional machining process selection. Ultrasonic Machining.

Self-study component:	Application of Ultrasonic Machining &Non-traditional machining processes.

UNIT – II	**8 Hours**

Abrasive Jet Machining and Thermal Metal Removal Processes: Principles — parameters of the process applications-advantages and disadvantages. Electric discharge machining-Principle of operation — mechanism of metal removal basic EDM circuitry-spark erosion generators — Analysis of relaxation type of circuit-material removal rate in relaxation circuits — critical resistance parameters in Ro Circuit-Die electric fluids.

Self-study component:	Application of Abrasive Jet Machining and Thermal Metal Removal Processes.

UNIT – III	**8 Hours**

Electro chemical and Chemical Processes and machining: Electro Chemical machining (ECM) Classification of ECM process-Principle of ECM-Chemistry of the ECM process- parameters of the process-determination of the metal removal rate —dynamics of ECM process-Hydrodynamics of ECM process-polarization-Tool Design-advantages and disadvantages-applications. Electro Chemical grinding-Electro Chemical holding. Electrochemical deburring. Introduction-fundamental principle types of chemical machining Maskants - Etchenes- Advantages and disadvantages-applications, environmental issues.

Self-study component:	Application of Electro chemical and Chemical Processes and machining.

UNIT – IV	**8 Hours**

Laser Beam Machining and Ion Beam Machining Introduction-principles of generation of lasers, Equipment and Machining Procedure-Types of Lasers-Process characteristics-advantages and limitations-applications..

High Velocity forming processes: Introduction-development of specific process-selection-comparison of conventional and high velocity forming methods-Types of high velocity forming methods-explosion forming process-electro hydraulics forming-magnetic pulse forming.

Self-study component:	Application of Laser Beam Machining and Ion Beam Machining High Velocity forming processes.

UNIT – V		8 Hours

Plasma arc Machining and Electron beam machining: Introduction-Plasma-Generation of Plasma and equipment — Mechanism of metals removal, PAN parameters-process characteristics — type of torches, applications.

Self-study component: Application of Plasma arc Machining and Electron beam machining .

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the fundamentals of non -machining processes to describe their Constructional feature and working.	Understand	L2
CO2	**Interpret** the process parameters affecting the functioning of various non-traditional machining processes.	Understand	L2
CO3	**Utilize** the concepts of NTM to identify the process characteristics.	Apply	L3
CO4	**Apply** the knowledge of NTM to infer the advantages, disadvantages and applications of various non-traditional machining processes.	Apply	L3
CO5	**Analyze** the mechanism of metal removal in various non-traditional machining processes.	Analyze	L4

Text Book(s):

1. M Pandey and Shah, **Modern machining process**:, TATA McGraw-Hill, 2000.
2. Saurabh kumar, **Non Traditional Machining Process.**

Reference Book(s):

1. Hindustan Machine Tools, **"Production Technology,"** Tata McGraw Hill. 2001.
2. P.K.Mishra, **"Non-Conventional Machining,"** The Institution of Engineers (India) Test book series, Narosa Publishing House, 2007.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (SOs)

CO	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the fundamentals of non - machining processes to describe their Constructional feature and working.	2	2	2	-	-	-	-	-	-	-	-	-	2	-	
2	**Interpret** the process parameters affecting the functioning of various non-traditional machining processes.	2	2	2	-	-	-	-	-	-	-	-	-	2	-	
3	**Utilize** the concepts of NTM to identify the process characteristics.	2	2	2	-	-	-	-	-	-	-	-	-	2	-	
4	**Apply** the knowledge of NTM to infer the advantages, disadvantages and applications of various non-traditional machining processes.	2	2	2	-	-	-	-	-	-	-	-	-	2	-	
5	**Analyze** the mechanism of metal removal in various non-traditional machining processes.	2	2	2	-	-	-	-	-	-	-	-	-	2	-	

Automotive Engines and Components (Integrated)
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21AU504**	**Credits:**	**04**
Teaching Hours/Week (L:T:P)	**L:T:P :- 3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40hrs[Theory] + 24hrs of [Lab]**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the construction, function, type & working principle of automotive power sources and its components.
2. **Comprehend**, the Dismantling/ assembling tools used & its application, Trouble shooting Charts and Technical Specifications of Engines & its components
3. **Compute** the major dimensions of the engine components
4. **Measure, compare, analyze** the dimensions of Engines components with the standard proportions, for wear & tear during Dismantling/ assembling of Engines.
5. Perform **tests to assess and understand** the status of functioning of engine components.

UNIT – I		**8 Hours**

INTRODUCTION

Historical development of automobiles, Introduction to Automobile propulsion sources, Internal Combustion Engine (ICE), Electric vehicles (EV), Hybrid vehicles, Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Electric Vehicle (FCEV), Natural Gas [Compressed natural gas (CNG) and liquefied natural gas (LNG) vehicles]

Heat Engines & their classification, Classification of I C engines, Reciprocating IC Engines - Basic Engine Components & Nomenclature, Principle of engine operation (SI & CI, 2 stroke & 4 stroke), Valve/port timing, Comparison of Engines, Relative merits & demerits of petrol & diesel engines, applications of IC Engines

Self-study component:	Differences in thermodynamic & operating variable & comparison of performance characteristics of SI & CI engines, recent developments with advanced technologies

Practical Topics	1. Study of hand tools- sketching, materials used and their applications. 2. Trouble shooting charts for all engine components.	**02 hours**

UNIT – II		**8 Hours**

Cylinder Block, Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, and valve seats. **Crank Case** – General form of crank case, oil sumps and cooling features, flywheel mountings, Engine mountings, Front & Rear mountings.

Manifolds and Mufflers - inlet and exhaust manifolds, mixture distribution, heating by exhaust gas, dual manifolds, General Design of Manifolds, effect of firing order, Mufflers, general design. Numerical, Determination of major dimensions.

Self-study component:	Manufacturing, Troubles & Remedies, recent developments with advanced technologies

Practical Topics	3.Specifications of given engines and component standard dimensions	**02 hours**

UNIT – III		**8 Hours**

Piston - Piston Temperatures, piston slap, compensation for thermal expansion in pistons.

Piston Rings - forms of gap, stresses in piston rings, ring collapse, heat treatment, piston ring selection, shape.

Piston pin - locking of piston pins, length of piston.

Numerical, Determination of major dimensions.

Self-study component:	Manufacturing, Troubles & Remedies, recent developments with advanced technologies	
Practical Topics	4. Dismantling & assembling of engines. a. Two stroke SI and/CI engine , b. Four stroke SI and/CI engine **c.** Four stroke multi cylinder SI and/ CI engine	**14 Hours**
UNIT – IV		**8 Hours**

Connecting Rod - Length of rod, Cross section, Buckling, Drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials, lubrication.

Crank Shaft - Balance weights, local balance, Crankshaft proportions, oil holes drilled in crank shafts, balancing and tensional vibration analysis, vibration dampers, firing order, bearings, lubrication.

Numerical, Determination of major dimensions.

Self-study component:	Manufacturing, Troubles & Remedies, recent developments with advanced technologies	
Practical Topics	5. Conducting compression test, vacuum test on diesel and petrol engines. 6. Determining Compression Ratio of four Stroke Petrol Engine	**04 hours**
UNIT – V		**8 Hours**

Flywheel-Introduction, Function & working principle, Determination of the mass of a flywheel for a given co- efficient of speed fluctuation, stresses on the rim of the flywheels. Design of hubs, arms of the flywheel, turning moment diagram.

Valve and Valve Mechanism

Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, , valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, **Camshaft**-drives of cams, cam types, tappets,-automatic zero clearance tappets, push rods, rocker arms & rocker Shaft.

Numerical & Determination of major dimensions.

Self-study component:	Manufacturing, Troubles & Remedies, recent developments with advanced technologies	
Practical Topics	7. Conducting Valve Timing Diagram for four Stroke Cycle Engine.	**02 Hours**

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with ***Action verbs*** for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the construction, function, type & working principle of automotive power sources and its components.	Understand	L2
CO2	**Comprehend**, the Dismantling/ assembling tools used & its application, Trouble shooting Charts and Technical Specifications of Engines & its components	Understand	L2
CO3	**Compute** the major dimensions of the engine components	Apply	L3
CO4	**Measure, compare, analyze** the dimensions of Engines components with the standard proportions, for wear & tear during Dismantling/ assembling of Engines.	Analyze	L4
CO5	Perform **tests to analyze and understand** the status of functioning of engine components.	Analyze	L4

Text Book(s):

1. Kirpal Singh ,**Automobile Engineering** Vol. II , Standard publications, New Delhi, 2014
2. R.B Gupta, **Auto Design** –Satyapraksh, New Delhi, 2000
3. Mathur & Sharma , A course in **I.C. Engine** - Dhanpat Rai & Sons, Delhi, 1999

Reference Book(s):

1. P.M.Heldt , High Speed Engines -, Oxford & IBH New Delhi, 1965
2. J.B.Heywood , Fundamentals of I.C.Engines , McGraw Hill International Edition, 1988
3. P.C. Sharma & D.K. Aggarwal, Machine design - S.K Kataria& sons, Delhi, 2012
4. Auto Service manual.

