

# SYLLABUS

(With effect from 2018-19)

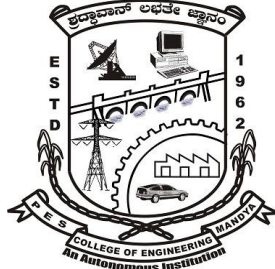
## ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2018-19)

**V & VI Semester (2020-21)**

**Bachelor Degree  
in  
Automobile Engineering**

**Out Come Based Education  
with  
Choice Based Credit System**



### **P.E.S. College of Engineering**

Mandya - 571 401, Karnataka

(An Autonomous Institution Affiliated to VTU, Belagavi,  
Grant -in- Aid Institution (Government of Karnataka), World Bank Funded College (TEQIP)  
Accredited by NBA, New Delhi and Approved by AICTE, New Delhi.)

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

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(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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### Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight Undergraduate and Six Postgraduate programs. It consists of four M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13<sup>th</sup> June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

*Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.*

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a ‘cafeteria’ type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills, Personality Development modules and Technical Skills have been added to the existing curriculum of the academic year 2018-19. Internship have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Technical Skills and Skill Oriented Lab are included in all undergraduate programs.

Dr. Umesh D R  
Deputy Dean (Academic)  
Associate Professor,  
Dept. of CS &Engg

Dr. Nagarathna  
Dean (Academic)  
Professor  
Dept. of CS &Engg



## **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.

### **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.



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### **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 modeling 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.



### V Semester, B.E, Automobile Engineering

Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18 AU 51	Industrial Management and Entrepreneurship	AU	4	-	-	4	50	50	100
2	P18 AU 52	Design of Machine Elements- II	AU	4	-	-	4	50	50	100
3	P18 AU 53	Automotive Fuels and Combustion	AU	4	-	-	4	50	50	100
4	P18 AU 54	Auxiliary Systems of Automotive Engines	AU	4	-	-	4	50	50	100
5	P18 AU 55X	<b>Professional Elective - I</b>	AU	2	2	-	3	50	50	100
6	P18 AUL 56	Fuel Testing and Measurement Lab	AU	-	-	3	1.5	50	50	100
7	P18 AUL 57	Engine and Components Lab	AU	-	-	3	1.5	50	50	100
8	P18 AU L58	Skill Oriented Lab- I (Computer Aided M/c Drawing-3D)	AU	-	-	2	1	50	50	100
9	P18AU591	Technical Skills – I (Simulation Lab)	AU	-	2	-	1	50	50	100
10	P18 HU 510	Aptitude and Reasoning Development-Advance(ARDA)	HM	-	2	-	1	50	50	100
<b>Total</b>							<b>25</b>	<b>500</b>	<b>500</b>	<b>1000</b>

Professional Elective – I						Technical Skills					
Sl. No	Course Code	Course title	Sl. No	Course Code	Course title						
1.	P18 AU 551	Advanced Engine Technology	1.	P18AU591	(Simulation Lab)						
2.	P18 AU 552	Production of Automotive Components									
3.	P18 AU 553	Micro controller & Embedded System									
4.	P18 AU 554	Non Traditional Machining									

VI – Semester										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18 AU 61	Automotive Chassis and Suspension	AU	4	-	-	4	50	50	100
2	P18 AU 62	Automotive Transmission	AU	4	-	-	4	50	50	100
3	P18 AU 63	Automotive Electricals and Electronics	AU	4	-	-	4	50	50	100
4	P18 AU 64X	<b>Professional Elective-II</b>	AU	2	2	-	3	50	50	100
5	P18 AU 065X	<b>Open Elective-I</b>	AU	3	-	-	3	50	50	100
6	P18 AU L66	Automotive Chassis and Transmission Lab	AU	-	-	3	1.5	50	50	100
7	P18 AU L67	Automotive Electricals and Autotronics Lab	AU	-	-	3	1.5	50	50	100
8	P18 AU L68	Skill Oriented Lab-II (Modelling and Analysis lab)	AU	-	-	2	1	50	50	100
9	P18 HU 693	Technical Skills-II (Internals of C Programming)	HM	2	-	-	1	50	50	100
<b>Total</b>							<b>23</b>	<b>450</b>	<b>450</b>	<b>900</b>

List of Electives										
Professional Elective - II						Open Elective – I				
Sl. No	Sl. No	Course Code	Course title	Sl. No.	Course Code	Course title				
1	1	P18AU641	Total Quality Management	1.	P18AU0651	Automotive Engines and systems				
	2	P18AU642	Automotive Air Conditioning							
3	3	P18AU643	Operation Research							
	4	P18AU644	Two and Three Wheeled Vehicles							

#### Evaluation Scheme for Theory Subjects

Scheme	Weightage	Marks	Event Break Up				
			Test I	Test II	Quiz I	Quiz II	Assignment
CIE	50%	50	35	35	5	5	10
SEE	50%	100	Questions to Set: 10			Questions to Answer: 5	
Scheme of SEE Question Paper (100 Marks)							
Duration: 3Hrs			Marks: 100			Weightage: 50%	
<ul style="list-style-type: none"> <li>Each of the two questions set shall be so comprehensive as to cover the entire contents of the unit.</li> <li>There will be direct choice between the two questions within each Unit</li> <li>Total questions to be set are 10. All carry equal marks of 20</li> <li>The number of subdivisions in each main question shall be limited to three only</li> <li>Number of questions to be answered by students is 5</li> </ul>							

#### Evaluation Scheme for Practical Subjects

CIE		SEE ( three hour duration of 50 Marks)		
Assessment	Weightage in Marks	Sl. No.	Marks allotment	
TEST I	20	1	Procedure & Conduction	40 Marks
TEST II	20			
Record	10	2	Viva	10Marks
Total	50		Total	50 Marks



**FIFTH SEMESTER**

<b>Course Title: Industrial Management and Entrepreneurship</b>			
Course Code: P18AU51	Semester: V	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

Subject requires student to know about Basic Knowledge about management concepts and Entrepreneurial knowledge.

**Course Learning Objectives (CLOs) :**

**This Course Aims to:**

1. Explain fundamental understanding of management, nature scope, and functions of a manager and development of management thought. Also explain planning and decision making processes.
2. Explain the organizational structure, departmentation, staffing and leading processes.
3. Describe the conceptual understanding of motivation and different control systems in management.
4. Understanding of Entrepreneurships and Entrepreneurship development process.
5. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.

**Course Content**

**UNIT-I**

**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, Development Of Management Thought - Early Management Approaches - Modern Management Approaches.

**PLANNING:** Nature, Importance and Purpose of Planning Process -Objectives - Types of Plans (Meaning only) - Decision Making - Importance Of Planning - Steps In Planning & Planning Premises - Hierarchy Of Plans.

**SSC:** study of scientific management according to different authors

**11 Hrs**

**UNIT-II**

**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, Communication - Meaning and Importance - Coordination, Meaning And Importance And Techniques Of Co -Ordination.

**SSC:** Study of organizing structure of any one of existing unit.

**10 Hrs**

**UNIT-III**

**CONTROLLING:** Meaning and Steps In Controlling - Essentials of A Sound Control System - Methods Of Establishing Control (In Brief)

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

**SSC:** Identify in entrepreneur nearby you & report in detail.

**10 Hrs**





### UNIT-IV

**SMALL SCALE INDUSTRY:** Definition; Characteristics; Need And Rationale: Objectives; Scope; Role Of SSI In Economic Development. Advantages Of SSI, Steps To Start An SSI - Government Policy Towards SSI; Different Policies Of S.S.L; Government Support For S.S.L During 5 Year Plans, 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).  
**SSC:** Sailable features of karnataka start up policy 2015-2020 **10 Hrs**

### UNIT-V

**PREPARATION OF PROJECT:** Meaning Of Project; Project Identification; Project Selection; Project Report; Need And Significance Of Report; Contents; Formulation; Guidelines By Planning Commission For Project Report; Network Analysis; Errors Of Project Report; Project Appraisal. Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.  
**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.  
**SSC:** Prepare project report, selecting your own components. **11 Hrs**

#### **Text Books:**

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 (2 &

#### **Reference Books:**

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 Pvt. Ltd. 2010

#### **Course Outcomes (COs):**

1. Demonstrate an ability to apply general management know-how in practical business situations
2. Draw upon specialist know-how, deploying concepts and sources incisively and with sensitivity
3. Demonstrate the ability to manage people, processes, and resources within a diverse organization
4. Demonstrate the ability to identify and evaluate business opportunities and trends
5. Summarize the preparation of project report, significance of report.





**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	Demonstrate an ability to apply general management know-how in practical business situations	3	2	-	-	1	-	-	-	3	-	-	3	-	-	
2	Draw upon specialist know-how, deploying concepts and sources incisively and with sensitivity	3	2	-	-	1	-	3	2	3	-	1	3	-	-	
3	Demonstrate the ability to manage people, processes, and resources within a diverse organization	3	2	-	-	1	-	1	3	3	1	1	3	-	-	
4	Demonstrate the ability to identify and evaluate business opportunities and trends	3	2	-	-	1	-	2	2	3	2	2	3	-	-	
5	Summarize the preparation of project report, significance of report.	3	2	-	-	1	-	2	2	2	2	3	3	-	-	



<b>Course Title: Design of Machine Elements -II</b>			
Course Code: P18AU52	Semester: V	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

Students should have the basic knowledge of Strength of materials, codes & Standards, selection of materials & factor of safety, workshop processes, Theory of Machines, Material Science and Fundamentals of Mechanical Engineering Design.

**Course Learning Objectives (CLOs)**

At the end of the course the student should be able to

1. Describe the basic types of curved beams and springs
2. Analyze the stresses in the critical section of a curved beam.
3. Illustrate the design procedure to arrive at the proper specifications of springs/gears/clutches
4. Select suitable size, module & type of gears for a required velocity ratio.
5. Demonstrate the suitability of a type and class of lubricant for a specific applicant

**Course Content**

**UNIT-I**

**Curved beams:** Difference between curved beam and straight beam, stresses in curved beams, assumptions for stress calculations in curved beams, derivation for stresses in curved beams, Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and chain links.

**Springs:** Introduction, types of springs, terminology, stresses and deflection in helical coil springs of circular and non-circular cross sections, springs under fluctuating loads, concentric springs. Leaf Springs, stresses in leaf springs, equalized stresses, length of spring leaves.

**SSC:** Design of a spring for an automotive engine, Design of Leaf springs of an Automobile

**12 Hrs**

**UNIT-II**

**Spur & helical gears:** Introduction, spur gears, standard proportions of gear systems, stresses in gear tooth, Lewis equation and form factor, design for strength, dynamic load and wear load. Helical Gears: definitions, formative number of teeth, design based on strength, dynamic and wear loads.

**SSC:** Design of spur gears for a Compressor Drive Train, Design of helical gears for a Automobile Gear Box

**10 Hrs**

**UNIT-III**

**Bevel and worm gears: Bevel Gears:** terminology, formative number of teeth, design based on strength, dynamic and wear loads.

**Worm Gears:** terminology, design based on strength, dynamic, wear loads and efficiency of worm gear drives.

**SSC:** Design of Bevel Gears of an Automobile differential

**10 Hrs**

**UNIT-IV**

**Belt drive:** Introduction, classification, velocity ratio, effect of slip, ratio of belt tensions, effect of centrifugal tension, power transmitted, effect of initial belt tension. V-belts – ratio of belt tensions, power transmitted. Numerical problems.

**Design of brakes:** Block and Band brakes: self locking of brakes: Heat generation & heat dissipation in brakes.

**SSC:** Automotive belt drives

**10 Hrs**

**UNIT-V**

**BEARINGS: Sliding Contact Bearings:** Introduction, principle of hydro dynamic lubrication, assumptions in hydrodynamic lubrication, bearing characteristic number and modulus, Sommerfeld number, coefficient of friction, power loss, heat Generated and heat dissipated, bearing materials, lubricants and properties, design of journal bearing and thrust bearing.



**Ball and Roller contact Bearings:** Introduction, Advantages and disadvantages, types of ball and rolling contact bearings, designation, static & dynamic capacity, Equivalent load, selection of suitable bearings based on rated life.

**SSC:** Design of Hydrodynamic Bearings for a Cam Test Fixture

**10Hrs**

**Text Books**

1. V.B. Bhandari, **Design of Machine Elements**., Tata McGraw Hill Publishing Company Ltd., New Delhi, 2016
2. T Krishna Rao, **Design of Machine Elements –II**, I K International Publishing house Pvt.Ltd., New Delhi, 2013

**References**

1. Hall, Holowenko, “Machine Design” Laughlin (Schaum’s Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
2. Robert.L. Norton, “Machine Design”, An integrated Approach, Pearson Education Asia, 2001
3. Joseph E Shigley and Charles R. Mischke., “Mechanical Engineering Design”, McGraw Hill International edition, 2003.

**Design Data Hand Book:**

1. K. Mahadevan and K. Balaveera Reddy “**Design Data Hand Book**” by, CBS Publication, 2013

Note: All the Case studies are only for CIE Assessment purpose only

**Course Outcomes (COs):** At the end of the course student will be able to

1. Analyze the stresses in the critical section of a curved beam and design springs for different applications
2. Design Spur and helical and gears
3. Design Bevel and worm gears
4. Design clutches and brakes, with an understanding of safety issues related to brakes
5. Select lubricants and design sliding contact bearings, select rolling contact bearings for different applications

**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	Analyze the stresses in the critical section of a curved beam and design springs for different applications	3	3		-	2		-	-	-	-	-	-	3	3	2
2	Design Spur and helical and gears	3	3	3	-	2		-	-	-	-	-	-	3	3	2
3	Design Bevel and worm gears	3	3	3	-	2		-	-	-	-	-	-	3	3	2
4	Design clutches and brakes, with an understanding of safety issues related to brakes	3	3	3	-	2		-	-	-	-	-	-	3	3	2
5	Select lubricants and design sliding contact bearings, select rolling contact bearings for different applications	3	3	3	-	2		-	-	-	-	-	-	3	3	-



Course Title: Automotive Fuels And Combustion			
Course Code: P18AU53	Semester: V	L:T:P:H- 4:0:0:4	Credits:4
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:**

Subject requires students know about:

- Different types of fuels used in IC engines and cycles of operations.
- Working principle of two stroke, four stroke, SI & CI engines

**Course Learning Objectives (CLOs)**

1. Explain about available energy sources for internal combustion engines and properties of different fuels
2. Discuss the significance of distillation curves & refining process.
3. Determine the A/F ratio for complete combustion.
4. Explain combustion process in SI&CI engines and types of SI &CI combustion chamber.
5. Design consideration for SI & CI combustion chamber.
6. Differentiate between multi fuel& duel fuel engines discuss the performance characteristics of multi fuel & duel fuel engines.
7. Discuss the recent developments in the field of IC engines.

**Course Content**

**UNIT-I**

**Cycle Analysis & Energy Sources: Cycle Analysis:** Air standard cycles, Otto, Diesel, Dual, comparison of fuel air and actual cycles, simple problems on the above topics. **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.

**SSC:** Alcohols, CNG, LPG.

**10 Hrs**

**UNIT-II**

**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.

**SSC:** Additives, Fuels for gas turbine and jet engines.

**10 Hrs**

**UNIT-III**

**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,

**SSC:** Types, features and design considerations of combustion chambers.

**12 Hrs**

**UNIT-IV**

**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.

**SSC:** performance characteristics of multi fuel engines.

**10 Hrs**



**UNIT-V**

**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.

**SSC:** HCCI engines, & free piston engines.

**10 Hrs**

**Text Books:**

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, 2<sup>nd</sup> revise edition 2014.

**Reference Books:**

1. V Ganesan, Internal Combustion Engines, Tata McGraw Hill, 3<sup>rd</sup> 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 Outcomes**

1. Explain available energy sources for I.C. Engines & discuss their advantages and limitation; Explain refining process of petroleum and their by-products and their properties
2. Determine A/F ratio for any given fuel & Rating of SI and CI Engine fuels
3. Analyze the combustion phenomena of SI & CI Engine.
4. Explain recent developments in the field of I.C. Engines
5. Explain the constructional and working principle of multi and dual fuel Engine and their advantages and limitation

**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	Explain available energy sources for I. C. Engine & discuss their advantages and limitation; Explain refining process of petroleum and their by-products and their properties	2		2	-	-	1	1	-	-	-	-	1	2	2	2
2	Determine A/F ratio for any given fuel & Rating of SI and CI Engine fuels	3	-	2	-	-	1	1	-	-	-	-	1	3	2	2
3	Analyze the combustion phenomena of SI & CI Engine.	3	-	2	-	-	1	1	-	-	-	-	1	3	2	2
4	Explain the constructional and working principle of multi fuel Engine and their advantages and limitation	2	-	2	-	-	1	1	-	-	-	-	1	2	2	2
5	Explain recent developments in I. C. Engines	2	-	2	-	-	1	1	-	-	-	-	1	2	2	2



<b>Course Title: Auxiliary Systems of Automotive Engines</b>			
Course Code: P18AU54	Semester: V	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

Subject requires student to know about

Students must have the back ground knowledge of different types of drives like belt drives, chain drives, gear drives and rope drives.

**Course Learning Objectives (CLOs):**

At the end of the course the student should be able to

1. Analyze the mixture requirement for different operating conditions
2. Explain Constructional and working principles of different types of carburettors
3. Design a carburettor
4. Distinguish between petrol injection and carburettor
5. Differentiate between petrol injection and diesel injection system
6. Explain the constructional and principle of operation of different types diesel injection systems

**Course Content**

**UNIT-I**

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

**SSC:** Bosch L tetronic fuel injection system

**11 Hrs**

**UNIT-II**

**Diesel engine Fuel supply system:** – Cleaning systems, transfer pumps, 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.

**SSC:** Cummins diesel engine fuel injection system

**10 Hrs**

**UNIT – III**

**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 thermodynamics of forced circulation, evaporative cooling and pressure cooling. regenerative, comparison of air and water cooling, antifreeze solution Heavy duty cooling system, ,fundamentals of radiator design, thermostats, cooling fan - power requirement, electric motor driven thermo switch controlled fan, automatic radiator shutter control

**SSC:** Heavy duty cooling systems

**11 Hrs**

**UNIT – IV**

**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 ), oil filters (centrifugal oil filters), pumps, crankcase ventilation – types

Governors – types, constructional features and operation (maximum speed governors, minimum-maximum speed governors and variable speed governors

**SSC:** Automatic radiator shutter control

**10 Hrs**

#### UNIT - V

**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. **Turbocharging:** Methods of turbocharging (constant pressure, pulse and pulse converter) two stage turbocharging miller turbocharging and hyperbar turbocharging. Dual stage scroll area turbocharged engine system and variable scroll area turbocharged engine system.

**SSC:** inter cooling systems

**10 Hrs**

#### **Text Books:**

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

#### **Course Outcomes (COs)**

**At the end of the course the student should be able to:**

1. Identify the different methods of fuel supply systems in SI engine , construction, working and their advantages, disadvantages
2. Identify and elaborate different ways of fuel supply systems in CI engines and their working
3. Design different cooling systems used in IC engines and their working principles
4. Identify appropriate lubrication system for IC engines and ignition systems for SI engines and explain their working principles
5. Understand the basic principles of supercharging and turbo charging and design modifications of an engine for supercharging and turbo charging





**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 different methods of fuel supply systems in SI engine , construction, working and their advantages, disadvantages	3	2	1	-	-	2	2	-	-	-	-	2	3	3	1
2	Identify and elaborate different ways of fuel supply systems in CI engines and their working	3	2	1	-	-	2	2	-	-	-	-	2	3	3	1
3	Design different cooling systems used in IC engines and their working principles	3	2	1	-	-	2	2	-	-	-	-	2	3	3	1
4	Identify appropriate lubrication system for IC engines and ignition systems for SI engines and explain their working principles	3	2	1	-	-	2	2	-	-	-	-	2	3	3	1
5	Understand the basic principles of supercharging and turbo charging and design modifications of an engine for supercharging and turbo	2	2	1	-	-	2	2	-	-	-	-	2	3	2	1



Professional Elective - I			
Course title:–Advanced Engine Technology			
Course code: P18AU551	Semester: V	L – T – P -H:2-2-0-4	Credits:3
Contact period-lecturer: 52hrs.	Exam:3 hrs	Weightage:CIE:50%; SEE:50%	

**Prerequisites:**

Basics of IC engines, combustion in SI and CI engines, different auxiliary systems

**Course Learning Objectives (CLOs):**

*At the end of the course the student should be able to*

1. **Explain** the combustion process in SI engines
2. **Explain** the combustion process in CI engines
3. **Identify** the advanced technology used in air and fuel supply systems
4. **Identify** the advanced technology used in cooling , lubrication and ignition
5. **Discuss** about the non conventional engines

**Course content**

**UNIT-I**

**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.

**SSC:** Abnormal combustion: knock fundamentals & surface ignition.

**12 Hrs**

**UNIT-II**

**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.

**SSC:** Fuel spray behavior, atomization, spray penetration, droplet size, spray evaporation,

**10 Hrs**

**UNIT-III**

**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, electronically controlled fuel injection system

**SSC:** Electronically controlled fuel injection system

**10 Hrs**

**UNIT-IV**

**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,

**SSC:** Capacitor discharge system, laser ignition system

**10 Hrs**

**UNIT – V**

**Non conventional engines:** free piston engine, homogeneous charge compression ignition engine, lean burn engines, sterling engine, stratified charge engine, variable compression ratio engine,



**SSC:** Wankel engine and gas turbine engine

**10 Hrs**

**Text books:**

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

**References:**

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

**Course outcomes**

1. **Explain** the combustion process in SI engines
2. **Explain** the combustion process in CI engines
3. **Identify** the advanced technology used in air and fuel supply systems
4. **Identify** the advanced technology used in cooling , lubrication and ignition
5. **Discuss** about the non conventional engines

**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	<b>Explain</b> the combustion process in SI engines	2	2					2					2	2	2	2
2	<b>Explain</b> the combustion process in CI engines	2	2					2					2	2	2	2
3	<b>Identify</b> the advanced technology used in air and fuel supply systems	2	2						2	2	2		2	3	3	3
4	<b>Identify</b> the advanced technology used in cooling , lubrication and ignition	2	2						2	2	2		2	3	3	3
5	<b>Discuss</b> about the non conventional engines	2	2						2	2	2		2	3	3	3



<b>Course title: Production of Automotive Components</b>			
Course code: P18AU552	Semester: V	L:T:P:H- 2:2:0:4	Credits:3
Contact period-lecturer: 52hrs,; Exam:3 hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:**

Basics of Automobile Engineering, Manufacturing Process and Production Technology.