Course Articulation Matrix - Automotive Engines and Components (Integrated)

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO	Statement	BL	Programme Outcomes												Programme Specific outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the construction, function, type & working principle of automotive power sources and its components.	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-
2	**Comprehend**, the Dismantling/ assembling tools used & its application, Trouble shooting Charts and Technical Specifications of Engines & its components	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2
3	**Compute** the major dimensions of the engine components	3	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
4	**Measure, compare, analyze** the dimensions of Engines components with the standard proportions, for wear & tear during Dismantling/ assembling of Engines.	4	2	2	-	2	-	-	-	-	-	-	-	2	2	-	2
5	Perform **tests to analyze and understand** the status of functioning of engine components.	4	2	2	-	2	-	-	-	-	-	-	-	2	2	-	2

Automotive Engines and Systems (Open Elective-I)

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21AUO5051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the basic principles of working of SI and CI engines
2. **Identify** the different methods of fuel supply systems in SI and CI engines
3. **Understand** the basic principles of ignition system, supercharging and turbo charging
4. **Understand** the necessity of cooling and lubrication in IC engines and different types
5. **Determine** the IC engines power and efficiencies

UNIT – I	**8 Hours**

Introduction to IC engines:

Energy conversion, basic engine components, working principle of engines, classification of IC engines, combustion in SI and CI engines ,stages of combustion in SI and CI engines

Self-study component:	rotary engines

UNIT – II	**8 Hours**

Fuel supply system in SI and CI engines, principle of carburetion , simple carburetor, essential parts of carburetor, petrol injection system, multipoint injection system, Diesel fuel supply system, different types of fuel injection systems like inline injection, distributor , CRDI.

Self-study component:	electronic diesel control system

UNIT – III	**8 Hours**

Ignition system, super charging and turbo charging:

Introduction, battery ignition, magneto ignition, supercharging, objects of supercharging, super charging limits for SI and CI engines, methods of supercharging and turbo charging.

Self-study component:	capacitor discharge system

UNIT – IV	**8 Hours**

lubrication and cooling systems

Variation of gas temperature, piston and cylinder temperature distribution, need for cooling, different liquid and air cooled systems. Function of lubrication, lubrication systems, properties of lubricants.

Self-study component:	synthetic oils

UNIT – V	**8 Hours**

Engine testing and performance parameters: engine power and its measurements Different types of dynamometer, pollutants from SI and CI engines, Different instrument for pollution measurements, smoke meter etc.

Self-study component:	Emission control Techniques

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the basic principles of working of SI and CI engines	Understand	L2
CO2	**Identify** the different methods of fuel supply systems in SI and CI engines	Understanding	L2

CO3	**Understand** the basic principles of ignition system, supercharging and turbo charging	Understanding	L2
CO4	**Understand** the necessity of cooling and lubrication in IC engines and different types	Applying	L3
CO5	**Determine** the IC engines power and efficiencies	Applying	L3

Text Book(s):

1. V. Ganesan-" Internal combustion engines, 4th edition , 2014
2. M L Mathur and R P sharma, " Internal combustion engines

Reference Book(s):

1. S S Thipse, " Internal combustion engines, 2012
2. Dr. Kirpal singh, "Automobile engineering vol . 2, 12 edition ., 2011

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the basic principles of working of SI and CI engines	2	2										2	2		
2	**Identify** the different methods of fuel supply systems in SI and CI engines	2	2										2	2		
3	**Understand** the basic principles of ignition system, supercharging and turbo charging	2	2										2	2		
4	**Understand** the necessity of cooling and lubrication in IC engines and different types	2	2										2	2		
5	**Determine** the IC engines power and efficiencies	2	2										2	2		

Skill oriented Laboratory-I (Simulation Lab)
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21AUL506**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Illustrate** the basics of machine programming, including G-code and M-code.
2. **Understand** the principles and techniques of computer-aided manufacturing for generating tool paths and instructions to control machines, such as, CNC machines, for product manufacturing.
3. **Outline** how to select appropriate cutting tools for different machining operations based on Material properties, machining requirements and tool life considerations in CAM package.
4. **Illustrate** the basics of machine programming, including G-code and M-code.
5. **Apply** proficiency in using CAM software to generate tool paths and machine instructions based on CAD models.
6. **Apply** skills in optimizing machining parameters such as cutting speed, feed rate, and depth of cut for different materials and machining operations.

UNIT – I	**10 Hours**
Modeling of simple machine parts and generating machine codes for CNC production using standard CAM packages.	

UNIT – II	**06 Hours**
Simulation of machining operations on a computer using CAM packages. I. Simulation of turning operation II. Simulation of drilling operation III. Simulation of milling/cutting operations	

UNIT – III	**10 Hours**
Three typical simulations to be carried out using simulation packages like Master CAM, or any equivalent software.	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO 1	**Illustrate** the basics of machine programming, including G-code and M-code.	Knowledge	L1
CO2	**Understand** the principles and techniques of computer-aided manufacturing for generating tool paths and instructions to control machines, such as, CNC machines, for product manufacturing	Understand	L2
CO3	**Outline** how to select appropriate cutting tools for different machining operations based on material properties, machining requirements and tool life considerations in CAM package.	Understand	L2
CO4	**Apply** proficiency in using CAM software to generate tool paths and machine instructions based on CAD models.	Apply	L3
CO5	**Apply** skills in optimizing machining parameters such as cutting speed, feed rate, and depth of cut for different materials and machining operations.	Apply	L3

Text Book / Reference Books:

1. P.N. Rao, CAD/CAM Principles and Application, Tata McGraw Hill, 3rd edition, 2010, ISBN: 0070681937.
2. Groover, Computer Aided Design/Computer Aided Manufacturing, Tata McGraw Hill. 2003.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**Illustrate** the basics of machine programming, including G-code and M-code.	3	3										2	2	2
CO2	**Understand** the principles and techniques of computer-aided manufacturing for generating tool paths and instructions to control machines, such as, CNC machines, for product manufacturing	3	3										2	2	2
CO3	**Outline** how to select appropriate cutting tools for different machining operations based on material properties, machining requirements and tool life considerations in CAM package.	3	3	2									2	2	2
CO4	**Apply** proficiency in using CAM software to generate tool paths and machine instructions based on CAD models.	3	3	2									2	2	2
CO5	**Apply** skills in optimizing machining parameters such as cutting speed, feed rate, and depth of cut for different materials and machining operations.	2	2	2									2	2	2

Internship - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21INT507**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:0**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

Internship-II: SEE component will be the only seminar/Presentation and question answer session

Social Connect and Responsibility

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21UHV509**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**25+5**	**SEE Marks:**	**--**

Course Outcomes: This course will enable the students to:

- **Identify** the needs of the community and involve them in problem solving.
- **Demonstrate** the knowledge about the culture and societal realities.
- **Develop** sense of responsibilities and bond with the local community.
- **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.
- **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

PART-I	

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.

PART-II	

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

PART-III	

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

PART-IV	

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

PART-V	

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the needs of the community and involve them in problem **solving.**	**Knowledge / Apply**	**L1 & L3**
CO2	**Demonstrate** the knowledge about the culture and societal realities.	**Understand**	**L2**
CO3	**Develop** sense of responsibilities and bond with the local community	**Apply**	**L4**
CO4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	**Apply**	**L4**
CO5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	**Create**	**L6**

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Identify** the needs of the community and involve them in problem **solving.**	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	**Demonstrate** the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	**Develop** sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period.

The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5th semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.

Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	**Group size**	Location	**Activity execution**	**Reporting**	**Evaluation Of the Topic**
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Employability Enhancement Skills (EES) - V
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21HSMC508**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Apply programming constructs of C language to solve the real-world problem.
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems.
- Design and Develop solutions to problems using functions.

UNIT – I	**10 Hours**

Problem solving through C -

Flow Control: If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs.

Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs

Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.

Self-Study: Variables and constants

UNIT – II	**10 Hours**

Problem solving through C -

Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples.

Strings: String Functions, String Examples, Programs.

Self-Study: Evaluation of Expression.

UNIT – III	**08 Hours**

Problem solving through C -

Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs.

Programming Files: Files Input/output

Self-Study: Error handling during I/O operations.

Course Outcomes: On completion of this course, students are able to:	
CO – 1:	Apply suitable programming constructs of C language to solve the given problem.
CO – 2:	Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting.
CO – 3:	Design and Develop solutions to problems using functions.

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Computer fundamentals and programming in c, "Reema Thareja", Oxford University, Second edition, 2017.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - V**]**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	2	2	2	-	-	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-

Heat Transfer [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AU601**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**2:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the basic concepts and mechanisms of heat transfer, including conduction, convection, and radiation.
2. **Apply** the principles of heat conduction to solve problems involving steady-state and transient conduction in various geometries and materials
3. **Solve** numerical problems related to heat transfer, including determining temperature distributions, heat fluxes, thermal resistances, and overall heat transfer coefficients.
4. **Analyze** and solve problems involving thermal radiation
5. **Analyze** and solve numerical methods for heat transfer analysis.

UNIT – I	**8 Hours**

Introductory concepts and definitions: - Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient; combined heat transfer mechanism. Conduction - Basic Equations: - General form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates.. Boundary conditions of first, second and third kinds.

Self-study component:	Illustrative problems on mathematical formulation of conduction problems

UNIT – II	**8 Hours**

One-dimensional Steady state conduction: - Steady state conduction in a slab, in a cylinder and in a sphere without and with heat generation; overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation; Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency**.**

Self-study component:	Conduction in solids with variable thermal conductivity**.**

UNIT – III	**8 Hours**

One-dimensional Transient conduction :- Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of Transient Temperature charts (JeiSSCr ‘s Charts) for transient conduction in slab, long cylinder and sphere; Use of transient temperature charts for transient conduction in semi infinite solids. **Forced Convection**: - Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydrodynamically and thermally developed flows.