**Course Learning Objectives (CLOs):**

At the end of the course the student will be able to –

1. Explain about the materials in automotive applications.
2. Understand about the manufacturing of engine parts.
3. Understand about the Manufacturing of automotive chassis
4. Enumerate about the Heat treatment of automotive components
5. Comprehend about the Painting technology of automobiles

**Course Content**

**UNIT-I**

**Introduction and materials:** Components of automobiles and its functions. Requirements of the 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 aluminium in automobiles and uses of plastics in automobiles. [Text Book 1: chapter 1 to 5]

**SSC:** Advanced materials used application of technologies in automobiles **12 Hrs**

**UNIT-II**

**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]

**SSC:** Manufacturing methods for crank shaft, connecting rod, cam shaft, piston pin, push rod rocker arm and tappets, technical aspects. **10 Hrs**

**UNIT-III**

**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 process of leaf spring, shock absorbers, and technical aspects. Manufacturing process of tires, tubes and flaps, technical aspects. [Text Book 1: Chapter 7]

**SSC:** Manufacturing methods for chassis, dead axle, wheel housing & steering system. **10 Hrs**

**UNIT-IV**

**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 technology of 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]

**SSC:** Heat treatment procedures for engine and chassis components. **10 Hrs**



### UNIT-V

**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]

**SSC:** Oven technology, performance and testing and future developments. **10 Hrs**

**Text books:**

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

**Reference books:**

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

**Course Outcomes**

**After learning all the units of the course, the student is able to**

1. Explain about the materials in automotive applications.
2. Understand about the manufacturing of engine parts.
3. Understand about the Manufacturing of automotive chassis
4. Enumerate about the Heat treatment of automotive components
5. Comprehend about the Painting technology of automobiles

### 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	Explain about the materials in automotive applications.	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	Understand about the manufacturing of engine parts.	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	Understand about the Manufacturing of automotive chassis	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	Enumerate about the Heat treatment of automotive components	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
5	Comprehend about the Painting technology of automobiles	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-



<b>Course Title: Micro controller &amp; Embedded System</b>			
Course Code: P18AU553	Semester: V	L:T:P:H- 2:2:0:4	Credits:3
Contact Period-Lecturer: 52hrs,: Exam:3 Hrs		Weightage:Cie:50%; See:50%	

**Prerequisites:** The students should have acquired the knowledge of Electronic Devices and Communication (P17EC15/25) and Basic Electrical Engineering (P17EE15/25).

**Course learning objective (CLOs):**

At the end of the course the student will be able to –

1. To explain the internal organization and working of Computers, microcontrollers and embedded processors.
2. To explain the registers of the 8051 microcontroller, manipulation of data using registers and MOV instructions.
3. To explain in detail the execution of 8051 Assembly language instructions and data types
4. To explain different addressing modes of 8051, arithmetic, logic instructions, and programs.
5. To explain develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic, arithmetic operations and data conversion.

**Course Content**

**UNIT-I**

**8051 Microcontroller Basics:** Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing with External ROM and RAM.8051 Addressing Modes.

**SSC:** Types of Special Function Registers and their uses in 8051 **11 Hrs**

**UNIT-II**

**Assembly programming and instruction of 8051:** Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming.

**SSC:** Data types and Assembler directives, **10 Hrs**

**UNIT-III**

**8051 programming in C:** Data types and time delay in 8051C, IO programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, Accessing code ROM space in 8051C, Data serialization using 8051C 8051 Timer programming in Assembly and C: Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.

**SSC:** Programming timers 0 and 1 in 8051 **10 Hrs**

**UNIT-IV**

**8051 serial port programming in assembly and C:** Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, serial port programming in 8051 C. 8051 Interrupt programming in assembly and C: 8051 interrupts, Programming timer, external hardware, serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C.

**SSC:** serial port programming in 8051 C. **10 Hrs**

**UNIT-V**

**Interfacing:** LCD interfacing, Keyboard interfacing.

**ADC, DAC and sensor interfacing:** ADC 0808 interfacing to 8051, Serial ADC Max1112 ADC interfacing to 8051, DAC interfacing, Sensor interfacing and signal conditioning.

**Motor control: Relay, PWM, DC and stepper motor:** Relays and opt isolators, stepper motor interfacing, DC motor interfacing and PWM. 8051 interfacing with 8255: Programming the 8255, 8255 interfacing, C programming for 8255.

**SSC:** stepper motor interfacing and DC motor interfacing **11 Hrs**



**Textbook:**

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C  
Muhammad Ali Mazadi Pearson 2nd Edition, 2008.

**Reference Books**

1. The 8051 Microcontroller Kenneth Ayala Cengage Learning  
3rd Edition, 2005
2. The 8051 Microcontroller and Embedded Systems  
Manish K Patel McGraw Hill 2014
3. Microcontrollers: Architecture, Programming, Interfacing and System Design  
Raj Kamal Pearson 1st Edition, 2012

**Course Outcomes (COs) :**

1. **Identify** Mechatronics system, measurement systems, Open & Closed loop control systems and different types of sensors.
2. **Understand** Electrical systems, Mechanical switches, relays, solid state switches, diodes, thyristors and triacs, bipolar transistors, MOSFETS, solenoids and distinguish DC motors, permanent magnet DC motors with field coils, brushless permanent magnet DC motors, AC motors, stepper motors and their merits and demerits.
3. **Analyse** signal conditioning process, protection, filtering, Multiplexers, Data Acquisition system.
4. **Evaluate** Organization of Microprocessor, instructions, machine and mnemonics codes, machine and assembly language programming, High level language programming.
5. **Generate** Decimal number system, Hexadecimal number system, conversion from one number system to another, negative number representation.

**Course Articulation Matrix**

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

Sl. No.	Course Outcomes	Program Outcomes (POs)												PSOs				
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
1	<b>Identify</b> Mechtronics system, measurement systems, Open & Closed loop control systems and different types of sensors.	3	2	1													2	2
2	<b>Understand</b> Electrical systems, Mechanical switches, relays, solid state switches, diodes, thyristors and triacs, bipolar transistors, MOSFETS, solenoids and distinguish DC motors, permanent magnet DC motors with field coils, brushless permanent magnet DC motors, AC motors, stepper motors and their merits and demerits.	3	1	1													1	2
3	<b>Analyse</b> signal conditioning process, protection, filtering, Multiplexers, Data Acquisition system.	3	3	2													2	2
4	<b>Evaluate</b> Organization of Microprocessor, instructions, machine and mnemonics codes, machine and assembly language programming, High level language programming.	3	3	2													2	2
5	<b>Generate</b> Decimal number system, Hexadecimal number system, conversion from one number system to another, negative number representation.	3	2	2													2	2





<b>Course Title: Non Traditional Machining</b>			
Course Code: P18AU554	Semester: V	L:T:P:H- 2:2:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam: 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

The course enables to understand the need for Non-Traditional Machining processes. It also highlights various Non-conventional machining processes.

**Course Learning Objectives (CLOs):**

At the end of the course the student will be able to –

1. Discuss the difference between conventional and non-conventional machining process.
2. Characterize the USM and AJM with the effect of parameters and process characteristics.
3. Explain the working principle ECM and CHM with the effect of parameters and process characteristics.
4. Discuss about the working principle of EDM with the effect of parameters and process characteristics
5. Describe the working principle PAM and LBM with the effect of parameters and process characteristics.

**Course Content**

**UNIT -I**

**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-Definition-Mechanism of metal removal- elements of the process-Tool feed mechanism, theories of mechanics of causing effect of parameter,

**SSC:** Application of Ultrasonic Machining & Non-traditional machining processes. **10 Hrs**

**UNIT -II**

**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-Dielectric fluids-Electrodes for spark erosion-surface finish, applications, pollution and safety issues.

**SSC:** Application of Abrasive Jet Machining and Thermal Metal Removal Processes. **10 Hrs**

**UNIT -III**

**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 - Etchents-Advantages and disadvantages-applications, environmental issues.

**SSC:** Application of Electro chemical and Chemical Processes and machining. **11 Hrs**

**UNIT -IV**

**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. Introduction-Mechanism of metal removal and associated equipment-process characteristics applications, safety issues.

**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.



**SSC:** Application of Laser Beam Machining and Ion Beam Machining High Velocity forming processes. **11 Hrs**

**UNIT -V**

**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. Thermal & Non thermal type-Process characteristics —applications, safety issues.

**SSC:** Application of Plasma arc Machining and Electron beam machining . **10 Hrs**

**Text Book:**

1 M PANDEY AND SHAH, **Modern machining process**;, TATA McGraw-Hill, 2000.

**References:**

- 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 Outcomes (Cos):**

After learning all the units of the course the students should be able to:

1. **Discuss** the difference between conventional and non-conventional machining process.
2. **Characterize** the USM and AJM with the effect of parameters and process characteristics.
3. **Explain** the working principle ECM and CHM with the effect of parameters and process characteristics.
4. **Discuss** about the working principle of EDM with the effect of parameters and process characteristics
5. **Describe** the working principle PAM and LBM with the effect of parameters and process characteristics.

**Course Articulation Matrix**

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

CO	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	<b>Discuss</b> the difference between conventional and non-conventional machining process.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
2	<b>Characterize</b> the USM and AJM with the effect of parameters and process characteristics.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
3	<b>Explain</b> the working principle ECM and CHM with the effect of parameters and process characteristics.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
4	<b>Discuss</b> about the working principle of EDM with the effect of parameters and process characteristics	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
5	<b>Describe</b> the working principle PAM and LBM with the effect of parameters and process characteristics.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1



<b>Course Title: Fuel Testing and Measurement Lab</b>			
Course Code: P18AUL56	Semester: V	L:T:P:H -0:0:3:3	Credits: 1.5
Contact Period-Lecturer: 39Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:**

1. Subject requires student to know about
2. Properties of fuel used in I C engines
3. Properties of lubricants used in I C engines
4. Automotive engines operation
5. Use of different instruments used in automotive industry/ workshop

**Course learning objectives (CLOs)**

- Determine the properties of any given fuel.
- Determine the properties of any given lubricating oil.
- Draw a valve timing /port timing diagram for an engine
- Determine the coefficient of discharge of venture meter, orifice meter.
- Calibrate the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,

**Course Content**

**Part-A**

1. Determination of Flash & Fire points of Liquid fuels / Lubricants using:
  - a) Abels Apparatus
  - b) Pensky Martens Apparatus
2. Determination of Viscosity of Liquid lubricants and Fuels using:
  - a) Saybolt Viscometer
  - b) Redwood Viscometer
  - c) Torsional Viscometer
  - c) Engler Viscometer
3. Determination of Calorific value of solid ,liquid and Gaseous Fuels using:
  - a) Junkers Gas Calorimeter
  - b) Bomb Calorimeter
4. Carbon residue test: Liquid fuels
5. Drop Point & Penetration Apparatus for Grease
6. ASTM Distillation Test Apparatus
7. Cloud & Pour point Apparatus

**Part –B**

1. Calibration of pressure gauge
2. Calibration of thermocouple.
3. Measurements of areas of irregular figures using planimeter.
4. Calibration of load cell.
5. Calibration of vernier caliper and micrometer.
6. Measurement of angle using sine bar/ sine center / bevel protractor.



**Text Book:**

1. M.L Mathur and R.P Sharma, a course in IC Engines, dhanpat ray and sons, Delhi, 1999.
2. Dr v Ganeshan , Internal combustion engines, Mc Graw hill, publication , fourth edition 2013 ISBN 10: 1259006190 / ISBN 13: 9781259006197
3. Metrology and Measurement – S.V Ragavendra
4. Fluid Mechanics - Bansal
5. Auto lab manuals

**Course Outcomes (COs):**

**After learning all the units of the course, the student is able to**

1. **Determine** the properties of any given fuel
2. **Determine** the properties of any given lubricating oil.
3. **Analyze** a valve timing /port timing diagram for an engine
4. **Determine** the coefficient of discharge of venturi meter, orifice meter
5. **Calibrate** the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,

**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	<b>Determine</b> the properties of any given fuel	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
2	<b>Determine</b> the properties of any given lubricating oil.	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
3	<b>Analyze</b> a valve timing /port timing diagram for an engine	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
4	<b>Determine</b> the coefficient of discharge of venturi meter, orifice meter	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
5	<b>Calibrate</b> the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2



<b>Course Title: Engine and Components Lab</b>			
Course Code: P18AUL57	Semester: V	L:T:P:H- 0:0:3:3	Credits:1.5
Contact period : Lecture: 39 Hrs., Exam 3 Hrs.	Weightage : CIE:50%; SEE:50%		

### **Prerequisites:**

Subject requires student to know about

- Basic of Heat Engines and their classification
- Components of IC Engines.
- Classification of IC Engines.
- Basics working Principle of Different Types IC Engines

### **Course Content**

1. Study of hand tools- sketching, materials used and their applications. **3Hrs**
2. Trouble shooting charts for all engine components. **3Hrs**
3. Specifications of given engines and component standard dimensions. **3Hrs**
4. Dismantling & assembling of engines.

[Note: Procedure of dismantling & assembly; identify the major components, noting their functions & materials used. **Measurement of Cylinder bore diameter, Stroke length, piston diameter, ovality, crank shaft main journal bearing diameter, Cam shaft lobe measurement** & comparison of major components dimension with standard specifications.

Inspection for wear and tear, crack and breakdown] and run the same

- a) Two stroke SI engine, **3Hrs**
    - i) TVS, BAJAJ, Hero Honda
  - b) Four stroke SI engine **3Hrs**
    - i) Enfield and hero Honda engine
  - c) Four stroke multi cylinder SI engine **3Hrs**
    - i) Ambassador engine **3Hrs**
    - ii) Jeep Engine **3Hrs**
    - iii) Chevarlet **3Hrs**
    - iv) Huandai Santro **3Hrs**
    - v) Maruthi Suzuki Esteem **3Hrs**
    - vi) Maruthi OMNI 3 Cylinder MPFI **3Hrs**
  - d) four stroke multi cylinder CI engine **3Hrs**
    - i) Six cylinder tata and ashok Leyland engine **3Hrs**
5. Conducting compression test, vacuum test on diesel and petrol engines. **3Hrs**
  6. **Conducting Compression Ratio of four Stroke Petrol Engine**
  7. **Conducting Valve Timing Diagram of four Stroke Diesel Engine**
  8. Study (Dismantling & assembly): Different carburetors, fuel injection pumps, injectors, fuel tanks, fuel filters, fuel pumps, turbo-chargers, cooling systems and lubricating systems. Identify location of above components in a vehicle and note their functions along with the brand names. **3Hrs**



**Text Book:**

1. KIRPAL SING automobile engineering volume-II Standard publications, New Delhi, 2014
2. M.L Mathur and R.P Sharma, a course in IC Engines, dhanpat ray and sons, Delhi, 1999
3. PM held , high speed engines, - Oxward and IBH New Delhi,1965.
4. Auto service Manual

**Course Outcomes (CO's):**

**At the end of the course the student should be able to,**

1. Identify the function & application of various hand tools used in automotive workshop/laboratory.
2. Examine various Troubles encountered with engine components and measures to overcome the same.
3. Take part in dismantle & assemble of engines and Inspect engine components for wear and tear and damage
4. Analyze the condition of the engines by Conducting compression test, vacuum test on engines
5. Examine performance of engine

**Course Articulation Matrix**

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

CO	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Identify the function & application of various hand tools used in automotive workshop/laboratory.	3	3	-	-	1	2	1	2	-	-	-	2	3	1	1
2	Examine various Troubles encountered with engine components and measures to overcome the same.	2	2	-	-	1	2	1	2	-	-	-	2	3	1	1
3	Take part in dismantle & assemble of engines and Inspect engine components for wear and tear and damage	2	2	-	-	1	2	1	2	-	-	-	2	3	1	1
4	Analyze the condition of the engines by Conducting compression test, vacuum test on engines	3	3	-	2	1	2	1	2	-	-	-	2	3	1	1
5	Examine performance of engine	3	3	-	2	2	2	1	2	-	-	-	2	3	1	1



<b>Course Title: Skill oriented Lab-I (Computer Aided M/c Drawing-3D)</b>			
Course Code: P18AUL58	Semester: V	L:T:P:H -0:0:2:2	Credits: 1
Contact Period-Lecturer: 26 Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:** Basics of Engineering Graphics, Drawing conventions, Sketching, Navigation Commands, Graphic interface of Software, Starting New Drawing Sheet, Sheet Sizes, Naming a Drawing, Drawing Units.

### **Course Learning Objectives (CLOs)**

#### **This Course aims to**

1. Sketch 2D and 3D drawings manually & using drawing software. Solve Problems on Sections of Solids resting on their bases and sketch true shape of sections.
2. Interpret Pictorial views of simple machine parts & Sketch Orthographic Projections of the same.
3. Distinguish and Sketch Various Thread forms as per the standard dimensions.
4. Distinguish and Sketch Various Fasteners as per the standard dimensions.
5. Sketch Various Keys, Couplings as per the standard dimensions
6. Sketch Various Riveted joints as per the standard dimensions
7. Sketch Proportionate/to scale Automotive Engine components.
8. Sketch and create 2D & 3D part drawings of different of Machine components, then assemble the 3D part drawings to Create an Assembled view of the complete Machine component and Create 2D drawings of Assembled view with required views along with 3D drawings

### **Relevance**

**Computer Aided M/c Drawing** is Skill oriented course in Automobile Engineering for B.E. Undergraduate programme. Profound skills in computer-aided methods are of growing importance for every engineer in all fields of professional activity. The Fifth-semester course in Automobile Engineering (CAMD-3D) is designed to broaden and increase the knowledge and practical use of computer-aided techniques in Automobile engineering. This course specifically addresses the needs of the practicing Automobile engineer. Its focus lies on the development and application of computer-aided methods and systems at all stages of product development, from the initial conception of machines to the manufacturing process.

### **Course Content**

#### **Assembly Drawings**

Assembly drawing of machine parts (Dimensional 3D parts to be created assembled and then getting 2D drawing with required views, along with 3D part drawings and listing of parts as per Industry Standard).

- Unit.1 Plummer block (Pedestal Bearing)
- Unit.2 Piston
- Unit.3 Connecting rod
- Unit.4. Screw jack
- Unit.5. Fuel Injector
- Unit.6 Clutches (Single and multi Plate)

**SSC:** Fuel Injector Clutches (Single and multi Plate)

**26 Hrs**





**Text books:**

1. N.D. Bhat & V.M. Panchal Machine Drawing, 2011
2. R.B. Gupta, Automobile Engineering Drawing, , Satya Prakashan, New Delhi, 2009.  
**ISBN-10:** 8176841471 **ISBN-13:** 978-8176841474
3. K.R. Gopala Krishna Machine Drawing, Subhash Publication, 2013

**Reference Books**

1. VTU, A Primer on Computer Aided Machine Drawing’, Published by, Belgaum, 2007
2. S. Trymbaka Murthy, A Text Book of Computer Aided Machine Drawing, CBS Publishers, New Delhi, 2007
3. Sidheshwar, Machine Drawing, Tata McGraw-Hill, New Delhi, 2001

**Course Outcomes**

**After learning all the units of the course, the student is able to**

- CO1. **Sketch and develop** 2D & 3D part and assembled drawings of Plummer block (Pedestal Bearing) using Solid Edge software tool.[L3,L6]
- CO2. **Sketch and develop** 2D & 3D part and assembled drawings of Piston using Solid Edge software tool.[L3,L6]
- CO3. **Sketch and develop** 2D & 3D part and assembled drawings of Connecting rod using Solid Edge software tool.[L3,L6]
- CO4. **Sketch and develop** 2D & 3D part and assembled drawings of Screw jack using Solid Edge software tool.[L3,L6]
- CO5. **Sketch and develop** 2D & 3D part and assembled drawings of Fuel Injector and Clutches (Single and multi Plate)using Solid Edge software tool.[L3,L6]

**Course Articulation Matrix**

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

CO	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	<b>Sketch and develop</b> 2D & 3D part and assembled drawings of Plummer block (Pedestal Bearing) using Solid Edge software tool.[L3	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
2	<b>Sketch and develop</b> 2D & 3D part and assembled drawings of Piston using Solid Edge software tool.[L3	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
3	<b>Sketch and develop</b> 2D & 3D part and assembled drawings of Connecting rod using Solid Edge software tool.[L3	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
4	<b>Sketch and develop</b> 2D & 3D part and assembled drawings of Screw jack using Solid Edge software tool.[L3	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
5	<b>Sketch and develop</b> 2D & 3D part and assembled drawings of Fuel Injector and Clutches (Single and multi Plate)using Solid Edge software tool.[L3	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3



<b>Course Title: Technical Skills-I (Simulation Lab)</b>			
Course Code: <b>P18AU591</b>	Semester: <b>V</b>	L:T:P:H -0:2:0:2	Credits: 1
Contact Period-Lecturer: 26 Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

**Course Objectives:** This course enables the students to simulate Turning, Drilling, and Milling/Cutting operations using simulation packages.

**Course Contents**

1. Modelling of simple machine parts and generating machine codes for CNC production using standard CAM packages. **10 Hrs**
2. Simulation of machining operations on a computer using CAM packages.
  - 2.1 Simulation of turning operation
  - 2.2 Simulation of drilling operation
  - 2.3 Simulation of milling/cutting operations **06 Hrs**
3. Three typical simulations to be carried out using simulation packages like Master CAM, or any equivalent software. **10 Hrs**

**Text/Reference Books**

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

**Course Outcomes**

**After learning all the units of the course, the student is able to:**

- CO1 - Build solid model of simple machine parts using Master CAM package.- L3  
 CO 2-4 - Demonstrate simulation of Turning, Drilling, Milling using software – L2  
 CO5 - Simulate using simulation packages like Master CAM or any equivalent software – L2

<b>Course Articulation Matrix</b>															
<b>Course Outcomes</b>		<b>Program Outcomes</b>												<b>PSO</b>	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	<b>Build</b> solid model of simple machine parts using Master CAM package.	-	2	1	3	2	-	-	-	3	1	-	1	2	-
CO2-4	<b>Demonstrate</b> simulation of Turning, Drilling, Milling using software	-	2		1	2	-	-	-	2	1	-	-	2	-
CO5	<b>Simulate</b> using simulation packages like Master CAM or any equivalent software	-	2		1	2	-	-	-	2	1	-	-	2	-



<b>Course Title: Aptitude and Reasoning Development - ADVANCED (ARDA)</b>			
Course Code: P18HU510	Semester: V	L:T:P:H -0:2:0:2	Credits: 1
Contact Period- Lecture: 32 Hr, Exam: 3 Hr		Weightage:CIE:50%; SEE:50%	

**Prerequisites: Vocabulary builder, Concept of Percentage.**

**Course Learning Objectives (CLOs)**

**This course aims to**

1. Describe the importance of reading with comprehension.
2. Explain seven dimensions approach to better reading skills.
3. Explain the purpose, plan and the ways to identify specific details in a paragraph for better comprehension.
4. Formulate easier ways to solve problems of averages.
5. Explain the Application of the technique of alligation while solving weighted average and mixture problems.
6. Describe the concepts of profit, loss, discount, marked price.
7. Explain the application of percentage in our daily life.
8. Discover different ways to identify the progressions and to compare between AP < GP and HP.
9. Explain the basic concepts in calculating simple interest and compound interest.
10. Differentiate between simple interest and compound interest and describes the importance of compound interest and its behaviour.