Self-study component:	Study of different boundary layer thickness, drag coefficient, drag force etc

UNIT – IV	**8 Hours**

Free or Natural convection :- Application of dimensional analysis for free convection-physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders. Heat Exchangers: - Classification of heat exchangers; overall heat transfer coefficient, Fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.

Self-study component:	NTU methods of analysis of heat exchangers.

UNIT – V		8 Hours

Radiation Heat Transfer :- Thermal radiation; Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law' Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; Effect of radiation shield; Intensity of radiation and solid angle; Lambert's Law; Radiation heat exchange between two finite surfaces

Self-study component: Radiation Heat Transfer Problems

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the basic concepts and mechanisms of heat transfer, including conduction, convection, and radiation.	Understand	L2
CO2	**Apply** the principles of heat conduction to solve problems involving steady-state and transient conduction in various geometries and materials.	Apply	L3
CO3	**Solve** numerical problems related to heat transfer, including determining temperature distributions, heat fluxes, thermal resistances, and overall heat transfer coefficients.	Apply	L3
CO4	**Analyze** and solve problems involving thermal radiation	Analyze	L4
CO5	**Analyze** and solve numerical methods for heat transfer analysis.	Analyze	L4

Text Book(s):

1. P.K. Nag, Heat Transfer by Tata Mc Graw Hill 3rd edition 2011. ISBN 10: 0070702535 / ISBN 13: 9780070702530
2. M NecatsOsisik , Heat Transfer- A Basic approach by Mc Graw Hill International Ed 1988

Reference Book(s):

1. Yunus A Cengel, Heat transfer a practical approaches by Tata Mc Graw Hill 2003. ISBN0072458933, 9780072458930
2. Kreith Thomas, Principles of Heat Transfer by learning 2001.
3. Frank. P. Incropera and David. P, Fundamentals of Heat and Mass Transfer by Dewitt Jhonwiley and Sons 7th edition 2011.**ISBN-10:** 0470917857 **ISBN-13:** 978-0470917855.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the basic concepts and mechanisms of heat transfer, including conduction, convection, and radiation.[L2]	2	2	2										2		
2	**Apply** the principles of heat conduction to solve problems involving steady-state and transient conduction in various geometries and materials[L4]	2	2	2										2		
3	**Solve** numerical problems related to heat transfer, including determining temperature distributions, heat fluxes, thermal resistances, and overall heat transfer coefficients.[L3]	2	2	2										2		
4	**Analyze** and solve problems involving thermal radiation[L4]	2	2	2										2		
5	**Analyze** and solve numerical methods for heat transfer analysis.[L4]	2	2	2										2		

Automotive Fuels And Combustion [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AU6021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the fundamentals of automobile fuels to **Gain knowledge** about different types of fuels used in automobiles, their properties and their impact on engine performance.
2. **Analyze** fuel properties and their effects on combustion to **Learn** & evaluate the properties of fuels to understand how these properties affect the combustion process.
3. **Study** combustion processes to Explore the various stages of the combustion process in internal combustion engines, including ignition, flame propagation, and pollutant formation.
4. **Study** combustion efficiency and emissions to **Learn** techniques to measure and assess performance of I C Engines.
5. **Study** alternative fuels and their applications to **understand** the characteristics and potential of alternative fuels to evaluate their suitability for automotive applications.

UNIT – I		**6 Hours**

Cycle Analysis & Energy Sources: Exhaustible sources - crude oil, Natural gas, **Inexhaustible sources** - Solar energy, Wind power, Tidal Power, Geo-thermal power Energy from Bio-gas, Synthetic fuels – Fuel Cells, Hydrogen- only a brief introduction, Bio fuels.

Self-study component:	Alcohols, CNG, LPG.

UNIT – II		**8 Hours**

Fuels: Origin of petroleum, its chemistry, Refining of petroleum: Fractional distillation, Cracking, Reforming process, Thermal reforming, Properties of fuels, diesel index, carbon residue and ash content determination. low sulphur diesels, Fuels for SI engines, Knock rating of SI engine fuels, octane number requirement, diesel fuels, Non petroleum fuels.

Self-study component:	Additives, Fuels for gas turbine and jet engines.

UNIT – III		**10 Hours**

Combustion in S.I Engines: Introduction, ignition limits, homogeneous mixture formation, Initiation of combustion, stages of combustion flame velocities, effect of variables on flame propagation, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, detonation, effects of engine variables on combustion, control of detonation, Types, features and design consideration of combustion chambers.

Combustion in C.I. Engines : Introduction, mixture requirements, Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, delay period correlations, diesel knock and engine variables,

Self-study component:	Types, features and design considerations of combustion chambers

UNIT – IV		**8 Hours**

Dual fuel and Multi fuel Engines: Introduction, construction and working of dual fuel and multi fuel engines, Combustion in dual fuel engines, Factor affecting combustion. Main types of gaseous fuels, Supercharge knock control & Performance of diesel fuel engines. Characteristics of multi fuel engines, Modification of fuel system, Suitability of various engines as multi fuel unit.

Self-study component:	performance characteristics of multi fuel engines.

UNIT – V		8 Hours
Recent developments in IC Engines: Introduction, Stratified charge engine, methods of Stratified charge engine, lean burn engines, VCR engines, Advantages and disadvantages of VCR engines, Multi Cycle Engines (MCE), CFR engine, Miller Cycle Engines.		
Self-study component:	HCCI engines, & free piston engines.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the fundamentals of automobile fuels to **Gain knowledge** about different types of fuels used in automobiles, their properties, and their impact on engine performance.	Understand	L2
CO2	**Analyze** fuel properties and their effects on combustion to Learn to evaluate the properties of fuels to understand how these properties affect the combustion process.	Analyze	L4
CO3	**Study** combustion processes to Explore the various stages of the combustion process in internal combustion engines, including ignition, flame propagation, and pollutant formation.	Apply	L3
CO4	**Study** combustion efficiency and emissions to Learn techniques to measure and assess performance of I C Engines.	Apply	L3
CO5	**Study** alternative fuels and their applications to **Understand** the characteristics and potential of alternative fuels to evaluate their suitability for automotive applications.	Apply	L3

Text Book(s):

1. M L Mathur &R P Sharma, I.C. Engines, Dhanpat Rai publications, New Delhi, 2013
2. S S Thipse, Internal combustion engine, JAICO publishing house, Mumbai, 2nd revise edition 2014.

Reference Book(s):

1. V Ganesan, Internal Combustion Engines, Tata McGraw Hill, 3rd reprint 2013.
2. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998
3. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.
4. Ram lingam, K.K., Internal Combustion Engines, SciTech publications (india) Pvt. Ltd., 2014.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the fundamentals of automobile fuels to **Gain knowledge** about different types of fuels used in automobiles, their properties, and their impact on engine performance.	2		2	-	-			-	-	-	-	2	2	2	2
2	**Analyze** fuel properties and their effects on combustion to Learn to evaluate the properties of fuels to understand how these properties affect the combustion process.	3	-	2	-	-			-	-	-	-	2	3	2	2
3	**Study** combustion processes to Explore the various stages of the combustion process in internal combustion engines, including ignition, flame propagation, and pollutant formation.	3	-	2	-	-			-	-	-	-	2	3	2	2
4	**Study combustion** efficiency and emissions to Learn techniques to measure and assess performance of I C Engines.	2	-	2	-	-			-	-	-	-	2	2	2	2
5	**Study** alternative fuels and their applications to **Understand** the characteristics and potential of alternative fuels to evaluate their suitability for automotive applications.	2	-	2	-	-			-	-	-	-	2	2	2	2

Total Quality Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21AU6022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** principles of quality contributed by quality guru's.
2. **Understand** different quality control tools used for continuous improvement.
3. **Understand** proactive improvement to develop new product.
4. **Understand** the involvement of different levels of management in TQM.
5. **Analyze** strategic planning in Hosing management and networking in TQM

UNIT – I	**8 Hours**

Overview of total quality management: history of TQM. Axioms of TQM, contribution of quality gurus – Deming's approach, Joran's quality trilogy, Crosby quality improvement, Kaizen, Ishikawa's companywide quality control, and Feigenbaum's theory of TQC.

Evolution of quality concepts and methods: quality concepts. Development of four fitness's, evolution of methodology, evolution of company integration, deviations to weaknesses to opportunities.

Self-study component:	Compare quality of conformance versus quality of design

UNIT – II	**8 Hours**

Four revolutions in management thinking: customer focus, continuous improvement, total participation, and societal networking.

Continuous improvement: improvement as problem solving process; management by process, wv model of continuous improvement, process control, process control and process improvement, process versus creativity.

Self-study component:	Compare process versus creativity in continuous improvement

UNIT – III	**8 Hours**

Reactive improvement: management diagnosis of seven steps of reactive improvement. General guidelines for management diagnosis of a QI story.

Proactive improvement; introduction to proactive improvement, standard steps for proactive improvement, semantics, example-customer visitation, applying proactive improvement to develop new products- three stages and nine steps.

Self-study component:	Discussion on case study for customer visitation

UNIT – IV	**8 Hours**

Total participation: Dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, initiation strategies, CEO involvement example strategies for TQM introduction. Infrastructure for mobilization, organization setting, training and e education, promotional activities, awards and incentives monitoring and diagnosis, phase-in, orientation phase, alignment phase.