**Course Content**

**Unit – I**

**Reading Comprehension:**

**Introduction:** Read more and more, the process of writing and its relevance to the process of writing, how reading skills are important for aspects other than the reading comprehension questions, the daily reading scheme.

**Seven dimension approach to better reading skills:**

Developing the ability of understanding vocabulary in context, Ability to identify and understand main ideas, Ability to predict and identify supporting details, Understanding the use of transition and idea organization patterns, Inferences, Identifying purpose and tone, Recognizing and evaluating arguments and their common structures.

**Theory of reading comprehension:**

Solving RC passages is an exact science, tackling RC on the basis of evaluation of support, All passages have a topic, purpose and a plan, Other things to pick up while reading the passage– The tonality and other software related the author’s viewpoint in the passage, specific details and their use in the passage, Types of questions asked in reading comprehension passage. **8 Hrs**

**Unit – II**

**Averages and Allegations mixtures:**

**Average:** relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. **Allegation method:** situation where allegation technique, general representation of allegations, the straight line approach, application of weighted average and allegation method in problems involving mixtures. Application of allegation on situation other than mixtures problems. **6 Hrs**

**Unit – III**

**Permutation and Combination:** Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of  $2^n$ , Arrangement in a circle.

**Probability:** Single event probability, multi event probability, independent events and



dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes. **6 Hrs**

#### Unit IV

**Progression:**

**Arithmetic Progression:** sum of given number of terms in an A.P., arithmetic mean, to insert a given number of arithmetic means between two given quantities, nth term of an A.P., finding common difference of an A.P. given 2 terms of an A.P., types of A.P.s– increasing A.P.s and decreasing A.P. s

**Geometric:** to find, the geometric mean between two given quantities, to insert a given number of geometric means between two given quantities, sum of a number of terms in a G.P. Types of G.P.s— increasing G. P. s type one and two , decreasing G. P. s type one and two.

**Harmonic Progression:** to find the harmonic mean between two given quantities, theorems related with progressions, solved examples Sample Company questions **4 Hrs**

#### Unit V

**Coding Decoding:** Letter Coding, Number coding, symbol coding

**Crypt arithmetic:** Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm

**Data Interpretation:** Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs **8 Hrs**

**Reference books:**

1. The Trachtenberg speed system of basic mathematics, published by Rupa publications.
2. CAT Mathematics by Abhijith Guha. Published by PHI learning private limited.
3. Quantitative aptitude by Dr. R. S Agarwal published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal published by S. Chand private limited.
5. Quantitative aptitude for CAT by Arun Sharma, published by McGraw Hill publication.

**Course Outcomes (CO)**

After learning all the units of the course, the student is able to:

1. Apply the approach of seven dimensions to better reading skills. L2
2. Solve the questions under reading comprehension confidently with higher accuracy than random reading. L4
3. Apply the technique of allegation for effective problem solving. L2
4. Interpret the requirement of different methods of calculating average and apply the right method at right scenario. L4
5. Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest. L5
6. Formulate the equations for summation and other functions for all the kinds of progressions– AP, GP and HP. L1



<b>Course Articulation Matrix (CAM)</b>												
Course Outcome (CO)		Program Outcome (ABET/NBA-(3a-k))										
		a	b	c	d	e	f	g	h	i	j	k
Apply the approach of seven dimensions to better reading skills.	L2	-	-	-	-	-	-	-	-	M	-	-
Solve the questions under reading comprehension confidently with higher accuracy than random reading.	L4	-	-	-	-	-	-	M	-	M	-	-
Apply the technique of allegation for effective problem solving.	L2	H	-	-	-	-	-	-	-	-	-	-
Effective solve the problems of permutation and combination. Predict different possibilities by the principle of probability.	L4	M	-	-	-	-	-	-	-	M	-	-
Formulate the equations for summation and other functions for all the kinds of progressions– AP<GP and HP.	L5	H	-	-	-	-	-	-	-	M	-	-
Effective solve the problems of coding decoding and crypt arithmetic and Interpret the data given in the graphical format and infer the results.	L1	M	-	-	-	-	-	-	-	-	-	-
<b>L- Low, M- Moderate, H-High</b>												

<b>Course Assessment Matrix (CAM)</b>												
Course Outcome (CO)		Program Outcome (ABET/NBA-(3a-k))										
		a	b	c	d	e	f	g	h	i	j	k
Apply the approach of seven dimensions to better reading skills.	L2	-	-	-	-	-	-	-	-	2	-	-
Solve the questions under reading comprehension confidently with higher accuracy than random reading.	L4	-	-	-	-	-	-	2	-	2	-	-
Apply the technique of allegation for effective problem solving.	L2	3	-	-	-	-	-	-	-	-	-	-
Interpret the requirement of different methods of calculating average and apply the right method at right scenario.	L4	2	-	-	-	-	-	-	-	2	-	-
Formulate the equations for summation and other functions for all the kinds of progressions– AP<GP and HP.	L5	3	-	-	-	-	-	-	-	2	-	-
Effective solve the problems of coding decoding and crypt arithmetic and Interpret the data given in the graphical format and infer the results.	L1	2	-	-	-	-	-	-	-	-	-	-
<b>1 – Low, 2 – Moderate and 3 – High</b>												



**SIXTH SEMESTER**

<b>Course Title: Automotive Chassis and Suspension</b>			
Course Code: P18 AU61	Semester: VI	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

Subject requires student to know about  
Basics of Engineering Mathematics and  
Engineering mechanics  
Basics of Automobile

**Course Learning Objectives (CLOs):**

At the end of the course the student should be able to

1. Identify different chassis layouts and frames and Analyze for Performance of Automobiles and suitability of frames.
2. Analyze Front Axles and Steering Systems and its auxiliaries and Determine major dimensions of the same
3. Analyze Propeller Shaft, Differential and Rear Axles and its auxiliaries and Determine major dimensions of the same
4. Analyze Braking system and Determine major dimensions of the same.
5. Analyze Suspension system and Wheels & Tyres. Also determine major dimensions of the Suspension system.

**Course Content**

**UNIT-I**

**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 dis-advantages. **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.

**SSC:** Advanced chassis layouts with different power Plant location. Advanced frames structures for automobiles. **12 Hrs**

**UNIT-II**

**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.

**SSC** – Trouble shooting and Study of Front Axle and Steering Systems used in recent vehicles with advanced technologies. **10 Hrs**

**UNIT-III**

**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.

**SSC** – Trouble shooting and Study of Propeller shafts, Differential and Rear axle used in recent vehicles with advanced technologies. **10 Hrs**





### UNIT-IV

**Brakes-** Necessity, stopping distance and time, brake efficiency, weight 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, Wagner air brake, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting, Numerical problems.

**SSC** – Trouble shooting and Study of Brake systems used in recent vehicles with advanced technologies. **10 Hrs**

### UNIT-V

**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 independent suspension, rear wheel independent suspension, types, stabilizer, Air & Hydro-gas suspension troubleshooting, Numerical problems.

**Wheels and Tires-** Types of wheels, construction, structure and function, wheel dimensions, structure and function of tires, static and dynamic properties of pneumatic tires, types of tires, materials, tyre section and designation, factors affecting tyre life, quick change wheels, special wheels, troubleshooting,

**SSC** – Trouble shooting and Study of Suspension system, Wheels and Tires used in recent vehicles with advanced technologies. **10 Hrs**

#### **Text Books:**

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 Books:**

1. Kirpal Singh “**Automobile Engineering**” Vol. I, 12th edition, Standard Publications, New Delhi, 2012
2. K.K. Ramalingam - “**Automobile Engineering**” – Sci tech Publication, Chennai – 2011
3. Joseph I Heintner, “**Automotive mechanics**” 2<sup>nd</sup> edition, Affiliated East West Press, New Delhi/Madras, 2013
4. William H. Crouse, “**Automotive Mechanics**” Tata McGraw Hill Publication, New Delhi, 2007

#### **Course Outcomes (COs):**

**After learning all the units, the student should be able to**

1. Identify different chassis layouts and frames and Analyze for Performance of Automobiles and suitability of frames. L1-L4
2. Analyze Front Axles and Steering Systems and its auxiliaries and Determine major dimensions of the same L1-L4
3. Analyze Propeller Shaft, Differential and Rear Axles and its auxiliaries and Determine major dimensions of the same L1-L4
4. Analyze Braking system and Determine major dimensions of the same. L1-L4
5. Analyze Suspension system and Wheels & Tires. Also determine major dimensions of the Suspension system. L1-L4





**Course Articulation Matrix**

**Mapping of Course Outcomes (CO) with Program Outcomes (POs) & 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 different chassis layouts and Frames and Analyze for Performance of Automobiles and suitability of frames.	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
2	Analyse Front Axles and Steering Systems and its auxiliaries and Determine major dimensions of the same	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
3	Analyze Propeller Shaft, Differential And Rear Axles and its auxiliaries and Determine major dimensions of the same	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
4	Analyze Braking system and Determine major dimensions of the same.	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
5	Analyze Suspension system and Wheels & Tires. Also Determine major dimensions of the Suspension system.	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-



Course Title: Automotive Transmission			
Course Code: P18AU62	Semester: VI	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.	Weightage : CIE:50%; SEE:50%		

**Prerequisites:**

Subject requires student to know about the back ground knowledge of different types of drives like belt drives, chain drives, gear drives and rope drives.

**Course Learning Objectives (CLOs):**

At the end of the course the student should be able to

1. Explain the need for transmission
2. Distinguish between positive and non positive drives
3. Explain the Constructional and working principles of different types of clutches
4. Design a clutch for any vehicle
5. Explain the constructional and working principle of different types of fluid flywheel, torque converter and one way clutches

**Course Content**

**UNIT – I**

**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, hydraulic clutches, Clutch - adjustment, Clutch troubles and their causes, requirements of a clutch , Clutch materials, clutch lining ,Vacuum operated clutch, Numerical problems

**SSC:** multiplate hydraulically operated clutch

**11 Hrs**

**UNIT-II**

**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 and field of application, working fluid requirements, fluid coupling characteristics,

**Torque converters,** comparison between fluid coupling and torque converters, single stage , two stage and three stage torque converter, 3 and 4 phase torque converters , performance characteristics, slip, principles of torque multiplication.

**SSC:** poly phase hydrokinetic torque converter

**10 Hrs**

**UNIT-III**

**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, five speed and reverse single stage synchromesh gear box with integral final drive,

Sixteen speed synchromesh with range change and integral splitter gears , twin counter shaft ten speed constant mesh gear box, auxiliary transmissions, compound transmissions ,dual- clutch transmission, continuously variable transmission, numerical problems

**SSC:** triple counter shaft transmission

**11 Hrs**

**UNIT-4**

**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, Vacuum control, pneumatic control, hydraulic control in the planetary gear system , Over drives

**SSC:** planetary final drives

**10 Hrs**



### UNIT-5

**Automatic transmission :** Automatic transmission - Principle, general description and Working of representative types like Borge-warner, 4-speed and 6-speed automatic transmission longitudinally mounted four speed automatic transmission, hydromantic transmission, transaxle three speed automatic layout, the fundamentals of a hydraulic control system, basic four speed hydraulic control system.

**SSC:** electric drives

**10 Hrs**

**Text Books:**

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

**Reference Books:**

1. Crouse W.H. "automotive transmissions and power trains", McGraw Hill Co. 5<sup>th</sup> 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, New Delhi

**Course outcomes:**

At the end of course the student will be able to

1. Design and select clutch for different automotive vehicles and discuss working of different types of clutches
2. Discuss different types of fluid flywheel and torque converters
3. Determine gear ratios and explain the different types of gear boxes for different vehicles requirements
4. Discuss and determine gear ratios of different epicyclic gear boxes and their working
5. Explain the different automatic transmission systems used in automotive vehicles and their advantages and limitation

**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	Design and select clutch for different automotive vehicles and discuss working of different types of clutches	3	3	-	-	-	1	-	-	-	-	-	1	3	3	1
2	Discuss different types of fluid flywheel and torque converters	3	2	-	-	-	1	-	-	-	-	-	1	3	2	1
3	Determine gear ratios and explain the different types of gear boxes for different vehicles requirements	3	2	2	-	-	1	-	-	-	-	-	1	3	2	1
4	Discuss and determine gear ratios of different epicyclic gear boxes and their working	3	2	2	-	-	1	-	-	-	-	-	1	3	2	1
5	Explain the different automatic transmission systems used in automotive vehicles and their advantages and limitation	3	2	1	-	-	1	-	-	-	-	-	1	3	2	1



Course Title: Automotive Electricals and Electronics			
Course Code: P18AU63	Semester: VI	L:T:P:H- 4:0:0:4	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

### **Prerequisites:**

Subject requires student to know about

- Basics of electrical Engineering
- Basics of electronic science
- Basics of electrical and electronic circuits
- Basics of electromagnetic principles
- Basics of Automobile
- Basic working principles of generator, alternator and electric motors

### **Course Learning Objectives (CLOs):**

This Course aims to

1. Explain electrical systems and different accessories used in automotive vehicles (L2)
2. Explain the construction and working Principle of different types of batteries used in automotive vehicles. (L2)
3. Explain the construction, working Principle and distinguish the generator, alternator starting motors and starting drives. (L2, L4)
4. Identify, describe about microelectronics and controllers, Basic principles of semiconductors technology.(L1,L2)
5. Identify Classification and Applications of sensors. (L1, L3)

### **Course Content**

#### **UNIT-I**

Fundamentals of Electricity, Vehicle Electrical System, tools and test equipment, circuit diagrams and symbol.

**Batteries:** Functions, Types, Construction and working principle of Lead-acid battery, alkaline battery, zinc-air battery, nickel-metal hydride battery, Lithium ion battery, battery charging, battery testing, performance of a battery, battery rating and capacity, battery efficiency, battery maintenance.

**SSC:** Recent development in Battery design.

**12 Hrs**

#### **UNIT-II**

**Charging Systems:** Requirement, principle, DC generator, regulator, alternator, types of alternator, construction, alternator regulation, alternator tests and trouble shooting, comparison of alternator with DC generator, wireless vehicle charging.

**Starting system:** Requirements, starter motors, types and construction, starter drive mechanisms, over running clutch drive, starter switches and control circuit, testing and trouble shooting of starters.

**SSC:** Charging & starting system in Indian vehicle (4 vehicle)

**10 Hrs**

#### **UNIT-III**

**Lighting:** Requirement, head lights, control of head light beam, head light dazzle, Anti dazzle devices, adjusting head light, fog lamps, side and tail light, brake warning light, direction indicator light, parking light, interior lighting.

**Accessories:** Speedometer, odometer, fuel gauge, horn, wind shield wiper, windshield washer power windows, air conditioner and control, rear view cameras door lock, central locking system.



**SSC:** Lighting system and various accessories in Indian cars

**10 Hrs**

#### UNIT-IV

Fundamental of Electronics, sensor principle, mass air flow sensor, manifold pressure sensor, engine speed sensor, position sensor, vehicle speed sensor, throttle position sensor, oxygen sensor, temperature sensor, actuators, different actuator used in Automobile.

**SSC:** Various sensors used in Indian cars.

**10 Hrs**

#### UNIT V

**Engine Management:** Micro controller, architecture of micro controller, actuators, electric gasoline injection system modern diesel injection system.

**Micro computer controlled system,** Electric power steering, anti-lock brake system, collision avoidance radar warning system, tyre pressure monitoring system, anti theft system, keyless entry system, day time running lights.

**SSC:** Study of Engine management system of Indian cars.

**10 Hrs**

#### **Text Books:**

1. Robert Bosch, “Automotive Electrics Automotive Electronics” GMBH Publication, 2004.
2. P.M. Kohli, “Automotive Electrical Equipment”, Tata McGraw Hill, New Delhi. 45<sup>th</sup> reprint 2015
3. Automotive Electricals and Electronics- A K babu , khana publication

#### **Reference Books:**

1. W. Bolton, Longman , Mechtronics , 2Ed, Pearson publications, 2007
2. A.P. Young & Griffiths, “Automobile Electrical Equipment”, ELBS & Newnes Butterworths, London
3. W. Judge, “Modern Electrical Equipment”
4. Parker and smith, “Electrical Equipment for Automobile
5. Kenneth J Ayala – “ The 8051 Microcontroller- Architecture, Programming, & Applications” 3<sup>rd</sup> edition Penram International Publishing (I) Pvt Ltd- Thomson Delmar Learning

#### **Course Outcomes (COs)**

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

1. Explain the evolution of electrical systems, different accessories, construction, working principle and trouble shooting of batteries used for automotive application
2. Explain the construction, working principle and identify troubles encountered in Starting & charging Systems
3. Explain the working principle of Lighting system and accessories.
4. Explain the working principle of various types of sensors and actuators used in automobile
5. Understand the application of micro controller in automobile



**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	Explain the evolution of electrical systems, different accessories, construction, working principle and trouble shooting of batteries used for automotive application	3	2	2	-	-	2	1	-	-	-	-	2	3	2	-
2	Explain the construction, working principle and identify troubles encountered in Starting & charging Systems	3		2	-	-	2	1	-	-	-	-	2	2		-
3	Explain the working principle of Lighting system and accessories.	2		2	-	-	2	1	-	-	-	-	2	3	2	-
4	Explain the working principle of various types of sensors and actuators used in automobile	3	1	2	-	-	2	1	-	-	-	-	2	3	2	-
5	Understand the application of micro controller in automobile	3	2	1	-	-	2	1	-	-	-	-	2	3	2	-



<b>Professional Elective - II</b>			
<b>Course Title: Total Quality Management</b>			
Course Code: P18AU641	Semester: VI	L:T:P:H -2:2:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:** basic knowledge of management & entrepreneurship, supply chain management and quality concepts.

**Course Learning Objectives (CLOs)**

1. Describe concept of TQM
2. Explain four revolutions in management thinking
3. Describe nine steps to applying proactive improvement to develop new products
4. Explain roles of creativity in team processes and the importance of CEO involvement in TQM
5. Explain centre for quality management with case study and explain dynamics of society learning system.

**Course content**

**UNIT – I**

**Overview of total quality management:** history of TQM. Axioms of TQM, contribution of quality gurus –Deming’s approach, Juran’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. Future fitness’s, four revolutions in management thinking and four level of practice.

**SSC:** Compare quality of conformance versus quality of design **11 Hrs**

**UNIT – II**

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

**Focus on customers;** change in work concept marketing, and customers.

**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. Qc tools; identifying the problem, standard steps and tools, seven steps case study, seven qc tools.

**SSC:** Compare process versus creativity in continuous improvement **10 Hrs**

**UNIT – III**

**Reactive improvement:** management diagnosis of seven steps of reactive improvement. General guidelines for management diagnosis of a QI story, discussion on case study for diagnosis of the seven steps.

**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.

**SSC:** Discussion on case study for customer visitation **10 Hrs**





### UNIT – IV

**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. Goal setting (vision/ mission), organization setting, training and e education, promotional activities, diffusion of success stories, awards and incentives monitoring and diagnosis, phase-in, orientation phase, alignment phase, evolution of the parallel organization.

**SSC:** Explain teamwork skill

**10 Hrs**

### UNIT – V

**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, Hoshin management and conventional business planning, Hoshin management as “systems engineering” for alignment.

**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. TQM as learning system, keeping pace with the need for skill, TQM model for skill development

**SSC:** TQM model for skill development

**11 Hrs**

**Text books:**

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 books:**

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	The students should learn and understand principles of quality contributed by quality guru’s	2	2	1	-	-	-	-	-	-	-	2	2	1	-	-
2	The students should be able to understand different quality control tools used for continuous improvement.	2	2	-	-	-	-	-	-	-	-	-	2	1	-	-
3	The students should be able to learn proactive improvement to develop new product.	2	2	1	-	-	-	-	-	-	-	2	2	1	-	-
4	Students should be able to understand the involvement of different levels of management in TQM.	3	2	1	-	-	-	-	-	-	-	2	2	1	-	-
5	Students should be able understand strategic planning in Hosing management and networking in TQM	3	1	1	-	-	-	-	-	-	-	2	2	1	-	-



<b>Course Title: Automotive Air Conditioning</b>			
Course Code: P18AU642	Semester: VI	L:T:P:H- 2:2:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

**Prerequisites:**

Subject requires students know about: basic thermodynamics, applied thermodynamics  
Different types IC engines and cycles of operations. Working principle of two stroke, four stroke, SI& CI engines.

**Course Outcomes CLOs:**

After learning all the units of the course, the student is able to

1. Know about the Basic air conditioning system.
2. Understand the concepts of Air conditioning and heating.
3. Interpret about the conventional and modern refrigerants for automotive applications.
4. Analyze about the air control, handling, trouble shooting and servicing.
5. Explain the causes of air conditioning failure and trouble shooting of air control system.

**COURSE CONTENT**

**UNIT – I**

**AIRCONDITIONING FUNDAMENTALS** Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator,

**SSC:** Evaporator temperature regulator **12 Hrs**

**UNIT-II**

**AIR CONDITIONER HEATING SYSTEM** Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection

**SSC:** Air conditioning protection, engine protection **10 Hrs**

**UNIT-III**

**REFRIGERANTS** Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential aspects. Handling refrigerants

**SSC:** Ozone Depleting Potential aspects **10 Hrs**

**UNIT-IV**

**AIR ROUTING AND TEMPERATURE CONTROL** Objectives, evaporator airflow through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems.

**SSC:** testing the air control and handling systems **10 Hrs**

**UNIT-V**

**AIR CONDITIONING SERVICE** Causes of air conditioner failure - Trouble shooting of air controlling system - Air conditioner maintenance and service - Servicing heater system. Removing and replacing components – leak testing - Compressor service.