Self-study component:	Explain teamwork skill

UNIT – V	**8 Hours**

Hoshin management: definition, phases in Hoshin management strategic planning (proactive), Hoshin deployment, controlling with métiers (control), check and act (reactive). Hoshin management versus management by objective.

Societal networking: networking and societal diffusion – regional and nationwide networking, infrastructure for networking, change agents, center for quality management case study, dynamics of a societal learning system.

Self-study component:	TQM model for skill development		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** principles of quality contributed by quality guru's	Understand	L2
CO2	**Understand** different quality control tools used for continuous improvement.	Understand	L2
CO3	**Understand** proactive improvement to develop new product.	Understand	L2
CO4	**Understand** the involvement of different levels of management in TQM	Understand	L2
CO5	**Analyze** strategic planning in Hosing management and networking in TQM	Analyze	L4

Text Book(s):

1. Shoji Shiba, Alan Graham and David Walden**, A New American TQM Four Practical Revolutions in Management –**, ""Productivity Press, Portlans (USA), 1993.
2. N Logothetis, **Management for Total Quality-** "" Prentice Hall Of India, New Delhi.1994.

Reference Book(s):

1. N V R Naidu, K M Babu, Rajendra, **Total quality management-**,", 2006
2. Kesavan R, **Total quality management** - - international publishing house pvt. Ltd, 2008

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs))

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Understand** principles of quality contributed by quality guru's	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
2	**Understand** different quality control tools used for continuous improvement.	2	2	-	-	-	-	-	-	-	-	-	2	2	-	-
3	**Understand** proactive improvement to develop new product.	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
4	**Understand** the involvement of different levels of management in TQM.	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
5	**Analyze** strategic planning in Hosing management and networking in TQM	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-

Operations Research [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AU6023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Solve** linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
2. **Determine** optimal strategy for Minimization of Cost and Maximization of profits using various methods
3. **Apply** the allocation of resources to the Demand using various techniques to minimize the cost / time of completion of number of jobs.
4. **Apply** the Model for competitive real-world phenomena using concepts from game theory
5. **Formulate** the models for service and manufacturing systems and **apply** OR techniques and algorithms

UNIT – I	**8 Hours**

Introduction: Definition, scope of Operations Research (O.R), limitations, OR Models, Characteristics and phases of OR. Mathematical formulation of L.P. Problems, Graphical solution methods.

Linear Programming Problems: The simplex method - slack, surplus , Concept of duality.

Self-study component:	Dual simplex method, Revised Simplex Method

UNIT – II	**8 Hours**

Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

Self-study component:	Assignment Problem by penalty Method

UNIT – III	**8 Hours**

Sequencing: Johnsons algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs m machines without passing sequence. 2 jobs n machines with passing. Graphical solutions

Queuing Theory, Queuing system and their characteristics, The M/M/1 Queuing system, Steady state performance.

Self-study component:	Sequencing of n jobs m machines

UNIT – IV	**8 Hours**

PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion.

Self-study component:	Crashing of simple networks.

UNIT – V	**8 Hours**

Game Theory: Formulation of games, Two person-Zero sum game, games with and without saddle point, Graphical solution (2x n , m x 2 game),

Inventory: Deterministic models with and without shortages; replenishment, mean time, ordering cost, carrying cost.

Self-study component:	Probabilistic Models

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Solve** linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.	Apply	L3
CO2	**Determine** optimal strategy for Minimization of Cost and Maximization of profits using various methods	Apply	L3
CO3	**Determine** the allocation of resources to the Demand using various techniques to minimize the cost / time of completion of number of jobs.	Apply	L3
CO4	**Determine** the Model for competitive real-world phenomena using concepts from game theory	Apply	L3
CO5	**Formulate** the models for service and manufacturing systems and **apply** OR techniques and algorithms	Apply	L3

Text Book(s):

1. S.D.Sharma, "Operation Research", Kedaranath&Ramnath Publications, 5th edition 2005
2. KantiSwaroop, "Operation Research", Sultan Chand Publications 8th edition 2000.

Reference Book(s):

1. Philip Ravindran, "Operation Research", Wiley Publications, 2nd edition 1987.
2. Hamid Taha, "Introduction to Operation Reaserch", Pearson 7th edition,2005.
3. TahaH . A. – Operations Research and Introduction, Pearson Education edition 2004.
4. B.S. GOEL, S.K. MITTAL - Operations Research

Course articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Statement**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Solve** linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
2	**Determine** optimal strategy for Minimization of Cost and Maximization of profits using various methods	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
3	**Apply** the allocation of resources to the Demand using various techniques to minimize the cost / time of completion of number of jobs.	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
4	**Apply** the Model for competitive real-world phenomena using concepts from game theory	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
5	**Formulate** the models for service and manufacturing systems and **apply** OR techniques and algorithms	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-

Two and Three Wheeled Vehicle [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P18AU6024**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Explain** the principles of balance, stability, and maneuverability of two and three-wheeled vehicles & its systems
2. **Discuss** & **understand** the historical and technological evolution, Classification, benefits and limitations of various types of **Two and Three Wheeled Vehicle**s & its systems.
3. To **understand**, in depth knowledge, the two and three wheeler technology to **compare** the underlying concepts and methods behind two and three wheeler technology.
4. **Apply** theoretical knowledge to practical situations, such as designing and optimizing vehicle systems or addressing specific user needs to **Develop** solutions for technical, operational and safety challenges in the context of these vehicles
5. Present and communicate information related to two and three-wheeled vehicles in a clear and organized manner and to **Analyze** the factors influencing the design and performance characteristics of two and three-wheeled vehicles & its systems

UNIT – I	**8 Hours**

Introduction: History, classification and layouts of the two wheeler, Types of Engine for two wheeler, Merits and demerits,

Ignition and Electric system: Battery charging system, Ignition system, Lighting System, Horn, Handle bar Control, Side stand/ Ignition Inter lock system, Instruments and Indicators

Self-study component:	Technical specification and manufacturer of two wheeler in india**.** Study of cooling system and lubrication system of Indian two wheeler

UNIT – II	**8 Hours**

Exhaust System: Exhaust system of Two wheeler, Tuned Exhaust system, Different layouts of Exhaust system, Muffler, Back pressure, Sound,

Cranking Mechanism: Introduction, Different types of Cranking Mechanism, Push Starting, Indirect Transmission, Direct Transmission, Kick Start Mechanism, Layout of Kick Start Mechanism, Auto start Mechanism.

Self-study component:	Study of different type of Exhaust system in Indian two wheeler

UNIT – III	**8 Hours**

Transmission System: Layout of transmission system of two wheeler, primary Reduction different types of clutch and Gear box Used in Two wheeler ,Gear shifting Mechanism hand operated shifting Mechanism, Foot operated shifting Mechanism, Continuous variable transmission (CVT),Final drive, Chain drive, Belt Drive, Shaft drive, Crush drive

Steering system: Steering Geometry and Effects, Steering Column Construction, Handle Bar type and construction

Self-study component:	Study of Different type of gear box used in Indian two wheeler

UNIT – IV	**8 Hours**

Suspension system: Designing Consideration for suspension system, Spring and shock Absorber Assembly Springer Forks Suspension, Ginder fork Suspension, Trailing and leading suspension,

Telescopic Suspension Single link type front suspension ,Double link type front suspension

Braking system: Introduction, Hand operated Mechanical Brake system, foot operated Mechanical brake, Hand operated hydraulic brake, foot operated hydraulic brake

Wheels and tyre: Spoked wheel, pressed steel wheel, Alloy wheel, specification of two wheeler tyre.

Self-study component:	Study of Different braking system of Indian two wheeler

UNIT – V		**8 Hours**

Frame and Body of Two wheeler: Engine Based Frame, Frame Material, body work, Ergonomic Consideration

Three Wheeler Vehicle: Classification of Three wheeler, Layout of Passenger Rickshaw, layout of loading Rickshaw, Engine for three wheeler, drive train of three wheeler, Suspension & brake, frame and Body

Self-study component:	Study of Different Indian three wheeler

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the principles of balance, stability, and maneuverability of two and three-wheeled vehicles & its systems	Knowledge	L1
CO2	**Discuss** & **understand** the historical and technological evolution, Classification, benefits and limitations of various types of **Two and Three Wheeled Vehicle**s & its systems	Understand	L2
CO3	To **understand**, in depth knowledge, the two and three wheeler technology to **compare** the underlying concepts and methods behind two and three wheeler technology.	Understand	L2
CO4	**Apply** theoretical knowledge to practical situations, such as designing and optimizing vehicle systems or addressing specific user needs to **Develop** solutions for technical, operational and safety challenges in the context of these vehicles.	Apply	L3
CO5	Present and communicate information related to two and three-wheeled vehicles in a clear and organized manner and to **Analyze** the factors influencing the design and performance characteristics of two and three-wheeled vehicles & its systems	Analyze	L4

Text Book(s):

1. Dhruv U Panchal, "**Two and three wheeler Technology**", PHI learning Pvt. Ltd., Aug 2018
2. P.E.Irving**"Motor Cycle engines**", Temple Press Book, London,1992
3. William H. Crouse and Donald L.Anglin **"Motor Cycle Mechanics**"- TATA McGraw-Hill , 1982

Reference Book(s):

1. Srinivas S, Motor cycle, scooters, Mopeds, New century book house, 1988
2. The Cycle Motor Manual - Temple Press Ltd, london1990
3. Michel M Griffin, Motor Cycles from inside and outside, Prenticehall inc, New Jersey, 1998
4. Service manuals of manufacturers of Indian two and three wheelers
5. Manoj Dole,Mechanic Two and three wheeler Training- 2018.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl No	Course Outcomes	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Explain** the principles of balance, stability, and maneuverability of two and three-wheeled vehicles & its systems	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
2	**Discuss** & **understand** the historical and technological evolution, Classification, benefits and limitations of various types of **Two and Three Wheeled Vehicle**s & its systems	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
3	To **understand**, in depth knowledge, the two and three wheeler technology to **compare** the underlying concepts and methods behind two and three wheeler technology.	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
4	**Apply** theoretical knowledge to practical situations, such as designing and optimizing vehicle systems or addressing specific user needs to **Develop** solutions for technical, operational and safety challenges in the context of these vehicles.	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
5	Present and communicate information related to two and three-wheeled vehicles in a clear and organized manner and to **Analyze** the factors influencing the design and performance characteristics of two and three-wheeled vehicles & its systems	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Automotive Transmission

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21AU6031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Identify** and describe the various components of transmission system.
2. **Explain** about hydraulic transmission such as fluid coupling and torque convertors.
3. **Describe** epicyclic type of transmission systems and its applications.
4. **Summarize** the Automotive transmission system such as manual and automatic transmission
5. **Sketch** the various components of transmission system such as gear box, automotive transmission system.

UNIT – I	**8 Hours**

CLUTCH Necessity of clutch in an automobile, different types of clutches, friction clutches namely Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, Clutch troubles and their causes, Clutch materials, clutch lining.

Self-study component:	multiplayer hydraulically operated clutch

UNIT – II	**8 Hours**

Fluid Coupling , One way clutches & torque converters: Constructional details of various types, percentage slip, one way clutches (Over running clutch) like sprag clutch, ball and roller one way clutches, necessity, working fluid requirements, fluid coupling characteristics,

Torque converters, comparison between fluid coupling and torque converters, single stage, two stage torque converter.

Self-study component:	poly phase hydrokinetic torque converter

UNIT – III	**8 Hours**

Gear box : Various Resistances to Motion of the Automobile, Traction, tractive effort, The need for transmission, Necessity of gear box, Calculation of gear ratios , Performance characteristics in different gears , Desirable ratios of 3speed & 4 speed gear boxes, Constructional details of, Sliding-mesh gear box , Constant-mesh gear box, synchromesh gear box, auxiliary transmissions, compound transmissions.

Self-study component:	triple counter shaft transmission

UNIT – IV	**8 Hours**

Epicyclic Transmission : Principle of operation, types of planetary transmission (dual and compound planetary assemblies), Calculation of gear ratio in different speeds, Wilson planetary transmission, Ford-T model gear box , Pre selective mechanism, Over drives.

Self-study component:	planetary final drives

UNIT – V	**8 Hours**

Automatic transmission: Automatic transmission - Principle, general description and Working of representative types like Borge-warner, 4-speed automatic transmission longitudinally mounted four speed automatic transmission, hydramatic transmission, the fundamentals of a hydraulic control system.

Self-study component:	electric drives

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** and describe the various components of transmission system.	Knowledge	L1
CO2	**Explain** about hydraulic transmission such as fluid coupling and torque convertors.	Knowledge	L1
CO3	**Describe** epicyclic type of transmission systems and its applications.	Knowledge	L1
CO 4	**Summarize** the Automotive transmission system such as manual and automatic transmission.	Apply	L2
CO5	**Sketch** the various components of transmission system such as gear box, automotive transmission system.	Apply	L3

Text Book(s):

1. N.K Giri, 'Automotive Mechanics', Khanna Publication, New Delhi, 2014
2. Advanced vehicle technology , Heinz Heisler , 2002

Reference Book(s):

1. Crouse W.H. "automotive transmissions and power trains", McGraw Hill Co. 5th edn, 1976
2. Newton K and Steeds. W. "motor Vehicle", Butter Worth's & Co., Publishers Ltd, 1997
3. Kirpal Singh, "Automobile engineering –. Vol.1, Standard Pub. 2011
4. G.B.S.Narang "Automobile Engineering', Khanna publication, New Delhi
   Joseph I Heitner, "Automotive mechanics ", Affiliated East West Press, NewDelhi

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Identify** and describe the various components of transmission system.	2	2										2	2		
2	**Explain** about hydraulic transmission such as fluid coupling and torque convertors.	2	2										2	2		
3	**Describe** epicyclic type of transmission systems and its applications.	2	2										2	2		
4	**Summarize** the Automotive transmission system such as manual and automatic transmission.	2	2										2	2		
5	**Sketch** the various components of transmission system such as gear box , automotive transmission system.	2	2										2	2		

Transport Management & Motor Vehicle Act

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21AU6032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

Develop a comprehensive understanding of various modes of public transportation, their operational characteristics, infrastructure requirements, and Organization management principles.

Learn the fundamentals of managing public transport operations. Understand how to optimize service levels, maintain fleet reliability, and manage customer service aspects such as passenger safety, comfort, and satisfaction.

Explore the role of technology and innovation in public transport management and other technological advancements to enhance efficiency, safety, and customer experience.

Understand the Motor Vehicle Act, Taxation and insurance.

Develop an awareness of environmental and sustainability issues in public transport management.

UNIT – I	**8 Hours**

Transport Management

History of transport with special reference to Road Transport in India, Modes of Road Transport, organization, structure of fleet organization, Road worthiness requirement maintenance of records, prevention and analysis of road accident,[1] Emphasis of safe driving annual awards, Bonus encouragement, Platform layout, Safety devices. Infrastructure, road network, Bus priorities, Bus -stops, shelters, Bus stations facilities for passengers,[2]Garages, types of garage, location, layout, selection of site, garage organization, Function, requirement of facilities, legal provisions for depot. Layouts, inspection of faulty vehicle, estimation of repairs, test reports. [1,2]Vehicle Design, Design Considerations, Design Options, Standardization, Safety, Convenience, Comfort, Security, Environmental Standards, Raising Standards. Garage Stores [1] Future of public transport [2].

Self-study component:	Fleet Maintenance–Preventive, Breakdown, Maintenance Standards Schedules.

UNIT – II	**8 Hours**

Organization Management

Forms of Ownership, Principle of Transport, Management–Internal organization, Centralized & Decentralized condition (Engineering, Traffic, Secretarial), Administration. Personnel Management and Training, training& for drivers & conductors, Staffing Levels, Staff Selection, Recruitment and Training, Discipline and Incentives. Factors affecting punctuality. Public Relations Divisions Dissemination of information, maintaining of goodwill-handling of complaints, Co-operation with the press news and articles, Forms of publicity. [2,3]

Self-study component:	Importance of quality, Inter departmental liaison advertisements, and Specialized publicity.

UNIT – III	**8 Hours**

Route Planning & Schedules

source of traffic, survey of route, preliminary schedule, test runs, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, Estimation of traffic flow- frequency, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency. Timings, Bus workings and Schedules-Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, , duty arrangements Source of traffic, Town planning, turning

points, Stopping places, Numerical Problems[2]		
Self-study component:	Cooperation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew	
UNIT – IV		**8 Hours**

Fare collections, Fare structure, Operating cost and types of vehicles

Need, Principles of collection, tickets and its types mechanical ticket machines, one-man operation, two stream boarding, pre-paid tickets, tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control.[2,3]Fare structure: Basis of fares, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares, concessions fares for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges. Operating cost and types of vehicles: Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, factor affecting cost per vehicles mile incidence of wages and overheads.[2]

Self-study component:	life of vehicles, sinking fund, types of vehicle, economic considerations

UNIT – V		**8 Hours**

Motor Vehicle Act

Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Accidents, Causes & analysis, Liabilities & preventive measures, Design of road complex, Responsibility of driver, Public & public authorities, Offences, penalties & procedures, Personnel, Authorities & duties, Rules & regulations, Rules regarding construction of motor vehicles. **Taxation** and **Insurance of vehicle** [1].

Self-study component:	Different types of forms. Government administration structure

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Develop** a comprehensive understanding of various modes of public transportation, their operational characteristics, infrastructure requirements, and Organization management principles.	Knowledge	L1
CO2	**Learn** the fundamentals of managing public transport operations. Understand how to optimize service levels, maintain fleet reliability, and manage customer service aspects such as passenger safety, comfort, and satisfaction.	Understand	L2
CO3	**Explore** the role of technology and innovation in public transport management and other technological advancements to enhance efficiency, safety, and customer experience.	Understand	L2
CO4	**Understand** the Motor Vehicle Act, Taxation and insurance.	Understand	L2
CO 5	**Develop** an awareness of environmental and sustainability issues in public transport management.	Apply	L3

Text Book(s):

1. V.S. Khilery, Dr. Satpal Sharma, Er.Shaman Gupta, Motor vehicle act and Transport Management, Ishan Publications, First Edition 2016-17
2. L D Kitchen ―Bus operation‖, ILIFFE & sons, London [Unit1-8]
3. Rex W. Faulks, Bus& coach operation, Butterworth Version Of 1988, London (**ISBN-10:** 0408028106, **ISBN-13:** 978-0408028103)

Reference Book(s):

1. P.G.Patankar, "Road Passenger Transport in India", CIRT, Pune.
2. Transport Management and Motor Vehicle act.-Dilip M kupade
3. Government Motor Vehicle Act –Publication on latest act to be used as on date

Course Articulation Matrix
Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	BL	Programme Outcomes												Programme Specific outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Develop** a comprehensive understanding of various modes of public transportation, their operational characteristics, infrastructure requirements, and Organization management principles.	2	2	-	-	-	-	-	-	-	-	-	-	2	-	2	-
2	**Learn** the fundamentals of managing public transport operations. Understand how to optimize service levels, maintain fleet reliability, and manage customer service aspects such as passenger safety, comfort, and satisfaction.	3	2	2	2	-	-	-	-	-	-	-	-	2	-	2	-
3	**Explore** the role of technology and innovation in public transport management and other technological advancements to enhance efficiency, safety, and customer experience.	2	2		-	-		-	-				-	2	-	2	-
4	**Understand** the Motor Vehicle Act, Taxation and insurance.	2	2	2	-	2		-	-				-	2	-	2	-
5	**Develop** an awareness of environmental and sustainability issues in public transport management.	2	2	2	-	2		-	-				-	2	-	2	-

Finite Element Methods [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AU6033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the basic principles, concepts and preliminaries of FEM required to solve basic field problems.
2. **Identify** the appropriate element types ,its application and characteristics of FEA
3. **Apply** interpolation models for 1D and 2D elements that satisfy convergence criteria for solving complex problems using FEM**.**
4. **Apply** suitable boundary conditions to a global equation for structural and heat transfer problems and solve the displacements, stress and strains induced.
5. **Analyze** element characteristic equation and formation of global equation to solve complex engineering problems.