**SSC:** Causes of air conditioner failure **10 Hrs**

**Text Book:**

1. William H. Crouse and Donald I. Anglin -“**Automotive Air conditioning**”- McGraw Hill 1990



**References:**

1. Mitchell information Services, Inc-“**Mitchell Automatic Heating and Air Conditioning Systems**” - Prentice Hall Ind.
2. Paul Weiser - “**Automotive Air Conditioning**” - Reston Publishing Co., Inc.,
3. Macdonald, K.I., - “**Automotive Air Conditioning**” - Theodore Audel series
4. Goings. L.F. – “**Automotive Air Conditioning**” - American Technical services
5. Boyce H. Dwiggins – “**Automotive Air Conditioning**” - Delmar –

**Course Outcomes COs:**

**After learning all the units of the course, the student is able to**

1. Explain the Basic air conditioning system.(L1)
2. Explain the concepts of Air conditioning and heating. (L1,L2)
3. Interpret about the conventional and modern refrigerants for automotive applications.(L1,L2.L3)
4. Summarize about the air control, handling, trouble shooting and servicing.(L1,L2)
5. Explain the causes of air conditioning failure and trouble shooting of air control system (L1, L2).

**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	Explain the Basic air conditioning system.	2		2	-	-	1	1	-	-	-	-	1	2	2	2
2	Explain the concepts of Air conditioning and heating.	3	-	2	-	-	1	1	-	-	-	-	1	3	2	2
3	Interpret about the conventional and modern refrigerants for automotive applications.	3	-	2	-	-	1	1	-	-	-	-	1	3	2	2
4	Summarize about the air control, handling, trouble shooting and servicing.	2	-	2	-	-	1	1	-	-	-	-	1	2	2	2
5	Explain the causes of air conditioning failure and trouble shooting of air control system	2	-	2	-	-	1	1	-	-	-	-	1	2	2	2



Course Title: Operation Research			
Course Code:P18AU643	Semester: VI	L:T:P:H- 2:2:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

### Course Learning Objectives (CLOs)

This course aims to:

1. Introduce students to use quantitative methods and techniques for effective decisions-making;
2. Fundamentals of OR, formulation of linear programming problems.
3. Graphical solution, Simplex method, duality principles.
4. Various types of transportation and assignment problems
5. Replacement of machines at suitable time, queuing model, Network analysis(PERT/CPM)
6. Games theory, replacement and maintenance management methods by graphical method and dominance rule.

### Course Content

#### UNIT-I

**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,

**SSC:** Dual simplex method, Revised Simplex Method **11 Hrs**

#### UNIT-II

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

**Assignment Problem:** Formulation, maximization, unbalanced assignment. travelling salesman problem

**SSC:** Assignment Problem by penalty Method **10 Hrs**

#### UNIT-III

**Sequencing:** Johnson's 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, analysis of M/M/1 queuing model

**SSC:** Sequencing of n jobs m machines **11 Hrs**

#### UNIT-IV

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

**SSC:** Crashing of simple networks. **10 Hrs**

#### UNIT-V

**Game Theory:** Formulation of games, Two person-Zero sum game, games with and without saddle point, Graphical solution ( $2 \times n$ ,  $m \times 2$  game), dominance property.



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

**SSC:** Probabilistic Models

**10Hrs**

**Text Books:**

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

**References:**

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.

**Course Outcomes (COs)**

After learning all the units of the course student should be able to:

1. Identify and develop operation research models from the verbal description of real life.
2. Analyze real life problems using mathematical tool such as linear programming.
3. Describe transportation model and solving technique and analyze the results.
4. Solve assignment problem using different methods.
5. Explain the game theory with their characteristics and solve related problems

**Course articulation Matrix**

**Mapping of Course Outcomes (CO) with Programme 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	Identify and develop operation research models from the verbal description of real life.	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-
2	Analyze real life problems using mathematical tool such as linear programming.	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-
3	Describe transportation model and solving technique and analyze the results.	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-
4	Solve assignment problem using different methods.	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-
5	Explain the game theory with their characteristics and solve related problems	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-



<b>Course Title: Two and Three Wheeled Vehicles</b>			
Course Code: <b>P18AU644</b>	Semester: VI	L:T:P:H- 2:2:0:4	Credits:3
Contact Period-Lecturer: 52Hrs, : Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

**Prerequisites:** To be an Automobile engineer, the student needs to have a basic knowledge of the automobile engineering, auxiliary systems of automobiles and two and three wheeled vehicles. The subject of two and three wheeled vehicles involves the study of different types and arrangement of engine, cooling and lubrication systems, chassis and suspension systems, maintenance of vehicles and case studies.

**Course Learning Objectives (CLOs)**

This Course aims to

1. Know different types of two wheeler and its engine fuel system, lubricating system, cooling system.
2. Know ignition and electric system, exhaust system and cranking mechanism of two wheeler.
3. To know Motor cycle transmission and steering system.
4. Know Front forks, fork type and spring type suspension systems and braking system used in two wheelers.
5. To understand the frame and body of two wheeler, basics on three wheelers.

**Course content**

**UNIT - I**

**Introduction:** History, classification and layouts of the two wheeler, Technical specification and Manufacturer of two wheeler in India, comparison of different two wheeler in India.

Types of Engine for two wheeler, Merits and demerits, Fuel supply system in two wheeler, Lubrication and cooling system in two wheeler.

**SSC:** Study of cooling system and lubrication system of Indian two wheeler **11 Hrs**

**UNIT - II**

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

**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, and Auto start Mechanism.

**SSC:** Study of different type of Exhaust system in Indian two wheeler **10 Hrs**

**UNIT - III**

**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

**SSC:** Study of Different type of gear box used in Indian two wheeler **10 Hrs**

**UNIT - IV**

**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, and foot operated hydraulic brake

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

**SSC:** Study of Different braking system of Indian two wheeler **10 Hrs**



**UNIT- V**

**Frame and Body of Two wheeler:** Load on the Frame, Design Consideration, Components of Frame, Mounting Provisions on Frame, Tubular Frame, 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

**SSC:** Study of Different indian three wheeler

**11 Hrs**

**Text Book:**

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 Books**

1. Srinivas S, Motor cycle, scooters, Mopeds, New century book house, 1988
2. The Cycle Motor Manual - Temple Press Ltd, london 1990
3. Michel M Griffin, Motor Cycles from inside and outside, Prentice hall 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 Outcomes:**

**At the end of the course the student will be able to:**

- 1 Know different types of two wheeler and its engine fuel system, lubricating system, cooling system.
- 2 Know ignition and electric system, exhaust system and cranking mechanism of two wheeler.
- 3 Know Motor cycle transmission and steering system.
- 4 Know Front forks, fork type and spring type suspension systems and braking system used in two wheelers.
- 5 To Understand the frame and body of two wheeler, basics on three wheelers

**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	Know different types of two wheeler and its engine fuel system, lubricating system, cooling system.	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	Know ignition and electric system, exhaust system and cranking mechanism of two wheeler.	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	Know Motor cycle transmission and steering system.	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	Know Front forks, fork type and spring type suspension systems and braking system used in two wheelers.	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
5	To Understand the frame and body of two wheeler, basics on three wheelers	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-





<b>(Open Elective-I)</b>			
<b>Course Title: Automotive Engines and Systems</b>			
Course Code: P18AUO651	Semester: VI	L:T:P:H -3:0:0:3	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

**Pre requisite:** This subject requires student to know about the primovers, and their basic principles of working

**Course Learning Objectives (CLOs)**

At the end of the course the student should able to

- a) Explain the combustion and working of IC engines
- b) Explain the different ways of fuel supplied to SI and CI engines
- c) Explain the different ignition system and super charging systems
- d) Explain about necessity of lubrication and cooling in IC engines and different methods
- e) Measure and analyze different engine parameters

**Course content**

**UNIT I**

**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

**SSC:** rotary engines

**10 Hrs**

**UNIT II**

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

**SSC:** electronic diesel control system

**11 Hrs**

**UNIT III**

**Ignition system, super charging and turbo charging:**

Introduction, battery ignition, magneto ignition, modern ignition system, spark advance mechanism, supercharging, objects of supercharging, super charging limits for SI and CI engines, methods of supercharging and turbo charging

**SSC:** capacitor discharge system

**11 Hrs**

**UNIT IV**

**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, SAE rating of lubricants

**SSC:** synthetic oils

**10 Hrs**

**UNIT V**

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

**SSC:** Emission control techniques

**10 Hrs**

**Text Books**

- V. Ganesan-" Internal combustion engines, 4<sup>th</sup> edition , 2014
- M L Mathur and R P sharma, " Internal combustion engines,

**References**

1. S S Thipse, " Internal combustion engines, 2012



2. Dr. Kirpal singh, "Automobile engineering vol. 2, 12 edition ., 2011

**Course Outcomes (CO)**

**At the end of the course the student will be able to**

**CO1. Understand** the basic principles of working of SI and CI engines

**CO2. Identify** the different methods of fuel supply systems in SI and CI engines

**CO3. Understand** the basic principles of ignition system, supercharging and turbo charging

**CO4. Understand** the necessity of cooling and lubrication in IC engines and different types

**CO5. Determine** the IC engines power and efficiencies

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



<b>Course Title: Automotive Chassis and Transmission Lab</b>			
Course Code: P18AUL66	Semester: VI	L:T:P:H-0:0:3:3	Credits:1.5
Contact period : Lecture: 39 Hrs., Exam 3 Hrs.		Weightage:CIE:50%;SEE:50%	

**Prerequisites:**

Subject requires student to know about

- Basic knowledge of an automobile and its layout
- Basic knowledge of requirements of an automobile
- Basic knowledge of Chassis types and components
- Basic knowledge of transmission types and parts

**Course Content**

- Unit-1** Technical specifications and brief description of chassis and transmission components of two wheeled vehicle
- Unit-2** Technical specifications and brief description of chassis and transmission components including body and interiors three wheeled vehicle.
- Unit-3** Technical specifications and brief description of chassis and transmission components including body and interiors Four wheeled vehicle (LMV/LTV & HMV/HTV)
- Unit-4** Trouble shooting of major parts of chassis and transmission components - Front axle (dead/ live), brakes (drum, disc), wheels, tyres, steering system and suspension system (Rigid axle & Independent).
- Unit-5** Trouble shooting of major parts of chassis and transmission components - Clutch, gear box, Propeller shaft, Universal Joint & Slip joint, differential, Rear axle.
- Unit-6** Dismantle and assemble major systems of chassis and transmission components. - Front axle (dead/ live), differential, Rear axle, brakes (drum, disc). Further, identify remedies for the possible problems, if any, based on trouble shooting charts.
- Unit-7** Dismantle and assemble major systems of chassis and transmission components. - Wheels, tyres, steering system and suspension system (Rigid axle & Independent). Further, identify remedies for the possible problems, if any, based on trouble shooting charts.
- Unit-8** Dismantle and assemble major systems of chassis and transmission components. - Clutch, Propeller shaft, Universal Joint & Slip joint- Further, identify remedies for the possible problems, if any, based on trouble shooting charts.
- Unit-9** Dismantle and assemble major systems of chassis and transmission components. - Gear box (Constant mesh – LMV & HMV). Further, identify remedies for the possible problems, if any, based on trouble shooting charts.
- Unit-10** Dismantle and assemble major systems of chassis and transmission components. - Gear box (Synchromesh & Automatic). Further, identify remedies for the possible problems, if any, based on trouble shooting charts.
- Unit-11** Sketch seating arrangements & seat adjustments mechanisms for Light & Heavy motor Passenger vehicle and study of comfort levels provided for driver and passengers.
- Unit-12** Sketch seating arrangements & seat adjustments mechanisms for Light & Heavy transport/commercial vehicle and study of comfort levels provided..
- Unit-13** Sketch & study of different door mechanisms in Light & Heavy motor Passenger vehicle/ Light & Heavy transport/commercial vehicle.

**Text book/References:**

- Heldt. P. M.- “Automotive Chassis”- Chilton Co., (Nyack, N.Y., P.M. Heldt, 1945) Literary Licensing, LLC, 2012
- Automotive Mechanics – N.K. Giri , Khanna Publications, New Delhi,2008
- Automotive Mechanics by William H. Crouse, Tata Mc Graw Hill Publication, New Delhi, 2007



- Service Manuals of the automobiles
- Automotive Transmissions and power trains - William H. Crouse, 5<sup>th</sup> edn., TMH, 1976
- Automotive chassis and body – P.L. Kohli, TMH
- Hand book of vehicle body design – SAE publication
- Vehicle body Engineering by Giles J pawlowski

**Course Outcomes (COs):**

At the end of the course the student should be able to,

1. Identify technical specifications of chassis and transmission components. (Unit-1-3)
2. Examine Trouble shooting charts for chassis and transmission components. (Unit-4,5)
3. Examine Dismantled of chassis and transmission components and identify remedies for the possible problems Comparing with trouble shooting charts (Unit-6-10)
4. Analyze seating arrangements, seat adjustments mechanisms and comfort levels for driver and passengers. (Unit-11,12)
5. Analyze door arrangements, adjustments and mechanisms in automobiles. (Unit-13)

**COURSE ARTICULATION MATRIX**

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) for 2013 scheme

Sl. No.	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Identify technical specifications of chassis and transmission components.	3	3	-	-	-	-	-	-	-	-	-	2	3	1	1
2	Examine Trouble shooting charts for chassis and transmission components.	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1
3	Examine Dismantled of chassis and transmission components and identify remedies for the possible problems Comparing with trouble shooting charts	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1
4	Analyze seating arrangements, seat adjustments mechanisms and comfort levels for driver and passengers.	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1
5	Analyze door arrangements, adjustments and mechanisms in automobiles.	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1



<b>Course Title: Automotive Electricals and Autotronics Lab</b>			
Course Code: P18AUL67	Semester: VI	L:T:P:H-0:0:3:3	Credits:1.5
Contact period : Lecture: 39 Hrs., Exam 3 Hrs.		Weightage:CIE:50%; SEE:50%	

- 1. Testing of Basic Electrical components**
  - a) Switches, Relays, Resistors
- 2. Battery Test**
  - a) High discharge test – Multi meter
  - b) Open voltage circuit test – cell tester
  - c) Specific gravity test – Hydro meter
  - d) Temperature correction test
  - e) Battery leakage test
  - f) Battery drain test
  - g) Capacity test
  - h) Types of charging (Trickle chargers)
- 3. Charging system**
  - a) Voltage output test
  - b) Current output test
  - c) Circuit and ground resistance
  - d) AC generator service
- 4. Electrical Accessories**
  - a) Wind shield wiper / washer systems
  - b) Wiper system service
- 5. Dynamo Armature Test:**
  - a) Open test
  - b) Ground test
  - c) Armature shorts
    - i) Field coils for open circuit test
    - ii) Testing field coils for short circuit
    - iii) Test insulated Brush holder for ground
- 6. Study of Automotive Lighting and Electric circuit**
- 7. Battery charger- front and rear wind shield cleaning**
- 8. Head lamp testing and Adjusting**
- 9. Study of Automotive wiring system**
- 10. Testing of Alternator and starting motors by Auto Electrical Test bench**

### Autotronics Lab

1. Interfacing LEDs and blinking them for specific amount of time
2. Interfacing 16 X 2 LCD panel and displaying characters
3. Interfacing keypad (4 X 4) and displaying key pressed
4. Interfacing temperature sensor and displaying the temp value
5. Interfacing displacement sensor and displaying amount of displacement
6. Interfacing stepper or DC motor and controlling speed and direction of rotation



**Text Book :**

1. Automotive Electricals and Electronics - AK BABU Khanna publications
2. Lab manuals.

**Course Outcomes (CO):**

At the end of the course the student should be able to,

1. **Identify** the faults in battery, generator, starter and alternators through conducting different tests
2. **Analyze** the defects in lighting system, wiring and other automotive electrical systems
3. **Understand** and relate interfacing of various devices to microcontroller
4. **Explain** Architecture of microcontroller and to learn programming

**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	<b>Identify</b> the faults in battery, generator, starter and alternators through conducting different tests	3	3	2	-	2	1	1	1	2	2	-	2	3	2	2
2	<b>Analyze</b> the defects in lighting system, wiring and other automotive electrical systems	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	<b>Understand</b> and relate interfacing of various devices to microcontroller	3	1	1	-	-	-	-	-	-	-	-	2	3	2	-
4	<b>Explain</b> Architecture of microcontroller and to learn programming	3	2	2	-	-	-	-	-	-	-	-	2	3	2	-



<b>Course Title: Skill Oriented Laboratory -II</b>			
<b>(Modelling and Analysis lab)</b>			
Course Code: P18AUL68	Semester: 6	L:T:P:H -0:0:2:2	Credits:1
Contact Period-Lecturer: 26Hrs,	Exam: 3Hrs	Weightage:CIE:50%; SEE:50%	

### **Prerequisites:**

Subject requires student to know about

- Basic knowledge of Engineering Mechanics, Mechanics of materials
- Basic knowledge of Computational Engineering Drawing & Machine Drawing ( Modelling )
- Basic knowledge of Finite Element Analysis
- Basic knowledge of CAD/CAM
- Basic knowledge of Production Technology (Machining Processes)
- Basic knowledge of Heat and Mass Transfer ,Mechanical Vibrations

### **Course Content**

#### **UNIT- I: FINATE ELEMENT ANALYSIS (Ansys / Nastran / Patran etc.)**

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

##### **1) Static Analysis 15 Hrs**

- 1.1 Bars subjected to axial loads for Constant cross section, Tapered cross section & stepped bars
- 1.2 Trusses – Simple trusses
- 1.3 Beams – Cantilever and simply supported beams subjected to point load, UDL, UVL and moments
- 1.4 Analysis of Rectangular Plates (with and without holes) subjected to axial and bending loads.
- 1.5 Thermal analysis – 2D problems (thermal and heat transfer) with conduction and convection boundary conditions
- 1.6 Fluid flow analysis – simple 2D problems Verification of Results of conventional problems

##### **2) Dynamic Analysis 06 Hrs**

- 2.1 Harmonic analysis of bars and beams
- 2.2 Natural frequency and modal analysis (Eigen values and Eigen vectors) of beams

#### **UNIT – II: ANALYSIS USING ANSYS - WORKBENCH (simple exercises) 05 Hrs**

##### **Introduction about workbench**

##### **3) Static stress analysis of structural elements using ANSYS workbench**

- 3.1 Plate with hole subjected to plane stress
- 3.2 Beams of different cross-section subjected to bending and shear

##### **4) Thermal analysis using ANSYS workbench**

- 4.1 Heat transfer in Circular fins

### **Text/Reference Books:**

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. 5<sup>th</sup> edition 2010 **eBook ISBN: 9780080952048 Hardcover ISBN: 9781856176613**

**Course Outcomes (CO):**

**At the end of the course the student should be able to,**

1. Study Static Analysis of Bars, Trusses, Beams, Rectangular Plates
2. Study thermal and fluid flow in a component
3. Study the Dynamic Analysis of bars and beams
4. Study Static stress analysis of structural elements using ANSYS workbench
5. Study Thermal analysis using ANSYS workbench

**Course Articulation Matrix**

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

CO	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Study Static Analysis of Bars, Trusses, Beams, Rectangular Plates	3	3	2	2	3	2	-	-	2	-	2	2	3	2	3
2	Study thermal and fluid flow in a component	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
3	Study the Dynamic Analysis of bars and beams	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
4	Study Static stress analysis of structural elements using ANSYS workbench	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
5	Study Thermal analysis using ANSYS workbench	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3



<b>Course Title : Internals of C Programming (Technical Skills – II)</b>			
<b>Course Code : P18HU693</b>	<b>Semester : VI</b>	<b>L-T-P:H : 0-2-0: 02</b>	<b>Credits : 01</b>
<b>Contact Period : 26Hrs</b>	<b>Exam Hours : 3 Hrs</b>	<b>Weight age :CIE: 50% ,SEE : 50%</b>	
<b>Prerequisites : -</b>			

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### **COURSE OUTCOME:**

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To enable students to:

- Strengthen their understanding of **Introduction to Computer Science, C, and Data Structures**
  - Write effective codes on **C Programming**
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### **OVERALL SYLLABUS BREAKUP:**

<b>Sl. No.</b>	<b>Module name</b>	<b>Classroom (Hours)</b>	<b>Lab (Hours)</b>	<b>Total duration (Hours)</b>
1.	<b>Introduction to Computer Science</b>	2	0	2
2.	<b>C Programming</b>	0	14	14
3.	<b>Introduction to Data Structures</b>	4	6	10
<b>Total Hours</b>		<b>6</b>	<b>20</b>	<b>26</b>

### **LEARNING OUTCOMES**

- After undergoing training in this course, the students will be in a position to –
  - Write complete program based on the requirements and to debug.
  - Frame effective programs using C programming and Data Structures.

### **ASSESSMENTS**

- Each of the modules (C and Data Structures) will have two types of assessments -
  - Multiple-choice assessment for programming logic, concepts and debugging
  - Coding



## COURSE PLAN:

### C Programming

Sl. No.	Topics covered	Learning outcome	Type of learning	Duration
1.	<b>Introduction to Computer Science:</b> <b>Basic Structure of Computers:</b> Basic Operational Concepts, Bus Structures, Performance– Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. <b>•Operating System - An Introduction:</b> Definition and functions of operating systems. Discussion on evolution of operating systems and different structures of operating systems.	<ul style="list-style-type: none"><li>● Understand the basics of computer structure and operation of computers and their peripherals and need of Operating System.</li></ul>	Class - 2	2
2.	<b>C Programming Language:</b> <b>• Basic level of Snippets for</b> <ul style="list-style-type: none"><li>○ Understanding basic syntax</li><li>○ If - else statement</li><li>○ Switch case</li><li>○ Struck</li><li>○ For loop</li><li>○ While and do - while loop</li><li>○ Array</li><li>○ Strings</li><li>○ Pointers</li><li>○ Function</li><li>○ String</li><li>○ File handling</li><li>○ Pre-processing</li></ul>	<ul style="list-style-type: none"><li>● Understand the concepts of snippets in a programming term for a small region of reusable source code, machine code, or text. In C it could be part of the program - A Function, typed or a part of the algorithm or code.</li><li>● Understand the concepts of programs as sequences or machine instructions.</li></ul>	Lab - 14	14
3.	<b>Introduction to Data Structures:</b> Data Structures Basics: Structure and Problem Solving, Data structures, Data structure Operations, Algorithm: complexity, Time- space tradeoff. <ul style="list-style-type: none"><li>○ Linked List</li><li>○ Stack and Queue</li><li>○ Searching and Sorting Techniques</li></ul>	<ul style="list-style-type: none"><li>● Understand common data structures and the algorithms that build and manipulate them including various sorting and searching algorithms. Data structures include arrays, linked lists, stacks, queues, Features, properties, applications, enumerators, and performance issues.</li></ul>	Class – 4 Lab - 6	10