UNIT – I	**8 Hours**

INTRODUCTION TO FEM: Need for use of FEM, Advantages and disadvantages of FEM, Engineering Applications of FEM, Steps involved in FEM, Discretization process – types of elements (1D,2D,3D), size of the elements, location of nodes, node numbering scheme, Method of solution of linear algebraic equations – Gauss elimination method. Numerical integration by Gaussian quadrature (one point and two point formula).

Self-study component:	Concept of plane stress and plane strain and their stress-strain relations.

UNIT – II	**8 Hours**

INTERPOLATION MODELS: Displacement function, selection of the order of displacement function, convergence criteria, geometric isotropy, Pascal's triangle for 2D polynomial, Different co-ordinate systems used in FEM, Interpolation or shape functions for 1D linear and quadratic bar elements and 2D linear triangular (CST) element in cartesian and natural co-ordinate systems. Lagrangian polynomial – Shape functions for linear quadrilateral element (QUAD 4).

Self-study component:	Concept of Jacobian matrix, Jacobian matrix for CST

UNIT – III	**8 Hours**

ELEMENT STIFFNESS MATRIX AND LOAD VECTORS: Strain displacement matrix, Stiffness matrix and load vector for linear and quadratic bar element and CST element. Assembly of elements by direct stiffness method, special characteristics of stiffness matrix, Treatment of boundary conditions-elimination and penalty methods.

Self-study component:	Analysis of axially loaded uniformly tapered and stepped bars

UNIT – IV	**8 Hours**

ANALYSIS OF PLANE TRUSSES AND BEAMS: Local and global coordinate systems, stiffness matrix for plane truss element, analysis of truss members. Hermite shape function for beam element in Cartesian coordinates, Stiffness matrix and load vector for beam element, element shear force and bending moment.

Self-study component:	analysis of beams & Plane stresses

UNIT – V	**8 Hours**

ANALYSIS OF HEAT TRANSFER PROBLEMS: Steady state heat transfer, 1D heat conduction-governing equation, boundary conditions, one-dimensional element, Galerkin's approach to heat conduction, heat flux boundary condition. 1D heat transfer in thin fins- Formulation of equations. Simple numerical of 1D heat transfer problems on composite walls and fins with conduction and convection.

Self-study component:	Analysis of 2D heat transfer

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the basic principles, concepts and preliminaries of FEM required to solve basic field problems.	Understand	L2
CO2	**Understand** the appropriate element types ,its application and characteristics of FEA	Understand	L2
CO3	**Apply** interpolation models for 1D and 2D elements that satisfy convergence criteria for solving complex problems using FEM**.**	Apply	L3
CO4	**Apply** suitable boundary conditions to a global equation for structural and heat transfer problems and solve the displacements, stress and strains induced	Apply	L3
CO5	**Analyze** element characteristic equation and formation of global equation to solve complex engineering problems.	Analyze	L4

Text Book(s):

1. Introduction to the Finite Element Method: C. S. Desai and J.F. Abel, EWP an East-West Edition
2. Introduction to Finite Elements in engineering: T R Chandrupatla and A D Belegundu, PHI.
3. The Finite Element Method in engineering: S S Rao, Elsevier. 5th edition 2010 **eBook ISBN:** 9780080952048 **Hardcover ISBN:** 9781856176613

Reference Book(s):

1. The FEM its basics and fundamentals: O.C.Zienkiewicz, Elsevier, 6e.2005. ISBN: 9780080472775
2. J.N.Reddy, Finite Element Method: McGraw –Hill International Edition.2004
3. Daryl. L. Logon, Finite Element Methods: Thomson Learning 6rd edition.2017 ISBN13: 9781305635111 ISBN10: 1305635116

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the basic principles, concepts and preliminaries of FEM required to solve basic field problems.	2	-	-	-	-	-	-	-	-	2	-	-	2	-	
2	**Understand** the appropriate element types ,its application and characteristics of FEA	2									2			2		
3	**Apply** interpolation models for 1D and 2D elements that satisfy convergence criteria for solving complex problems using FEM**.**	2	2	-	-	-	-	-	-	-	-	-	-	2	-	
4	**Apply** suitable boundary conditions to a global equation for structural and heat transfer problems and solve the displacements, stress and strains induced.	2	2	-	-	-	-	-	-	-	-	-	-	2	-	
5	**Analyze** element characteristic equation and formation of global equation to solve complex engineering problems..	2	2	-	-	-	-	-	-	-	-	-	-	2	-	

Battery Technology & Charging Infrastructure [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AU6034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.
2. **Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries.
3. **Analyze** battery monitoring and diagnostics methods.
4. **Analyze** Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.
5. **Explore** Sustainable Charging Solutions and Charging Protocols and Standards.

UNIT – I	**8 Hours**

Introduction to Electric vehicles: Introduction: Limitations of IC Engines as prime mover, History of EVs, EV system, components of EV, Basic Structure-Electric vehicle drive train-advantages and limitations. Configuration of electric vehicle, performance of electric vehicle, traction motor characteristics, tractive effort and transmission requirement , vehicle performance.

Self-study component:	Advance battery management system.

UNIT – II	**6 Hours**

Introduction to Battery Management System: Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power brief concepts. Types of battery management systems active and passive types and working principle with circuit layout, MOSFET and its applications

Self-study component:	Measurement of temperature, voltage , current using algorithm.

UNIT – III	**8 Hours**

Battery Performance Parameters: Battery State of Charge and State of Health Estimation, Cell Balancing: Battery state of charge estimation (SOC)- voltage-based methods to estimate SOC.

Battery Management System Requirement: BMS Functionality and requirements, Voltage Sensing, Temperature Sensing, Current Sensing, High-voltage contactor control.

Self-study component:	Types, features and design considerations of BMS

UNIT – IV	**8 Hours**

Charging Infrastructure: Requirements for charging infrastructure for -Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

Self-study component:	Charging infrastructure using alternative source solar .

UNIT – V	**10 Hours**

Battery Chargers and stations: General system requirements for charging stations, types of charging mode- AC and DC mode, adapters and extension sets, environmental safety and electrical safety measures to be maintained.

Self-study component:	Case Study on fast charging for EV

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.	Understanding	L2
CO2	**Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries.	Understanding	L2
CO3	**Analyze** battery monitoring and diagnostics methods.	Analyze	L4
CO4	**Analyze** Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.	Analyze	L4
CO5	**Explore** Sustainable Charging Solutions and Charging Protocols and Standards.	Analyze	L4

Text Book(s):

1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Book(s):

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001. 3 Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.[L2]	2	2	2										2		
2	**Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries[L2]	2	2	2										2		
3	**Analyze** battery monitoring and diagnostics methods.[L4]	2	2	2										2		
4	**Analyze** Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.[L4]	2	2	2										2		
5	**Explore** Sustainable Charging Solutions and Charging Protocols and Standards.[L4]	2	2	2										2		

Automotive Chassis and Suspension (Integrated)

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21AU604**	**Credits:**	**04**
Teaching Hours/Week (L:T:P)	**L:T:P :- 3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40hrs [Theory]+ 24 hrs of [Lab]**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understand** the construction, function, type & working principle of automotive Chassis & its components.
2. **Comprehend** the Technical Specifications and Troubleshooting Charts of Chassis & its components
3. **Compute** the major dimensions and about the working of Chassis components and analyze the same
4. **Measure, compare, analyze** the dimensions of Chassis & its components with the standard proportions, for wear & tear during Dismantling/ assembling of Chassis & its components.
5. Perform, **analyze and understand** the status and functioning of Chassis & its components.

UNIT – I		**8 Hours**

Introduction-General consideration relating to chassis layout, Requirements of good chassis design, types of automobiles, power Plant location, and layout of an automobile with reference to location of engine and transmission along with relative advantages and disadvantages. Power for propulsion, Resistance, Traction and Tractive effort, Relation between Engine and Vehicle speed, weight distribution, stability of a vehicle on a slope.

Frames-Types of frames, general form and dimensions, materials, frame stresses, frame sections, cross members, proportions of channel sections, constructional details, loading points, sub frames, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems

Self-study component:	Advanced chassis layouts with different power Plant location. Advanced frames structures for automobiles

Practical Topics	**Technical specifications** and brief description of chassis and transmission components of:- a) Two wheeled vehicle b) three wheeled vehicle (including body and interiors) c) Four wheeled vehicle (LMV/LTV & HMV/HTV) (including body and interiors)	**4 Hrs**

UNIT – II		**8 Hours**

Front Axle – Axle parts and materials, loads and stresses, center sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, center point steering, correct steering angle. **Steering Systems** steering mechanisms, cornering force, self-righting torque, under steer and over steer, steering linkages, steering gears, special steering columns, power steering, Four wheel steering, trouble shooting, Numerical problems.

Self-study component:	Trouble shooting and Study of Front Axle and Steering Systems used in recent vehicles with advanced technologies.

Practical Topics	**Trouble shooting** of major parts of chassis and transmission components:- a) Front axle (dead/ live), brakes (drum, disc), wheels, tyres, Steering system and suspension system (Rigid axle & Independent). b) Clutch, gear box, Propeller shaft, Universal Joint & Slip joint, differential, Rear axle.	**4 Hrs**

<table>
<tr><td>UNIT – III</td><td colspan="2"></td><td>8 Hours</td></tr>
<tr><td colspan="4">Propeller shafts:- Construction and types of propeller shafts, whirling of propeller shaft, universal joints, analysis is of Hooke’s joint-ratio of shafts velocities, maximum and minimum speeds of driven shaft, condition for equal speeds of the driving and driven shafts, angular acceleration of the driven shaft, maximum fluctuation of speed, double Hooke’s joint, Numerical problems.
Final drive-construction details, types. Differential:- Principle, types of differential gears, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, trans-axle 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, trouble shooting, numerical problems.</td></tr>
<tr><td colspan="2">Self-study component:</td><td colspan="2">Trouble shooting and Study of Propeller shafts, Differential and Rear axle used in recent vehicles with advanced technologies.</td></tr>
<tr><td>Practical Topics</td><td colspan="2"><u>Dismantle and assemble</u> major systems of chassis and transmission components: -
a) Front axle (dead/ live), differential, Rear axle, brakes (drum, disc).
b) Wheels, tyres, steering system and suspension system (Rigid axle & Independent).</td><td>06 Hours</td></tr>
<tr><td>UNIT – IV</td><td colspan="2"></td><td>8 Hours</td></tr>
<tr><td colspan="4">Brakes- Necessity, stopping distance and time, brake efficiency, weigh transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems-mechanical, hydraulic, disc, drum, details of hydraulic system, mechanical system and components, types of master and wheel cylinders, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc,. Brake compensation, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes- Air brakes, wagnerair brake, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting, Numerical problems.</td></tr>
<tr><td colspan="2">Self-study component:</td><td colspan="2">Trouble shooting and Study of Brake systems used in recent vehicles with advanced technologies.</td></tr>
<tr><td>Practical Topics</td><td colspan="2"><u>Dismantle and assemble</u> major systems of chassis and transmission components:
a) Clutch, Propeller shaft, Universal Joint & Slip joint.
b) Gear box (Constant mesh – LMV & HMV)</td><td>08 hours</td></tr>
<tr><td>UNIT – V</td><td colspan="2"></td><td>8 Hours</td></tr>
<tr><td colspan="4">Suspension - Objects, basic considerations, Types of suspension springs, construction, operation and materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel in dependent suspension, rear wheel independent suspension, types, stabilizer, Air & Hydro-gas suspension troubleshooting, Numerical problems.
Wheels and Tyres- Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section and designation, factors affecting tyre life, quick change wheels, special wheels, troubleshooting,</td></tr>
<tr><td colspan="2">Self-study component:</td><td colspan="2">Trouble shooting and Study of Suspension system, Wheels and Tyres used in recent vehicles with advanced technologies.</td></tr>
<tr><td>Practical Topics</td><td><u>Dismantle and assemble</u> major systems of chassis and transmission components:
a. Gear box (Synchromesh & Automatic)</td><td colspan="2">02 Hours</td></tr>
</table>

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the construction, function, type & working principle of automotive Chassis & its components.	Understand	L2
CO2	**Comprehend** the Technical Specifications and Troubleshooting Charts of Chassis & its components	Understand	L2
CO3	**Compute** the major dimensions and about the working of Chassis components and analyze the same	Compute	L3
CO4	**Measure, compare, analyze** the dimensions of Chassis & its components with the standard proportions, for wear & tear during Dismantling/ assembling of Chassis & its components	analyze	L4
CO5	Perform, **analyze and understand** the status and functioning of Chassis & its components.	analyze	L4

Text Book(s):

1. Heldt. P.M.- "**Automotive Chassis**"- Chilton Co., Literary Licensing, LLC, 2012
2. N.K. Giri, "**Automotive Mechanics**",8th Edition , Khanna Publications, New Delhi,2013

Reference Book(s):

1. Kirpal Singh"**AutomobileEngineering**"Vol.I,12thedition,Standardpublications,New Delhi, 2012
2. K. K. Ramalingam -"Automobile Engineering"– Sci tech Publication, Chennai– 2011
3. Joseph I Heintner, "Automotive mechanics" 2ndedition, Affiliated East West Press, New Delhi/Madras,2013
4. William H.Crouse, "Automotive Mechanics" Tata McGraw Hill Publication, New Delhi, 2007

Course Articulation Matrix - Automotive Chassis and Suspension (Integrated)

Mapping of Course Outcomes (CO) with Program Outcomes (POs) &Program Specific Outcomes (PSOs)

CO	Statement	BL	Programme Outcomes												Programme Specific outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the construction, function, type & working principle of automotive Chassis & its components.	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-
2	**Comprehend** the Technical Specifications and Troubleshooting Charts of Chassis & its components	2	2		-	-		-	-				-	2	2	-	2
3	**Compute** the major dimensions and about the working of Chassis components and **analyze** the same	3	2	2	2	-	-	-	-	-	-	-	-	2	2	-	-
4	**Measure, compare, analyze** the dimensions of Chassis & its components with the standard proportions, for wear & tear during Dismantling/ assembling of Chassis & its components.	4	2	2	-			-	-				-	2	2	-	2
5	Perform, **analyze and understand** the status and functioning of Chassis & its components.	4	2	2	-			-	-				-	2	2	-	2

Automotive chassis and Transmission (Open Elective-II) [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21AUO6051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Identify** the various chassis and transmission systems used in a vehicle.
2. **Understand** the concept of transmission systems such as clutch, gear box, final drives and suspension systems.
3. **Understand** the final drives and how the power is transferred from engine to wheels.
4. **Summarize** the whole transmission system mainly clutch, gear box, final drives, steering and suspension systems.
5. **Sketch** the transmission units and learn their working and their purposes

UNIT – I	**8 Hours**

Introduction: Chassis layout and its components, Types of chassis [ladder and x- member type].**CLUTCHES** :Necessity of clutch in an automobile, different types of clutches, friction clutches, namely single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, fluid coupling, torque converters, comparison between fluid coupling and torque converters, single stage.

Self-study component:	3 & 4 phase torque converters

UNIT – II	**8 Hours**

GEAR BOX : Various Resistances to Motion of the Automobile, Traction, tractive effort, The need for transmission, Desirable ratios of 3speed & 4 speed gear boxes, Constructional details of Sliding-mesh gear box , Constant-mesh gear box, synchromesh gear box.

Self-study component:	Continuously variable transmission

UNIT – III	**8 Hours**

FINAL DRIVES AND REAR AXLE: introduction, single reduction, double reduction and planetary final drives, differential, differential lock, Hotchkiss drive, torque tube drive, construction of rear axle supporting.

Self-study component:	Skid reducing final drives

UNIT – IV	**8 Hours**

STEERING AND SUSPENSION :Steering mechanisms, steering geometry, steering linkages, steering gears[rack and pinion], power steering,
Suspension **system:** objects, types of suspension springs, coil springs, shock absorbers, air suspension system.

Self-study component:	Rack and pinion electric power assisted steering

UNIT – V	**8 Hours**

BRAKES: Necessity, types of brakes, drum brake, disc brake, hydraulic brake, air brake, servo brakes, power brake, electric brake, ABS.

Wheels and Tyres- Types of wheels, construction, structure and function, wheel dimensions, types of tyres, designation.

Self-study component:	Servo Brakes

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the various chassis and transmission systems used in a vehicle.	Knowledge	L1
CO2	**Understand** the concept of transmission systems such as clutch, gear box, final drives and suspension systems.	Understand	L2
CO3	**Understand** the final drives and how the power is transferred from engine to wheels.	Knowledge	L2
CO4	**Summarize** the whole transmission system mainly clutch, gear box, final drives, steering and suspension systems.	Understand	L2
CO 5	**Sketch** the transmission units and learn their working and their purposes.	Apply	L3

Text Book(s):

1. Kirpal Singh, "Automobile engineering –. Vol.1, Standard Pub. 2014
2. N.K Giri, 'Automotive Mechanics', Khanna Publication, New Delhi, 2014

Reference Book(s):

1. G.B.S.Narang "Automobile Engineering', Khanna publication, New Delhi, 2015
2. Heinz Heisler , Advanced vehicle technology , , 2002

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Identify** the various chassis and transmission systems used in a vehicle.	2	2				2						2	2		
2	**Understand** the concept of transmission systems such as clutch, gear box, final drives and suspension systems.	2	2				2						2	2		
3	**Understand** the final drives and how the power is transferred from engine to wheels.	2	2				2						2	2		
4	**Summarize** the whole transmission system mainly clutch, gear box, final drives, steering and suspension systems.	2	2				2						2	2		
5	**Sketch** the transmission units and learn their working and their purposes.	2	2				2						2	2		

Electric vehicle, Battery Technology & Charging Infrastructure (Open Elective)

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21AU6052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.
2. **Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries.
3. **Analyze** battery monitoring and diagnostics methods.
4. **Analyz**e Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.
5. **Explore** Sustainable Charging Solutions and Charging Protocols and Standards.

UNIT – I	**10 Hours**

Introduction to Electric Vehicles: Electric vehicles (EV), Hybrid vehicles, Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Electric Vehicle (FCEV).

Introduction to Batteries: Functions, Types, Construction and working principle of Lead-acid battery, nickel-metal hydride battery, Lithium ion battery, battery charging, performance of a battery, battery rating and capacity, battery efficiency.

Self-study component:	Advance battery management system.

UNIT – II	**6 Hours**

Introduction to Battery Management System: Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power brief concepts. Types of battery management systems active and passive types and working.

Self-study component:	Measurement of temperature, voltage, current using algorithm.

UNIT – III	**8 Hours**

Battery Performance Parameters: Battery State of Charge and State of Health Estimation, Cell Balancing: Battery state of charge estimation (SOC) - voltage-based methods to estimate SOC.

Battery Management System Requirement: BMS Functionality and requirements, Voltage Sensing, Temperature Sensing, Current Sensing, High-voltage contactor control system.

Self-study component:	Types, features and design considerations of BMS

UNIT – IV	**10 Hours**

Charging Infrastructure: Requirements for charging infrastructure for -Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

Self-study component:	Charging infrastructure using alternative source solar.

UNIT – V	**06 Hours**

Battery Chargers and stations: General system requirements for charging stations, types of charging mode- AC and DC mode, adapters and extension sets, environmental safety and electrical safety measures to be maintained.

Self-study component:	Case Study on fast charging for EV

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.	Understand	L2
CO2	**Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries.	Understand	L2
CO3	**Analyze** battery monitoring and diagnostics methods.	Analyze	L4
CO4	**Analyze** Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.	Analyze	L4
CO5	**Explore** Sustainable Charging Solutions and Charging Protocols and Standards.	Analyze	L4

Text Book(s):

1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Book(s):

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001. 3 Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understanding** the fundamental concepts related to electric vehicles, batteries, including their specifications, energy storage capabilities.[L2]	2	2	2		2		2						2		
2	**Understanding** the functionality of battery management systems, which are responsible for monitoring and controlling the charging, discharging, and overall health of batteries[L2]	2	2	2		2		2						2		
3	**Analyze** battery monitoring and diagnostics methods.[L4]	2	2	2		2		2						2		
4	**Analyze** Charging Infrastructure Requirements, Develop the ability to assess the charging infrastructure needs for different settings.[L4]	2	2	2		2		2						2		
5	**Explore** Sustainable Charging Solutions and Charging Protocols and Standards.[L4]	2	2	2		2		2						2		

Skill Oriented Laboratory – II (Modeling and Analysis lab)
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21AUL606**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. **Develop** proficiency in using ANSYS software, including understanding the user interface, navigation, and basic commands for static and dynamic analysis.
2. **Utilize knowledge** and practical experience in performing FEA using ANSYS. **Learn** how to create finite element models, define material properties, apply boundary conditions, and analyze stress, strain, and deformation of structures under various loading conditions.
3. **Make use of** skills in analyzing structural components and systems using ANSYS. **Learn** how to model and analyze static and dynamic structural behavior
4. **Understand** the principles and application of CFD using ANSYS. Learn how to set up and solve fluid flow problems, analyze heat transfer, and visualize fluid flow patterns and results.
5. **Build knowledge** of thermal analysis techniques using ANSYS. Learn how to model and analyze heat transfer phenomena, including conduction, convection, and radiation.

UNIT – I	**FINATE ELEMENT ANALYSIS** (Ansys / Nastran / Patran etc.)	**21 Hours**

Study of FEA packages, Modeling, Static and Dynamic analysis (simple exercises)

1) Static Analysis 15 Hrs

a) Bars subjected to axial loads for Constant cross section, Tapered cross section & steppedbars
b) Trusses – Simple trusses
c) Beams – Cantilever and simply supported beams subjected to point load, UDL, UVL andmoments
d) Analysis of Rectangular Plates (with and without holes) subjected to axial and bendingloads.
e) Thermal analysis – 2D problems (thermal and heat transfer) with conduction andconvection boundary conditions
f) Fluid flow analysis – simple 2D problems Verification of Results of conventionalproblems

2) Dynamic Analysis 06 Hrs

a. Harmonic analysis of bars and beams
b. Natural frequency and modal analysis (Eigen values and Eigen vectors) of beams

UNIT – II	**ANALYSIS USING ANSYS - WORKBENCH** (simple exercises)	**05 Hours**

Introduction about workbench

1.**Static stress analysis of structural elements using ANSYS workbench**

a. Plate with hole subjected to plane stress
b. Beams of different cross-section subjected to bending and shear

2. **Thermal analysis using ANSYS workbench**

a. Heat transfer in Circular fins

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Develop** proficiency in using ANSYS software, including understanding the user interface, navigation, and basic commands for static and dynamic analysis.	Analyze	L3
CO2	**Utilize knowledge** and practical experience in performing FEA using ANSYS. **Learn** how to create finite element models, define material properties, apply boundary conditions, and analyze stress, strain, and deformation of structures under various loading conditions.	Analyze	L3
CO3	**Make use of** skills in analyzing structural components and systems using ANSYS. **Learn** how to model and analyze static and dynamic structural behavior.	Analyze	L3
CO4	**Understand** the principles and application of CFD using ANSYS. Learn how to set up and solve fluid flow problems, analyze heat transfer, and visualize fluid flow patterns and results.	Analyze	L3
CO5	**Build knowledge** of thermal analysis techniques using ANSYS. Learn how to model and analyze heat transfer phenomena, including conduction, convection, and radiation.	Analyze	L3

Text Books/ Reference Books:

1. C. S. Desai and J.F. Abel, EWP,Introduction to the Finite Element Method: an East-WestEdition
2. T R Chandrupatla and A D Belegundu, PHI, Introduction to Finite Elements in engineering:
3. S S Rao, Elsevie, The Finite Element Method in engineering: 5^{th} edition 2010, e-Book: ISBN: 9780080952048 Hardcover ISBN: 9781856176613.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs)

CO	Statement	BL	Programme Outcomes												Programme Specific outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Develop** proficiency in using ANSYS software, including understanding the user interface, navigation, and basic commands for static and dynamic analysis.	L3	3	3	-	-	-		-	-	-	-	2	2	3	2	3
2	**Utilize** knowledge and practical experience in performing FEA using ANSYS. Learn how to create finite element models, define material properties, apply boundary conditions, and analyze stress, strain, and deformation of structures under various loading conditions.	L3	3	3	-	-	-		-	-		-	2	2	3	2	3
3	**Make use of** skills in analyzing structural components and systems using ANSYS. Learn how to model and analyze static and dynamic structural behavior.	L3	3	3	2	-	-		-	-		-	2	2	3	2	3
4	**Understand** the principles and application of CFD using ANSYS. Learn how to set up and solve fluid flow problems, analyze heat transfer, and visualize fluid flow patterns and results.	L3	3	3	-	-	-		-	-		-	2	2	3	2	3
5	**Build knowledge** of thermal analysis techniques using ANSYS. Learn how to model and analyze heat transfer phenomena, including conduction, convection, and radiation.	L3	3	3	2	-	-		-	-		-	2	2	3	2	3

Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21AUMP607**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

Employability Enhancement Skills (EES) - VI
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21HSMC608**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Explain the basic concepts in Race and games, Linear equations, mensuration, height and distance.
- Apply the logical skills in decoding Number, letter series and Game based assessments.
- Calculations involving Time, Speed and distance, HCF & LCM, Averages and Partnerships

UNIT – I	**10 Hours**

Quantitative Aptitude: Race and games, Linear equations

Logical Reasoning: Number and letter series

Self-Study: Types of cryptarithm.

UNIT – II	**10 Hours**

Quantitative Aptitude: Mensuration, Height & distance.

Logical Reasoning: Game based assessments.

Self-Study: Inferred meaning, Chain rule.

UNIT – III	**08 Hours**

Quantitative Aptitude: Time, Speed and distance, HCF & LCM, Averages and Partnerships

Self-Study: Decimal fractions

Course Outcomes: On completion of this course, students are able to:

CO – 1:	Solve the problems based on Race and games, Linear equations, mensuration, height and distance.
CO – 2:	Solve logical reasoning problems based on Number, letter series and Game based assessments.
CO – 3:	Solve the problems based on HCF & LCM, averages and partnerships.

Text Book(s):

1. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
2. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd
2. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
3. CAT Mathematics by Abhijith Guha, PHI learning private limited.

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - VI**]**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	-	-	-	-	-	-	-	-	-	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	2
CO-3	2	2	-	-	-	-	-	-	-	-	-	2

Universal Human Values and Professional Ethics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21UHV609**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25 + 5**	**SEE Marks:**	**50**

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous selfevolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module - 1

Introduction to Value Education **(3 hours)**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); • They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. • They would have better critical ability. • They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). • It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Expected to positively impact common graduate attributes like: 1. Ethical human conduct 2. Socially responsible behaviour 3. Holistic vision of life 4. Environmentally responsible work 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions,** each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
- The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM