SYLLABUS

(With effect from 2017-18)

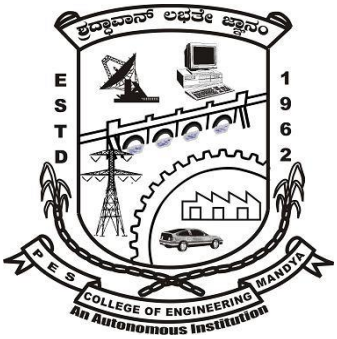
ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)

V & VI Semester

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)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

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

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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 Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently 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 13th 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 and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction 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.

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	Subject Code	Title of the Subject	Teaching Dept.	Credit Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P17AU 51	Industrial Management and Entrepreneurship	AUTO	4:0:0:4	4	50	50	100
2	P17AU 52	Design of Machines Elements-I	AUTO	3:2:0:5	4	50	50	100
3	P17AU 53	Automotive Engines and Components	AUTO	4:0:0:4	4	50	50	100
4	P17AU 54	Theory of Machines-II	AUTO	3:2:0:5	4	50	50	100
5	P17AU 55	Foundation Elective	AUTO	4:0:0:4	3	50	50	100
6	P17AU 56	Elective-I	AUTO	4:0:0:4	3	50	50	100
7	P17AU L57	Engine and Components Lab	AUTO	0:0:3:3	1.5	50	50	100
8	P17AU L58	Modelling and Analysis Lab	AUTO	0:0:3:3	1.5	50	50	100
9	P17AU59	Industrial Visit & Interaction	AUTO	0:0:2:2	1	50	-	50
10	P17AU510	Aptitude and Reasoning Development- Advance(ARDA)	HS & M	2:0:0:2	1	50	50	100
				Total	27	500	450	950

List of Electives

Foundation Elective			Elective-1		
Sl. No.	Course Code	Course Title	Sl. No.	Course Code	Course Title
1	P17AU551	Auxiliary System of Automotive Engines	1	P17AU561	Automotive Fuel and Combustion
2	P17AU552	Manufacture of Automobile Components	2	P17AU562	CAD/CAM
3	P17AU553	Advanced Material Science	3	P17AU563	Non Traditional Machining
4	P17AU554	Mechtronics & Microprocessor	4	P17AU564	Gas turbine

VI SEMESTER B.E. AUTOMOBILE ENGINEERING

Sl. No.	Subject Code	Title of the Subject	Teaching Dept.	Credit Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P17AU 61	Automotive Chassis and Suspension	AUTO	4:0:0:4	4	50	50	100
2	P17AU 62	Automotive Transmission	AUTO	4:0:0:4	4	50	50	100
3	P17AU 63	Design of Machines Elements-II	AUTO	3:2:0:5	4	50	50	100
4	P17AU 64	Mechanical Vibrations	AUTO	3:2:0:5	4	50	50	100
5	P17AU 65	Elective II	AUTO	4:0:0:4	3	50	50	100
6	P17AU 66	Elective III	AUTO	4:0:0:4	3	50	50	100
7	P17AU L67	Automotive Chassis and Transmission Lab	AUTO	0:0:3:3	1.5	50	50	100
8	P17AU L68	Automotive Electricals and Autotronics Lab	AUTO	0:0:3:3	1.5	50	50	100
9	P17AU610	Mini Project	AUTO	0:0:2:2	1	50	-	50
10	P17AU611	Aptitude and Reasoning Development- Expert(ARDE)	HS & M	2:0:0:2	1	50	50	100
				Total	27	500	450	950

List of Electives

Elective-II			Elective-III		
Sl. No.	Course Code	Course Title	Sl. No.	Course Code	Course Title
1	P17AU651	Automotive Electrics and Autotron ics	1	P17AU661	Operations Research
2	P17AU652	Theory of Elasticity	2	P17AU662	Two and Three Wheeled Vehicles
3	P17AU653	Non destructive testing	3	P17AU663	Total Quality Management
4	P17AU654	Automotive Air Conditioning	4	P17AU664	Statistical Quality Control and Reliability

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%		

- Each of the two questions set shall be so comprehensive as to cover the entire contents of the unit.
- There will be direct choice between the two questions within each Unit
- Total questions to be set are 10. All carry equal marks of 20
- The number of subdivisions in each main question shall be limited to three only
- Number of questions to be answered by students is 5

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

Course Title: Industrial Management and Entrepreneurship			
Course Code: P17AU51	Semester: 5	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 (CLO) :

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.
6. Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership.

Relevance of the course:

Industrial Management and Entrepreneurship is a management course in BE (Automobile Engineering) program which Provide a fundamental understanding of management, Planning, organizing, staffing, directing and controlling.. These are essential in Industries to get managerial skills. The course also aims to provide basic understanding of Entrepreneurships and to create awareness about various types of supporting agencies and financing available for an entrepreneur and to impart strategies to be followed in managing and growing new venture. It also helps in preparing project report and to know about Industrial ownership.

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: Vtudy 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).

FINANCIAL MANAGEMENT: Evolution of Financial Management, Financial Decisions in Firm, Goals, Forms of Business Organization, Risk- Return Tradeoff**.**

RISK AND REQUIRED RETURN: Risk And Return Relationship, Business Risk, Financial Risk, And Risk In Portfolio Context, Expected Rate Of Return, Capital Asset Pricing Model.

SSC: INSTITUTIONAL SUPPORT**:**

Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC

Single Window Agency: SISI; NSIC; SIDBI, KSFC. **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, taking anyone of the product. **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	-	-

Course Title: Design of Machine Elements-I			
Course Code: P17AU52	Semester: 5	L:T:P:H- 3:2:0:5	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites:

Subject requires student to know about the knowledge of the fundamentals of Engineering Mathematics, Engg physics, Mechanics of Materials, Engineering Drawing, Workshop Processes, Theory of Machines and Material Science

Course Learning Objectives (CLOS)

This Course aims to:

a) Define and explain various terms connected to the design of machine elements-I like static strength, fatigue strength, Impact stresses, theories of failures, rigidity based design, factor of safety, and stress concentration etc.
b) Demonstrate how engineering design make use of the principles learnt in science courses and identify their practical applications.
c) Develop problem-solving skill in design of machine elements using appropriate assumptions and correct methodology.
d) Consider environmental impact of the design and take measures to avoid environmental deterioration.
e) Work on the given assignment and to get first hand information and also be able to present and submit a brief report.

Relevance of the course:

1. Get expertise in the selection of material for designing a particular machine element
2. Design machine element based on static and dynamic strengths.
3. Identify the type of joints required for a particular application and to design as per ASME standards

Course Content

UNIT –I

INTRODUCTION:

Basic design procedure, types of machine design, design consideration, codes and standards, stress – strain diagrams. Design against static loading, modes of failure, factor of safety, design of simple machine members subjected to static loading including eccentric load, limited to biaxial stresses (normal, shear, bending, torsional, crushing/bearing), principal stresses.

THEORIES OF FAILURE - Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory.

IMPACT STRENGTH: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia.

SSC: Bicycle Brake lever loading analysis Automobile Scissors-jack loading analysis Bicycle Brake arm factor of safety **10 Hrs**

UNIT –II

DESIGN FOR FATIGUE STRENGTH: Stress concentration, Stress concentration factors, Reduction of Stress concentration, fluctuating stresses, fatigue and endurance limit, S-N Diagram, Low cycle & High cycle fatigue, notch sensitivity, endurance limit, modifying factors; load, size and surface factors, Stress concentration effects; design for infinite life, combined steady and variable stress, Soderberg and Goodman relationship, stresses due to combined loading, cumulative fatigue damage.

SSC: Hand-Operated Crimping-Tool failure Analysis, Automobile Scissors-Jack failure Analysis, Bicycle Brake Arm factor of safety **10 Hrs**

UNIT –III

DESIGN OF COTTER JOINT, KNUCKLE JOINT AND COUPLINGS: Design of Cotter and Knuckle joints, Design of keys

DESIGN OF SHAFTS: Transmission shaft, shaft design on strength and rigidity basis, ASME code for shaft design, Design of Hollow shaft.

SSC: Design of Flexible and flange coupling **12 Hrs**

UNIT –IV

RIVETED JOINTS: Types of riveted joints, failures of riveted joints, efficiency, and boiler Joints, structural joints,.

WELDED JOINTS: Types, Strength of butt and fillet joints, welds, eccentrically loaded welded joints.

SSC: Design of eccentrically loaded riveted joints Design of eccentrically loaded welded joints **10 Hrs**

UNIT – V

THREADED JOINTS: Introduction, basic terminology of screw threads, types of screw threads, types of screw fastenings, designations of screw threads, Stresses in threaded fasteners due to static loading, Effect of initial tension, threaded joints for cylinder covers, design of eccentrically loaded bolted joints

POWER SCREWS: Introduction, Types of screw threads used for power screws, Design of Power Screws, efficiency, self-locking and over hauling

SSC: Design of screw jack **10 Hrs**

Text Books:

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

Reference Books:

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

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. Explain basic design concept and Analyze the various modes of failure of machine components under different static and impact load conditions and use appropriate theories of failures to design machine components
2. Compute the dimensions of the machine components subjected to dynamic loads
3. Design shafts as per ASME standards and Design mechanical joints such as Cotter, Knuckle joint and couplings
4. Design typical riveted joints and welded joints for boiler and structural applications
5. Select standard thread elements and design power screws 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	Explain basic design concept and Analyze the various modes of failure of machine components under different static and impact load conditions and use appropriate theories of failures to design machine components	2	2	2	-	-	-	2	-	-	-	-	2	3	3	-
2	Compute the dimensions of the machine components subjected to dynamic loads	3	2	2	-	-	-	2	-	-	-	-	2	3	3	-
3	Design shafts as per ASME standards and Design mechanical joints such as Cotter, Knuckle joint and couplings	3	3	3	-	-	-	2	-	-	-	-	2	3	3	-
4	Design typical riveted joints and welded joints for boiler and structural applications	3	3	3	-	-	-	2	-	-	-	-	2	3	3	-
5	Select standard thread elements and design power screws for different applications	3	3	3	-	-	-	2	-	-	-	-	2	3	3	-

Course Title: Automotive Engines and Components			
Course Code: P17AU53	Semester: 5	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
- Basics of I.C. Engines
- Simple Numerical problems regarding determination of Engine performance parameters.

Course Learning Objectives (CLOS):

The course aims to

1. Classify Heat engine and Analyze actual working principle of Heat engines.
2. Analyze engine block and its auxiliaries and Determine major dimensions of the same
3. Analyze Piston-rings-pin and Determine major dimensions of the same
4. Analyze Connecting rod and crank shaft and Determine major dimensions of the same
5. Analyze valve operating mechanism and Determine major dimensions of the same. Study of engine components of state of the art technologies.

Relevance of the course:

Automotive Engines & components is a foundation course in BE (Automobile Engineering) program that helps for the understanding of the basic classifications and principles of operation of IC Engines.

Further this course also helps to understand different Types, function, materials, construction details, manufacturing, Troubles & Remedies and calculation of major dimensions of the major components engine components

Course Content

UNIT-I

INTRODUCTION- Historical development of automobiles, Heat Engines & their classification. Reciprocating IC Engines - Basic Engine Components & Nomenclature, Principle of engine operation, Comparison of SI & CI Engines, Classification of I C engines, applications of IC Engines

Four stroke engines - Principles of engine operation (SI & CI), Actual Valve timing - mechanical and dynamic factors,

Two stroke engines - Principles of engine operation (SI & CI), Port timing diagrams. Types - Three port engine, Separate pumps or blowers, Symmetrical & unsymmetrical timing, Cross flow, loop flow & uniflow type Scavenging systems. Scavenging Process: – Pre blow down, Blow down, Scavenging, Additional Charging. Theoretical Scavenging processes, Scavenging parameters, Comparison of Different Scavenging Systems; port design, scavenging pumps.

Relative merits & demerits of petrol & diesel engines. Comparison of Two Stroke & Four Stroke Engines.

SSC: Differences in thermodynamic and operating Variable and Comparison of performance characteristics of SI & CI Engines. **12 Hrs.**

ENGINE COMPONENTS (Units-II to V)

Types, function, materials, construction details, manufacturing, Troubles & Remedies and Determination of major dimensions of the following engine components

UNIT-II

Cylinder Block, Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, and valve seats.

Crank Case – General form of crank case, oil sumps and cooling features, flywheel mountings, Engine mountings, Front & Rear mountings.

Production of engine blocks

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

SSC: Production of Cylinder Block, Cylinder heads, Crank Case & Manifolds and Mufflers and their use in recent vehicles with advanced technologies **10Hrs.**

UNIT-III

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

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

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

SSC: Production of Piston, Piston Rings & Piston pin and their use in recent vehicles with advanced technologies **10Hrs**.

UNIT-IV

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

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

SSC: Production of Connecting Rod & Crank Shaft and their use in recent vehicles with advanced technologies **10Hrs**.

UNIT-V

Valve and Valve Mechanism Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, , valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, **Camshaft**-drives of cams, cam types, tappets,-automatic zero clearance tappets, push rods, rocker arms & rocker Shaft. Testing of I.C. Engines: Testing of two-stroke and four strokes SI and CI engines. Performance related numerical problems. Heat balance, Morse test

SSC: Production of Valve, Valve Mechanism &Camshaft and their use in recent vehicles with advanced technologies **10Hrs**.

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

At the end of the course students are able to:

1. Classify Heat engine and Analyze actual working principle of Heat engines.
2. Analyze engine block and its auxiliaries and Determine major dimensions of the same
3. Analyze Piston-rings-pin and Determine major dimensions of the same
4. Analyze Connecting rod and crank shaft and Determine major dimensions of the same
5. Analyze valve operating mechanism and Determine major dimensions of the same. Study of engine components of state of the art technologies.

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	Classify Heat engine and Analyze actual working principle of Heat engines.	3	3	-	-	-	-	1	-	-	-	-	2	3	-	-
2	Analyze engine block and its auxiliaries and Determine major dimensions of the same	3	3	-	-	-	-	1	-	-	-	-	2	3	2	-
3	Analyze Piston-rings-pin and Determine major dimensions of the same	3	3	-	-	-	-	1	-	-	-	-	2	3	2	-
4	Analyze Connecting rod and crank shaft and Determine major dimensions of the same	3	3	-	-	-	-	1	-	-	-	-	2	3	2	-
5	Analyze valve operating mechanism and Determine major dimensions of the same. Study of engine components of state of the art technologies.	3	3	-	-	2	-	1	-	-	-	-	2	3	2	-

Course Title: Theory of Machines-II			
Course Code: P17AU54	Semester: 5	L:T:P:H- 3:2:0:5	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites:

Subject requires students to know about

- Basics of Engineering Mathematics
- Engineering Mechanics
- Theory of Machine-I

Course Learning Objectives (CLOS)

This Course aims to

1. Explain equilibrium of forces and calculate static forces at various points in different types of mechanism(L3,L2)
2. Identify, describe inertia force in a link and calculate fluctuation of energy in flywheel(L1, L2,L3)
3. Explain method of balancing of rotating masses and to solve analytically and graphically to balance the systems(L2,L3)
4. Explain method of balancing of reciprocating masses in internal combustion engine, V engine, radial engine and to solve analytically and graphically to balance the systems(L2,L3)
5. Describe the various types of governors and to understand method of finding controlling force Describe gyroscopic couple and to understand effect of gyroscopic couple(L1,L2)

Relevance of the Course:

Theory of Machine is a fundamental course in B.E (Mechanical and Automobile Engineering) programme that helps in understanding various mechanisms and various forces transmitted from one link to other.

Course Content

UNIT – 1

Static force Analysis: Equilibrium of two force, three force and four force members, Members with two forces and couple, Free body diagrams, Static force analysis of single slider-crank mechanism, Quick return motion mechanism, four link mechanism, rivets mechanism, effect of sliding friction, friction in pin joints.

SSC: Static force analysis considering friction. **10 Hrs**

UNIT – 2

Dynamic/Inertia force Analysis: Introduction, D'Alembert's principle, Inertia force, inertia torque, dynamically equivalent systems, correction couple, line of action of inertia force in a link, inertia force analysis (graphical) of a four bar mechanism, inertia force analysis (analytical) of slider crank mechanism [(i) neglecting the mass of the connecting rod; (ii) considering the mass of the connecting rod].

Flywheels: Introduction, Turning moment diagrams, Fluctuation of Energy and speed, energy stored in a flywheel, determination of size of flywheels.

SSC: Fly wheels used in punching machine and power hammers. **10 Hrs**

UNIT – 3

Balancing of rotating masses: Introduction, Static and dynamic balancing, balancing of single revolving mass by balancing masses in same plane and in different planes, Balancing of several masses revolving in the same plane, balancing of several masses revolving in different planes.

SSC: Study of balancing of automotive wheels and crank shaft. **10 Hrs**

UNIT – 4

Balancing of reciprocating masses: Introduction, acceleration of the reciprocating mass of a slider crank mechanism, primary balancing, secondary balancing, Inertia effect of crank and connecting rod, balancing of single cylinder engine, balancing of multi cylinder-inline engine, balancing of radial engines.

SSC: Balancing of V–Engines. **10 Hrs**

UNIT – 5

Governors: Introduction, Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, condition for stability, sensitiveness, isochronisms, hunting, effort and power of governor.

Gyroscopes: Introduction, Vectorial representation of angular motion, gyroscopic couple, effect of gyroscopic couple on bearings, aircraft, ship, two wheelers and four wheelers.

SSC: Proell governors **12 Hrs**

Text Books:

1. V.P. Singh ,**Theory of Machines**:, Dhanpat Rai & Co., 2012
2. Rattan S.S., **Theory of Machines**: Tata McGraw Hill Publishing Company Ltd., 2012

Reference Books:

1. Joseph E. Shigley, **Theory Of Machines And Mechanism**, Jr. Uicker John, McGraw- hill publications., 2011
2. R L. Norton, **Kinematics & Dynamics of Machinery**, , Tata - McGraw Hill., 2010
3. R.S.Khurmi and J.K.Gupta, **Theory of Machines,** S.Chand and Co., 2011
4. P.L. Ballaney, **Theory of Machines**, Khanna Publishers.2011

Course Outcomes (Cos):

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

1. Analyze graphically the static forces acting in different links of simple planar mechanisms.
2. Analyze inertia forces acting on different links of simple planar mechanisms. Design suitable fly wheel for simple mechanical systems
3. Determine the magnitude and location of balancing masses for the rotating machines
4. Determine the magnitude and location of balancing masses for the reciprocating machines.
5. Explain working principle of Governors and Gyroscopes and analyze the gyroscopic stability of mechanical systems.

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 graphically the static forces acting in different links of simple planar mechanisms.	3	3	2	-	-	-	2	-	-	-	-	2	2	2	-
2	Analyze inertia forces acting on different links of simple planar mechanisms. Design suitable fly wheel for simple mechanical systems	2	2	2	-	-	-	2	-	-	-	-	2	2	2	2
3	Determine the magnitude and location of balancing masses for the rotating machines	3	2	2	-	-	-	2	-	-	-	-	2	3	2	2
4	Determine the magnitude and location of balancing masses for the reciprocating machines.	3	2	2	-	-	-	2	-	-	-	-	2	3	2	2
5	Explain working principle of Governors and Gyroscopes and analyze the gyroscopic stability of mechanical systems.	2	2	2	-	-	-	2	-	-	-	-	2	3	2	1

Course Title: Auxiliary Systems of Automotive Engines			
Course Code: P17AU551	Semester: 5	L:T:P:H- 4:0:0:4	Credits:3
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 (CLO):

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 carburetors
3. Design a carburetor
4. Distinguish between petrol injection and carburetor
5. Differentiate between petrol injection and diesel injection system
6. Explain the constructional and principle of operation of different types diesel injection systems
7. Design considerations for diesel injection system
8. Explain the necessity and working of governors in injection system
9. Explain the purpose and advantages of supercharging and turbo charging
10. Distinguish between types and advantages of different types of cooling and lubrication systems.
11. Calculate the quantity of water required for cooling
12. Modifications required in engine for supercharging
13. Distinguish between Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption

Relevance of the course:

Auxiliary Systems of Automotive Engines is a course deals with the different ways through which the fuel is supplied to engines and also deals with purpose and different method of cooling, lubrication and super charging and turbo charging and it is hoped that through this programme student will gain sufficient knowledge to make them employable in automotive industries carburetor and fuel injection system manufacturing industries

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, types and different makes of carburettors, fuel feed systems, fuel pumps, filters, design of carburettors, 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), high pressure fuel injector

SSC: Bosch L tetronic fuel injection system **10Hrs**

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: Cumnis diesel engine fuel injection system **10Hrs**

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, and thermodynamics of forced circulation, evaporative cooling and pressure cooling. regenerative cooling, 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 **11Hrs**

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 **10Hrs**

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

Reference Books

1. Domkundwar, V.M, A Course in **Internal Combustion Engines**, Dhanpat Rai and Co., 2016.
2. Ganeshan, V, **Internal Combustion Engines**, Tata McGraw-Hill Book Co., 2014.
3. Duffy Smith, **Auto Fuel Systems**, the Good Heart Willcox Company Inc., Publishers, 1987.

4. Edward F, Obert, **Internal Combustion Engines and Air Pollution**, in text Education Publishers, 1980.
5. William kimberly , **Gasoline- Engine Management**, published by Robert bosch GmbH,2002
6. William kimberly , **Diesel- Engine Management** , published by Robert bosch GmbH,2004

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 turbocharging and design modifications of an engine for supercharging and turbocharging	2	2	1	-	-	2	2	-	-	-	-	2	3	2	1

Course title: Manufacture of Automobile Components			
Course code: P17AU552	Semester: V	L:T:P:H- 4:0:0:4	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)

This course aims to

1. Learn the various production processes of engine & engine components.
2. Explain the manufacturing of clutch, gear box and propeller shaft components.
3. Describe about the production of axles, springs, steering system and others.
4. Summarize about the manufacture of engine components using ceramic matrix composites and advanced machining process.

Relevance of the course:

The subject **Manufacture of Automotive Components** is an elective course in BE (Automobile Engineering) program that helps to understanding the manufacturing process of various automobile components.

Further this course aims at developing and understanding the production of automotive components and the latest manufacturing methods & developments in automotive field.

Course Content

UNIT-I

Manufacturing of engine & engine components:

Casting of engine block – conventional and expandable pattern, machining of engine blocks in machining center. Preparation of casting for cylinder heads, forging of crankshaft, connecting rod and gudgeon pins, machining and heat treatment, casting of piston by gravity casting, squeeze casting.

SSC: Machining and finishing, upset forging of valves, heat treatment and surface improvement, cylinder liners and piston ring manufacturing. 1**0hrs**

UNIT-II

Manufacture of clutch and gear box components:

Manufacturing friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite molding of phenol formaldehyde lining. Casting of gear box casting, gear hobbing, shaping powder metallurgy.

Manufacture of propeller shaft:

Continuous casting of propeller shaft, extrusion of propeller shaft, extrusion of dies**,** heat treatment and surface hardening of propeller shaft, composite propeller shaft manufacturing.

SSC: Orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing. **11hrs**

UNIT-III

Manufacture of axles and springs:

Forging of front and rear axles, casting of rear axle casing, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs, other springs advanced, steering systems.

SSC: Wheels, brakes, tyre and tube manufacturing, painting, painting booth, coach work. **10hrs**

UNIT-IV

Manufacture of body panels: Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance welding and other welding processes.

Manufacture of automotive plastic components:

Introduction, principle of injection molding, injection molding of instrument panel, molding of bumpers, tooling and tooling requirements.

SSC: Hand layup process for making composite panels, manufacture of metal/polymer/metal panels. **10hrs**

UNIT-V

Manufacture of engine components using ceramic matrix composites:

Introduction, ceramic matrix piston rings, chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sol-gel processing, advanced machine processes using rpt, cnc, etc.

Advanced machining process:

Interfacing the CNC machine and manufacturing package. Introduction to rapid prototyping using fused deposition, laser sintering.

SSC: Machining concepts using NC, generation of numerical control codes using pro-e and ideas package, **11hrs**

Text Books:

1. Heldt P.M. "**High Speed Combustion Engines**", Oxford IBH Publishing Co.
2. Philip F., Steward & Jairo Munuz, "**Manufacturing processes and systems**," John wiley & sons.

Reference Books*:*

1. Kalpakjian. "Manufacturing and engineering technology", addison wesloy, publishing company.
2. Degarmo E.P., "Materials and process in manufacturing", Macmillan publishing co.,

Course Outcomes

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

1. Explain the various manufacturing processes of Automotive Engine components.
2. Explain the manufacturing Process of clutch, gear box and propeller shaft.
3. Describe the manufacturing process of automotive axles, springs, steering system
4. Illustrate various methods of manufacturing the automobile vehicle body panels and plastic components
5. Analyze the application of Ceramic matrix Composite (CmC) Technology to produce Engine components and explain the advance machining and manufacturing packages

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 various manufacturing processes of Automotive Engine components.	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	Explain the manufacturing Process of clutch, gear box and propeller shaft.	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	Describe the manufacturing process of automotive axles, springs, steering system	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	Illustrate various methods of manufacturing the automobile vehicle body panels and plastic components	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
5	Analyze the application of Ceramic matrix Composite (CmC) Technology to produce Engine components and explain the advance machining and manufacturing packages	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

Course title: Advanced Materials Science			
Course code: P17AU553	Semester:5	L:T:P:H- 4:0:0:4	Credits:3
Contact period-lecturer: 52hrs,: Exam:3 hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Knowledge of Material Science and Metallurgy (P17ME32).

Course learning objective: The objective of the course is to enable the students to understand the fundamentals of materials science and engineering and get an exposure to some of the advanced materials processing technologies.

Course Content

UNIT – I

Structural features of Materials: Introduction, Atomic bonding, primary interatomic bonds, ionic bonding, covalent bonding, metallic bonding, secondary bonding or van der Waals bonding, bonding forces and energies, density computations-metals, density computations-ceramics, polymorphic forms of carbon, crystallographic directions, crystallographic planes, atomic arrangements, close-packed crystal structures.

SSC: Bragg's law, single crystals, polycrystalline materials, anisotropy, noncrystalline solids. Impurities in solids, impurities in metals, solid solutions, specification of composition.

10 Hrs

UNIT – II

Structure-Property relationship: Introduction, dislocations, edge dislocation, screw dislocation, mixed dislocations, burgers vector, interfacial defects, external surfaces, grain boundaries, twin boundaries, grain size. dislocation density, slip systems, Deformation mechanisms for metals, elastic deformation, plastic deformation, influence of dislocation on plastic deformation, plastic deformation of polycrystalline metals, mechanisms of strengthening in metals, strengthening by grain size reduction, solid-solution strengthening, strain hardening, recovery, recrystallization and grain growth, recrystallization temperature.

SSC: Time-Temperature-Transformation (T-T-T) of Iron-Carbon alloys, precipitation hardening, solution heat treating, precipitation heat treating, mechanism of precipitation hardening. **10 Hrs**

UNIT – III

Polymer Structures: Introduction, hydrocarbon molecules, polymer molecules, chemistry of polymer molecules, molecular shape, molecular structure, linear polymers, branched polymers, cross-linked polymers, network polymers, thermoplastic and thermosetting polymers, copolymers, polymer crystallinity, polymer crystals, types of polymers-plastics and elastomers.

Mechanical behaviour of polymers: stress-strain behaviour, macroscopic deformation, tear strength and hardness of polymers, mechanisms of deformation of polymers,

SSC: Mechanism of elastic deformation, mechanism of plastic deformation, deformation of elastomers, vulcanization. **10 Hrs**

UNIT – IV

Composite Materials: Introduction, classification, matrix and reinforcement materials, properties, rule of mixtures, longitudinal strength and modulus (isostrain model), transverse strength and modulus (isostress model), Numericals, applications of composites.

Powder metallurgy technique: Blending of powder, Powder Compaction, Sintering.

SSC: Processing of PMCs - hand lay-up process, filament winding process. Processing of MMCs-Stir casting, squeeze casting, 1**2 Hrs**

UNIT – V

Nano technology: Concept of Nanotechnology, Nanomaterials, preparation of Nanomaterials: plasma arcing, CVD, sol-gel method, electrode deposition, ball milling, New forms of carbon, types of nanotubes,

SSC: Properties of nanotubes, applications of nanotechnology. **10 Hrs**

Text books:

1 William D. Callister, Jr., **"Fundamentals of Materials Science and Engineering,**" John Wiley & Sons, Inc, 5th Edition, 2001, ISBN: 9780471395515.
2 William F Smith, Javad Hashemi, Ravi Prakash, **"Materials Science and Engineering,"** Tata McGraw Hill Publishing Company, Ned Delhi, 5th edition, ISBN: 9781259062759.
3 Mick Wilson, Kamali kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, **"Nano Technology- Basic science and Emerging Technology,"** Chapman and Hall/CRC, 1st edition, 2002, ISBN: 978-1584883395.

References:

1 V.S.R Murthy, A. K. Jena, K.P.Gupta, G.S.Murthy, **"Structure and Properties of Engineering Materials,**" Tata McGraw Hill,
2 Er. Rakesh Rathi, **"Nanotechnology,"** S. Chand and Company, 2010, ISBN: 978-8121930826.

Course Outcomes:

At the end of the course the students should be able to:

1. **Explain** the structural characteristics of materials.
2. **Analyze** the structure – property relationship of materials.
3. **Explain** the structural and mechanical characteristics of polymer materials.
4. **Explain** the characteristics and processing techniques of composite materials.
5. **Explain** the characteristics and processing techniques of nano-materials.

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	**Explain** the structural characteristics of materials.	2	2		2									2		
2	**Analyze** the structural – property relationship of materials.	3	3	3	3			2					2	2		
3	**Explain** the structural characteristics of polymer materials.	2	2	2	2			2					2	2		
4	**Explain** the characteristics and processing techniques of composite materials.	3	3	3	2			2					2	2		
5	**Explain** the characteristics and processing techniques of nano-materials.	2		2	3			2					2	2		

Course Title: Mechtronics and Microprocessor			
Course Code: P17AU554	Semester: 5	L:T:P:H- 4:0:0:4	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: The course aims at enabling the students to understand the basic concepts of Mechatronics, Mechatronic products and their applications, Different Electrical and Mechanical actuation systems, Signal condition process, Basic concepts of Microprocessor and data representation using different number systems.

Course Content

UNIT – I

INTRODUCTION: Introduction to Mechtronics systems, measurement systems, control systems, Open & Closed loop control systems, basic elements of closed loop control system, Microprocessor based controllers such as automatic camera and engine management system, classification of sensors, light sensors, Tactile sensors, inputting data by switches, their merits and demerits

SSC: Hall – effect sensors, eddy-current Proximity sensors, selection of sensors.

10 Hrs

UNIT – II

ELECTRICAL ACTUATION SYSTEMS: Electrical systems, Mechanical switches, relays, solid state switches, diodes, thyristors and triacs, bipolar transistors, MOSFETS, solenoids, DC motors, permanent magnet DC motors with field coils, brushless permanent magnet

SSC: DC motors, AC motors, stepper motors and their merits and demerits. **10 Hrs**

UNIT – III

SIGNAL CONDITIONING: Introduction to signal conditioning, signal conditioning process, operational amplifiers, inverting and non- inverting operational amplifiers, protection, filtering, wheat stone bridge, Digital signals, ADC, DAC, Multiplexers, Data Acquisition system, pulsed modulation.

SSC: Digital signals, ADC, DAC, Multiplexers, Data Acquisition system, pulsed modulation. **10 Hrs**

UNIT – IV

INTRODUCTION TO MICROPROCESSOR: Evolution of Microprocessor, Organization of Microcontroller, instructions, machine and mnemonics codes, machine and assembly language programming, High level language programming, organization of INTEL 8085 microprocessor, Data and Address busses, registers in the 8085, instruction set of 8085, instruction types,.

SSC: CPU of Microprocessors, the fetch operation, execute cycle, memory read / write cycle, timing diagram, HALT and HOLD states. **10 Hrs**

UNIT – V

MICROPROCESSOR DATA REPRESENTATION: Positional number system, binary number system, octal number system, decimal number system, Hexadecimal number system, conversion from one number system to another, negative number representation, representation of floating point numbers, accuracy and range in floating point numbers, Binary Arithmetic: addition and subtraction of binary integers, overflow and underflow,

SSC: Logic gates, AND, OR, NOT, NAND, NOR and EXCLUSIVE – OR gate. **12 Hrs**

Text books

1 W. Bolton, **"Mechatronics,"** 2nd edition, Addison Wesely Longman, Inc.(Pearson Education, Essex, England), 1999, ISBN: 0-582-35705-5.
2 A P Mathur, **"Introduction to microprocessor,"** 3rd edition, Tata McGraw-Hill Publishing Co. Ltd., 1989 & reprint in 2006, ISBN: 0-07-460222-5.
3 R S Ganokar, **"Microprocessor Architecture, programming and applications with 8085/8085A,"** 6th edition, Wiley Eastern Publication, 1993, ISBN: 978-0852262979.

References:

1 Malvino, **"Digital computer Electronics,"** McGraw Hill Education, 3rd edition, 2001, ISBN: 978-0074622353.
2 **Mechatronics & Microprocessors:** K P Ramachandran, G K Vijaya Raghava, M S Bala sundaram, Wiley precise India, 1st Edition, 18th May 2009, ISBN: 978-8126519859.

Course Outcomes:

At the end of the course the students should be able to:

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	**Identify** Mechtronics system, measurement systems, Open & Closed loop control systems and different types of sensors.	3	2	1										2		2
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	1	1										1		2
3	**Analyse** signal conditioning process, protection, filtering, Multiplexers, Data Acquisition system.	3	3	2										2		2
4	**Evaluate** Organization of Microprocessor, instructions, machine and mnemonics codes, machine and assembly language programming, High level language programming.	3	3	2										2		2
5	**Generate** Decimal number system, Hexadecimal number system, conversion from one number system to another, negative number representation.	3	2	2										2		2

Course Title: Automotive Fuels And Combustion			
Course Code: P17AU561	Semester: 5	L:T:P:H- 4:0:0:4	Credits:3
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.

Relevance of the Course:

Automotive fuels and combustion course deals with understand the properties of IC engine fuels & their ratio system. Requirements for combustion, A/F ratio calculation. To understand &study the different cycles and to derive the relations MEP & efficiency to study the SI&CI engine combustion process &to understand the detonation & knocking process in SI&CI engines to learn about combustion chamber used discuss the same recent developments in the field of ICE like construction & working of duel & multi fuel, VCR, MCF, miller cycle engine, free piston engine etc.

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.

SSC: Energy from Bio-gas, Synthetic fuels – Fuel Cells, Hydrogen- only a brief introduction. Biofuels, 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,

SSC: octane number requirement, diesel fuels, Non petroleum fuels, Additives, Fuels for gas turbine and jet engines. **10Hrs**

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. **12Hrs**

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,

SSC: Suitability of various engines as multi fuel unit, performance characteristics of multi fuel engines. **10Hrs**

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,

SSC: Miller Cycle Engines, 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, 2nd revise edition 2014.

Reference Books:

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

Course Outcomes

1. Explain available energy sources for IC.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 IC.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

Course Title: CAD/CAM			
Course Code: P17AU562	Semester: 5	L:T:P:H- 4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites: The students should have acquired the knowledge of Computer Concept & C Programming (P17CS13/23) and Manufacturing Process-II (P17ME46)

Course Learning Objective: The course aims at enabling the students to understand the hardware and basics of CAD, also programming of CNC machines.

Course Content

UNIT – I

Introduction: Role of computers in design and manufacturing, Product cycle in conventional and computerized manufacturing environment, introduction to CAD and CAM, advantages and limitations of CAD/CAM.

SSC: Latest display systems, Input devices and Output devices. **10 Hrs**

UNIT – II

Computer Graphics and Geometric Modeling Techniques: Software configuration of a graphics system, functions of graphics software. Graphic primitives, 2-D transformation, homogeneous transformation, concatenation, problems on transformations, Geometric modeling wire frame, surface & solid modeling. Drawing interchange files DXF, IGES and STEP, representation of curves and surfaces, cubic splines, Bezier curves,

SSC: B-splines and Nurbs, Bicubic polynomial surface patches, Bezier bicubic surface patches, cubic B-spline surfaces. **11 Hrs**

UNIT – III

Numerical Control (NC) and CNC Machine Tools: Basic components of NC Systems , NC procedure, co-ordinate system, open loop & closed loop system (position controlled NC), NC motion control system, application of NC, Advantage & limitations of NC. Features of CNC,

SSC: CNC machining centers, CNC turning centers, high speed machining. **10 Hrs**

UNIT – IV

CNC Hardware Basics and CNC Tooling: Structure of CNC machine tools, spindles, drives, actuation systems, feedback devices, Axes-standards. Cutting tool materials, Tool representation, milling tooling system,

SSC: Tool presetting, ATC, work/job holding devices. **10 Hrs**

UNIT – V

CNC Programming: Part program fundamentals, ISO Codes, simple programming exercises in drilling including canned cycle,

SSC: Turning and milling using ISO codes. **11 Hrs**

Text Books

1. P.N. Rao**, "Principles and application of CAD/CAM,"** Tata McGraw Hill, 3rd edition, 26th May 2010,
2. Groover, **"CAD/CAM"**, Tata McGraw Hill, 1st edition 2003

References

1 S.E. Goodman, S.T.Headetniemi "**Introduction to the Design and Analysis of Algorithms"**, McGraw Hill Book Company, 1977
2 Newman and Sproull**, "Principles of interactive Computer Graphics"**, Tata McGraw Hill, 28th Nov 2007
3 Chno-Hwachang, Michel.A.Melkanoff, "**NC Machine programming and software Design",** Prentice Hall, 1988.
4 Pressman RS and Williams JE, "**Numerical Control and CAM",** Johnwiley Publication, 2000.
5 Steven Harrington, "**Computer Graphics"**, McGraw Hill Book Co., 1st July 2014
6 Ibrahim Zeid, "**CAD-CAM,"** Tat McGraw Hill, 2nd edition, 25th June 2009,

Course Outcomes

At the end of the course the students should be able to:

1. **Describe** in-put and out-put devices used in CAD.
2. **Apply** modeling techniques to **solve** problems on transformations.
3. **Discuss** the basic components of NC system and the different NC motion control systems.
4. **Identify** CNC machine components.
5. **Develop** CNC part program for different operations and **use** it for the production of parts.

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	**Describe** in-put and out-put devices used in CAD.	3	1	1										1		
2	**Apply** modelling techniques to **solve** problems on transformations.	3	3	1		1								1		
3	**Discuss** the basic components of NC system and the different NC motion control systems.	3	2	1									1	1		
4	**Identify** CNC machine components.	3	2	2									2	2		
5	**Develop** CNC part program for different operations. and **use** it for the production of parts	3	3	2		3							2	2		

Course Title: Non Traditional Machining			
Course Code: P17AU563	Semester: 5	L:T:P:H- 4:0:0:4	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.

Relevance of the Course:

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

Course Content

UNIT -I

Introduction to Mechanical Process: Need for nontraditional 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-Die electric 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 - Etchenes-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 Books:

1M 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:

At the end 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	**Discuss** the difference between conventional and non conventional machining process.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
2	**Characterize** the USM and AJM with the effect of parameters and process characteristics.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
3	**Explain** 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	**Discuss** 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	**Describe** the working principle PAM and LBM with the effect of parameters and process characteristics.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1

Course Title: Gas Turbine			
Course Code: P17AU564	Semester: 5	L:T:P:H- 4:0:0:4	Credits:3
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Basics of Thermodynamics and Fluid Mechanics

Course Objective: The objectives of the course are to develop the student's ability to understand the thermodynamics of each component, the linked system performance of all components in the Gas turbine engine and performance trends for each component which include compressors, burners, turbines regenerator.

Course Learning Objectives (CLOs)

The Course aims to:-

1. Analyze and predict the cycle performance of gas turbine engines.
2. Solve the problem for aircraft propulsion systems, in particular gas turbine engines.
3. Analyze and predict the performance of compressors, turbines, and combustion system.
4. Apply the dimensionless parameters involving different variables in predicting the performance of a gas turbine power plant.
5. Understand the environmental aspects of gas turbines.

Course Content

UNIT -I

Ideal plant cycles: Introduction, Carnot cycle, Stirling cycle with regenerator, Ericsson cycle, Joule air cycle, Brayton cycle with regenerator, complex cycles, The closed cycle, Operating media other than air,

Performance of actual gas turbine cycle: Efficiency of compressor and turbine, Pressure or flow losses, Heat exchanger effectiveness, Effect of varying mass flow, Loss due to incomplete combustion, Mechanical loss, Effect of variable specific heat, Calculation of fuel consumption and cycle efficiency, Poly tropic efficiency, Performance of actual cycle, Jet propulsion, Specific thrust of the turbo-jet engine,

SSC: Thermal efficiency of turbo jet engine, propulsive efficiency, Effect of forward speed, Effect of altitude, Numerical examples. **10 Hrs**

UNIT- II

Centrifugal compressors: Components, Method of operation, Theory of operation, Ideal energy transfer. Actual energy transfer- Slip, Analytical method of finding slip factor, Power input factor, Pressure coefficient, Compressor efficiency. Inlet or inducer section- when the entrance is axial, sizing of inducer section, Pre whirl. Impeller passage- Effect of impeller blade shape on performance, the impeller channel. The compressor diffuser, Losses in centrifugal compressor, Compressor characteristic, Surging and choking

Axial flow compressor: Introduction, Description, Performance analysis. Momentum or filament analysis –Special velocity diagram, Symmetric stage, Non-symmetric axial inflow, Non-symmetric axial out flow, Actual energy transfer. Airfoil analysis - One dimensional ideal incompressible flow, two dimensional flows with friction. Blading efficiency – Losses in terms of air angles and drag coefficient. Coefficient of performance- flow coefficient, Pressure coefficient, Work coefficient. Blade loading, Cascade characteristic, Blade angles, Reynolds and Mach number effects.

SSC: Three dimensional flow analysis- Radial equilibrium theory, free vortex blades, Constant reaction blades, Forced vortex or solid rotation blades, the general design. Three dimensional blade losses, Compressor stall and surge, overall performance, Compressor characteristics. Numerical examples **12Hrs**

UNIT -III

Combustion systems: Introduction, Combustion mechanism, Pressure losses, Combustion intensity, Combustion efficiency, Requirement of Combustion chamber, Shape of the combustion chamber, Stabilizing or primary zone, Dilution and mixing, Combustion chamber arrangements, Fuel injection system

Regenerator: Introduction, Types of regenerator, Heat transfer in direct type exchangers- Exchanger heat transfer effectiveness, Number of exchanger heat transfer units, Capacity ratio, Relation between NTU and Stanton number, Relations between NTU and effectiveness(no derivation), Effect of flow arrangement, Effect of $C_{min}/C_{max}<1$ for regenerator, Log mean rate equation compared to effectiveness –NTU approach.

SSC: Rotary heat exchanger- Effect of Mateix speed, Effect of longitudinal conduction, Core pressure drop. Some economics approach of heat exchanger design. Numerical examples **10 Hrs**

UNIT-IV

Axial flow gas turbines: Introduction, Turbine and nozzle efficiencies. Degree of reaction- Impulse turbine, Ideal impulse turbine, Impulse turbine with loss, Blade speed ratio, Velocity ratio and torque, Velocity compounded turbine. The reaction turbine- Reheat factor, Blade speed ratio for reaction turbine. Comparison of turbine types, Forces on blade, Cascade analysis, three dimensional flow analysis – The free vortex blades, Constant angle nozzle stage. Turbine flow passage- Impulse blading, Reaction blading. Turbine characteristics **10 Hrs**

UNIT -V

Performance of Gas turbine power plant: Non dimensional representation of compressor and turbine performance, Performance characteristics of compressor and turbines compressors, Matching of compressor and turbine in a self driving system, Equilibrium running of simple jet and propeller turbine engines, Simple jet unit, nozzle characteristic, Effect of adding a propelling nozzle to the compressor turbine combination,.

Environmental consideration: Air pollution, Aircraft emission standards, Stationary engine emission standards, NO_x formation, NO_x reduction in stationary engines, Noise, Noise standards, Noise reduction.

SSC: Variation of thrust with forward speed and rpm, Variation of specific fuel consumption with forward speed and rpm, Discussion on the equilibrium running diagram ,Propeller turbine engines(turboprop), Combined turbines **10 Hrs**

Text Books:

1. P.R. Khajuria.and S. P. Dubey, Gas Turbines and Propulsive System, Dhanpat Rai Publication, 2012
2. V Ganeshan, Gas Turbines MCgraw –Hill Publication, 3rd Edition, 2010,

References:

1. H. I. H Saravanamutt, GFC Rogers, H Cohen, Gas Turbine Theory, Pearson Education, 5th Edition, 2001
2. S. M. Yahya, Turbines Compressor and Fans, , Tata MCgraw-Hill Publication, 4th Edition , 29 October 2010

Course Outcomes:

At the end of the course the students should be able to:

1. Analyze and predict the cycle performance of gas turbine engines.
2. Solve the problem for aircraft propulsion systems, in particular gas turbine engines.
3. Analyze and predict the performance of compressors, turbines, and combustion system.
4. Apply the dimensionless parameters involving different variables in predicting the performance of a gas turbine power plant.
5. Understand the environmental aspects of gas turbines.

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 and predict the cycle performance of gas turbine engines.	2	2	2							2			2		
2	Solve the problem for aircraft propulsion systems, in particular gas turbine engines.	2	2	2							2			2		
3	Analyze and predict the performance of compressors, turbines, and combustion system.	2	2	2							2			2		
4	Apply the dimensionless parameters involving different variables in predicting the performance of a gas turbine power plant.	2	2	2							2			2		
5	Understand the environmental aspects of gas turbines.	2	2	2			2	2						2		

Course Title: Engines and Components Lab			
Course Code: P17AUL57	Semester: 5	L:T:P:H- 0:0:3:3	Credits:1.5
Contact period : Lecture: 52 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

Relevance of the Course

This is a core laboratory course in BE (automobile engineering) program that helps for the understanding of the basic classifications and principles of operation of IC Engines.

Further this course also helps to understand, in practical classes by dismantling the engine Types, function, materials, construction details, manufacturing, Troubles & Remedies through physical inspection. Also calculation of Power, SFC, and Speed etc. of engine is carried out in the laboratory.

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 & 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**

b) Four stroke SI engine

i) Enfield and hero Honda engine **3Hrs**

c) Four stroke multi cylinder SI engine

i) Four cylinder engine **3Hrs**

ii) Three cylinder MPFI maruti engine **3Hrs**

d) Four stroke multi cylinder CI engine

i) Six cylinder tata and ashok Leyland engine **3Hrs**

5. Conducting compression test, vacuum test on diesel and petrol engines. **3Hrs**
6. 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**

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

Course Title: Modelling and Analysis lab			
Course Code: P17AUL58	Semester: 5	L:T:P:H -0:0:3:3	Credits:1.5
Contact Period-Lecturer: 39Hrs,: Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites:

Subject requires student to know about

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

Relevance of the Course:

- The Modeling and Analysis Laboratory is a foundation course in BE (Automobile Engineering) program that builds the program design and implementation competence in student by learning through Computation about various Modeling, Analysis, Simulation and Part programming exercises.
- The course aims at developing and understanding of Computational exercises pertaining to static, dynamic analysis and simulations of turning and milling operations using respective software.

COURSE CONTENT

PART-A

I. FINATE ELEMENT ANALYSIS (Ansys / Nastran / Patran etc.)

Study of FEA packages, Modelling, Static and Dynamic analysis

1) STATIC ANALYSIS **21 Hrs**

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

2) DYNAMIC ANALYSIS **9 Hrs**

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

PART-B

II SIMULATION AND PART PROGRAMMING (simple exercises) **9 Hrs**

a) Simulation of Turning and Milling operations (Master cam/ Solid cam/ Edge cam etc.)
b) CNC part programming - Turning and Milling operations (G and M codes)

Course Outcomes (CO):

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

1. Analyze Static Analysis of Bars, Trusses, Beams, Rectangular Plates
2. Analyze thermal and fluid flow in a component
3. Analyze the Dynamic Analysis of bars and beams
4. Analyze, Simulation of Turning and milling operations
5. Analyze, Turning and milling operations Using CNC part programming

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	Analyze Static Analysis of Bars, Trusses, Beams, Rectangular Plates	3	3	2	2	3	2	-	-	2	-	2	2	3	2	3
2	Analyze thermal and fluid flow in a component	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
3	Analyze the Dynamic Analysis of bars and beams	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
4	Analyze, Simulation of Turning and milling operations	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3
5	Analyze, Turning and milling operations Using CNC part programming	3	3	-	2	3	2	-	-	1	-	-	2	3	2	3

Course Title : Industrial Visit & Interaction			
Course Code : P17HU510	Semester : 5	L:T:P:H:0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr		Weightage: CIE:50;% SEE:50%	

Guidelines proposed for the conduction and evaluation of the **Industry Interaction** and **Mini Projects (**One credit courses**)** are as follows-

1. **Industry Interaction:**

a) To provide minimum of two activities, such as Industry/Field visit, Technical talk/Seminar during V semesters.

b) Two faculty members shall be assigned as Coordinators for arranging and monitoring the industry related activities.

c) Student shall submit a write up on the activities attended/held during the semester, (minimum of 10 A4 pages).

d) The Internal Assessment marks (CIE) shall be based on the evaluation as per the guidelines at the end of the semester by a committee consisting of Head of the concerned department, two senior teachers of the department, one of them may be the internal guide.

Course Title : Aptitude and Reasoning Development - Advanced (ARDA)			
Course Code : P17HU510	Semester : 5	L:T:P:H :0:0:2:2	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 behavior.

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. **10 Hrs**

UNIT – II

Averages and Alligations mixtures:

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

UNIT – III

Profit and Loss: percentage change, original 100 concept effect of percentage increase or decrease in number, effect of successive percentage change, amount of change, comparison of two numbers through percentage and ratio, return to original concept, net percentage change to keep product fixed. Definition of basic terms— cost price, selling price, profit percentage, discount and marked price, solving problems using n/d method, techniques to tackle from standard set of problems, the concept of mark up. Concept of partnership and problems involving partnership **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 **6 Hrs**

UNIT- V

Simple Interest and Compound Interest

Concept of time value of money, Terminology pertaining to interest, Relation among Principal, Time, Rate percent per annum and total interest. Compound interest, Depreciation of value, Population, Application of interest in D.I.– The difference between simple annual growth rate and compound annual growth rate. **4 Hrs**

Reference books:

1. **Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. AbhijithGuha **"CAT Mathematics"**published by PHI learning private limited.
3. Dr. R. S Agarwal "**Quantitative aptitude**" published by S.Chand private limited.
4. Dr. R. S Agarwal, "**Verbal reasoning** "published by S. Chand private limited.
5. Arun Sharma "**Quantitative aptitude**" for CAT by, 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 dimension 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 alligation 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

Course Articulation Matrix (CAM)															
Course Outcome (CO)	Program Outcome (ABET/NBA-(3a-k))														
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
Apply the approach of seven dimension 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 alligation 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	-	-	-	-	-
Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest.	L5	3	-	-	-	-	-	-	-	2	-	-	-	-	-
1 – Low, 2 – Moderate and 3 – High															

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SIXTH SEMESTER

Course Title: Automotive Chassis and Suspension			
Course Code: P17AU61	Semester: 6	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

Relevance of the course

Automotive chassis and suspension is a foundation course in BE (automobile engineering) program that helps for the understanding, types of automobiles, the basic principles of operation of chassis and suspension components of automobiles.

Further this course also helps to understand different types, function, materials, construction details, troubles and remedies and calculation of major dimensions of the major chassis and suspension components of automobiles

Course Content

UNIT- I

Introduction - General consideration relating to chassis layout, types of automobiles, power plant location, layout of an automobile with reference to power plant, Power for propulsion, Road, wind & Grade resistance, Traction and Tractive effort, Relation between Engine and Vehicle speed, Road performance curves, acceleration, gradability and Draw bar pull, calculation of equivalent weight, gear for maximum acceleration, weight distribution, stability of a vehicle on a slope, Calculation of maximum acceleration, Maximum tractive effort and reactions, Dynamics of a vehicle on a banked track, Numerical problems.

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: Gyroscopic forces and Stability of a vehicle taking a turn in case of four and two wheeled vehicles. **12 Hrs**

UNIT- II

Front Axle Axle parts and materials, loads and stresses, centre sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, centre 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, 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 of Hooke's joint- ratio of shafts velocities, maximum and minimum speeds of driven shaft, condition for equal speeds of thee 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, transaxle types. **Rear axle**: - Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings, 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, Numerical problems. 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, trouble shooting, Numerical problems.

Wheels and Tyres - Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section and designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting,

SSC – Trouble shooting and Study of Suspension system, Wheels and Tyres 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"** – Scitech Publication, Chennai – 2011

3. Joseph I Heintner , "**Automotive mechanics**" 2nd edition, Affiliated East West Press, New Delhi/Madras,2013
4. William H. Crouse, **"Automotive Mechanics**" Tata Mc Graw Hill Publication, New Delhi, 2007

Course Outcomes (COS):

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. 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 &Tyres. Also determine major dimensions of the Suspension system. L1-L4

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 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	Analyse Propeller Shaft, Differential and Rear Axles and its auxiliaries and Determine major dimensions of the same	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
4	Analyse Braking system and Determine major dimensions of the same.	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-
5	Analyse Suspension system and Wheels & Tyres. Also Determine major dimensions of the Suspension system.	3	3	-	-	-	1	1	-	-	-	-	2	3	2	-

Course Title: Automotive Transmission			
Course Code: P17AU62	Semester: 6	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 (CLO):

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

a) Explain the need for transmission

b) Distinguish between positive and non positive drives

c) Explain the Constructional and working principles of different types of clutches

d) Design a clutch for any vehicle

e) Explain the constructional and working principle of different types of fluid flywheel, torque converter and one way clutches

f) Explain the constructional and working principle of different types of gear box

g) Determine the gear ratio, speed of vehicle and number of teeth on driving and driven gears

h) Explain the constructional and principle of operation of different types epicyclic gear box i) Calculating gear ratio for epicyclic gear box

j) Explain the necessity and advantages of automatic transmission

k) Explain the constructional and principle of operation of different types of automatic transmissions and hydraulic control.

l) Distinguish between the terms phase and stage used in torque converter

Relevance of the course

Automotive transmission is a course deals with the different ways through which the power is transmitted from engine to driving wheels and design of above systems and it is hoped that through this programme student will gain sufficient knowledge to make them employable in automotive industries

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 clutches **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: torque converter with lock-up and gear change function clutches **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, auxiliary transmissions, compound transmissions ,dual- clutch transmission, continuously variable transmission, numerical problems.

SSC: Triple counter shaft transmission **11 Hrs**

UNIT-IV

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, Over drives.

SSC: hydraulic control in the planetary gear system, **10 Hrs**

UNIT-V

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, hydramatic transmission,

SSC: the fundamentals of a hydraulic control system, basic four speed hydraulic control system.

10 Hrs

Text Books:

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

Reference Books:

1. Crouse W.H. "**Automotive transmissions and power trains**", McGraw Hill Co. 5th edn, 1976
2. Newton K and Steeds. W. "**Motor Vehicle**", Butter Worth's & Co., Publishers Ltd, 1997
3. Kirpal Singh, "**Automobile Engineering** –. Vol.1, Standard Pub. 2012
4. G.B.S.Narang "**Automobile Engineering**", Khanna publication, New Delhi
5. Joseph I Heitner, "**Automotive mechanics** ", Affiliated East West Press, New Delhi, 2014

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: Design of Machine Elements -II			
Course Code: P17AU63	Semester: 6	L:T:P:H- 3:2:0:5	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. Emphasize on the conditions for safe operating speeds of an engine using springs for its operations of valves.
4. Illustrate the design procedure to arrive at the proper specifications of springs/gears/clutches
5. Select suitable size, module & type of gears for a required velocity ratio.
6. Calculate the dimensions and suggest suitable materials for any application.
7. Define the terminology of gears and springs.
8. Demonstrate the suitability of a type and class of lubricant for a specific applicant

Relevance of the Course:

Yield expertise in understanding the difference between curved and straight beams

Design orientation towards the selection of proper type of gear drive based on the speed and space constraints.

Design spring for pitch, free length, spring rate, wire size, etc

Oriented towards making the students to identify the machine elements in their vehicles, machines, etc. and to innovate or improvise the design.

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 engines, 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 **10Hrs**

UNIT-IV

Clutches & Brakes: Design of clutches: single plate, multi plate and cone clutches.

Design of brakes: Block and Band brakes: self locking of brakes: Heat generation & heat dissipation in brakes. **10Hrs**

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: Mechanical Vibration			
Course Code: P17AU64	Semester: 6	L:T:P:H- 3:2:0:5	Credits:4
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites:

Subject requires students to know about

- Basics of engineering mathematics
- Basic physics

Course Learning Objectives (CLO):

The course aims to:

1. **Formulate** mathematical models of single degree of freedom, free, undamped and damped vibrating systems and **determine** their natural frequencies. **Formulate** mathematical models for damped free vibratory systems.(L5,L6)
2. **Determine** the response of simple single degree of freedom systems subjected to forced vibration.(L5)
3. **Explain** the working principle of vibration measuring instruments. **Determine** the whirling speed of shafts. **Compute** harmonics of general forcing functions using Fourier series.(L2,L5,L6)
4. **Formulate** mathematical models and **Solve** vibration problems related to Two degrees of freedom. **Determine** influence coefficients. (L3,L5,L6)
5. **Solve** multi degree of freedom systems using Rayleigh and Dunkerley, Stodola, Holzer and Matrix iteration methods. (L3).

Relevance of the course

Mechanical Vibrations is a foundation course in B.E Automobile engineering program that helps in understanding vibrations of various components in machines, vibrations due to unbalanced forces in a machine.

Further this course also helps in understanding, solving numerically various systems vibrating with multi degrees of freedom and method of damping the system.

Course Content

UNIT – I

Undamped Free Vibrations: Introduction, basic concepts of vibration, Simple harmonic motion, types of vibration, elements of vibrating system, Single degree of freedom systems, determination of natural frequency using Newton's law and energy methods. **Damped Free Vibrations:** Introduction, types of damping, free vibrations with viscous damping, under-damped, over-damped and critically-damped systems, logarithmic decrement.

SSC: A vehicle as a single degree undamped and damped system. **12 Hrs**

UNIT – II

Forced Vibrations: Introduction, forced vibration with constant harmonic excitation, steady state vibrations, forced vibration with rotating and reciprocating unbalance. Vibration isolation, force transmissibility. Forced vibrations due to excitation of the support: Absolute motion and relative motion.

SSC: Sources of vibration in automobile rider comfortable criteria **10Hrs**

UNIT – III

Vibration measuring instruments: Vibrometer, velocity pick-up and accelerometer**. Whirling of Shafts:** Introduction, critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping.

SSC: Fourier series and Harmonic Analysis: Analytical methods and numerical methods. **08 Hrs**

UNIT – IV

Two Degrees of Freedom Systems: Introduction, undamped systems, principle and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions, combined rectilinear and angular modes, undamped dynamic vibration absorber (No numerical on vibration absorber). Influence coefficients, Maxwell's reciprocal theorem.

SSC: A vehicle as two degree undamped system. **10 Hrs**

UNIT – V

Multi Degree Freedom Systems: Introduction, determination of natural frequencies, Stodola's method, Holzer's method. Orthogonality principle, matrix iteration method.

SSC: Rayleigh's method, Dunkerley's method to find natural frequencies of multi degree freedom system. **12 Hrs**

Text Books:

1. G.K. Grover, Nem Chand & brothers, Mechanical **vibrations**: Roorkee.
2. V.P. Singh, **Mechanical Vibrations** Dhanpat Rai & Company Pvt. Ltd.

References:

1. S.S. Rao, **Mechanical Vibrations** Pearson Education Inc, 4th Edition, 2003.
2. S. Graham Kelly, Schaum's Outline Series, **Mechanical Vibrations** Tata McGraw Hill, Special Indian edition, 2007.
3. J.S. Rao & K. Gupta, **Theory & Practice of Mechanical vibrations** New Age International Publications, New Delhi, 2001.
4. Leonanrd Meirovitch, **Elements of Vibrations Analysis** Tata McGraw Hill, Special Indian edition, 2007.
5. Austin H Church, John Wiley & Sons. **Mechanical Vibrations**

Course Outcomes

1. Formulate mathematical models of single degree of freedom damped and undamped free vibratory systems and determine their natural frequencies.
2. Analyze the response of simple single degree of freedom systems subjected to forced vibration.
3. Explain the working principle of vibration measuring instruments. Determine the whirling speed of shafts and harmonics of general forcing functions using Fourier series.
4. Formulate mathematical models and determine natural frequencies and corresponding mode shapes of two degrees of freedom systems.
5. Use numerical methods to solve multi degree of freedom systems for their natural frequencies and mode shapes.

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	Formulate mathematical models of single degree of freedom damped and undamped free vibratory systems and determine their natural frequencies.	3	3	2	-	-	-	-	-	-	-	-	-	3	1	1
2	Analyze the response of simple single degree of freedom systems subjected to forced vibration.	3	3	3	-	-	-	-	-	-	-	-	-	3	2	1
3	Explain the working principle of vibration measuring instruments. Determine the whirling speed of shafts and harmonics of general forcing functions using Fourier series.	3	2	3	-	-	-	-	-	-	-	-	-	2	2	1
4	Formulate mathematical models and determine natural frequencies and corresponding mode shapes of two degrees of freedom systems.	3	3	3	-	-	-	-	-	-	-	-	-	2	2	1
5	Use numerical methods to solve multi degree of freedom systems for their natural frequencies and mode shapes.	3	1	1	-	-	-	-	-	-	-	-	-	2	2	1

Course Title: Automotive Electrics and Autotronicss			
Course Code: P17AU651	Semester: 6	L:T:P:H- 4:0:0:4	Credits:3
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 (CLO):

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. Sketch and explain different types of ignition system used in Automotive Vehicles and comparison .(L3,L4)
5. Identify, describe about microelectronics and controllers, Basic principles of semiconductors technology.(L1,L2)
6. Identify, Classification and Applications of senses. (L1, L3)

Relevance of the course:

Automotive electrical and Autotronics is a fundamental course in B.E (automobile engineering) program that helps to understand vehicle electrical system, construction and testing of a battery, working of ignition system.

Further this course also helps to understand application of electronic system in automobile and microcontroller based controlling system.

Course Content

UNIT-I

Vehicle Electricals System: History Vehicle Electricals System, electrical power supply in conventional Vehicle Electricals System, Future electrical system, dimensions of wire, plug- in connections, circuit diagrams and symbols.

Starter Batteries:

Battery design, method of operation, battery construction, substitute batteries, special cases, electrically powered vehicles, Battery systems. Principle of lead acid cells, Construction of battery, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency,

SSC: Methods of charging, defects and remedies of batteries, different types of batteries and their principles like alkaline, lithium and zinc air etc., **10 Hrs**

UNIT-II

Charging and Starting Systems:

Generation of electrical energy in the motor vehicle, Basic Principles, Alternator versions , voltage regulator versions, over voltage protection, cooling and noise, power losses, characteristics curves, alternator operations in the vehicles.

Starter motors: development of starting systems, starting the internal combustion engine, starter motor design, design variations, technology of electrical starting systems, and types of drives.

SSC: Development and production of Alternators and Starter motors: quality management, development and production. **12 Hrs**

UNIT-III

Automotive Lighting Technology:

Introduction, Technical demands, legal frame work, development of lighting technology, physical principles, front and rear lighting system(components), interior lighting system, instrument clusters, display types, special purpose lamps, diagram of typical wiring system, Principle of automobile illumination,

SSC: Head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, windshield and head lamp cleaning systems. **10Hrs**

UNIT-IV

Automotive Micro Electronics and Micro Control:

Overview, Definition and classification, working principle, Demands on Electronic Systems, History of Development, Basic Principals of Semi conductor Technology, Electronic Components,

SSC: Manufacturing of Semi Conductor Components and Circuits **08 Hrs**

UNIT V

Automotive Sensor:

Introduction, Basics, position sensors (Travel/ angle), Measuring Principles, Application and examples Throttle valve sensor, Fuel Level Sensor Accelerator Pedal sensors Steering wheel angle sensors, axle sensor, Ultra sonic sensors, sensor plate potentiometer, half differential short circuiting ring sensors.

Speed and RPM sensors:

Measured Variables and Measuring Principals Application and examples:-Relative RPM and speed Measurement, Inductive Engine speed sensors, wheel speed sensors, gear box RPM sensors, Nozzle holder with needle motion sensors,

SSC: Absolute rotating speed measurement, radar sensor, rotational speed sensor and incremental angle of rotation sensor, Hall Effect face sensor. **12 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. 45th reprint 2015

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" 3rd 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 different types of ignition system, lighting technology, wipers and horns and describe their legal requirements
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 different types of ignition system, lighting technology, wipers and horns and describe their legal requirements	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	-

Course Title: Theory of Elasticity			
Course Code: P17AU652	Semester: 6	L:T:P:H- 4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Course objective: The course aims at enabling the students to understand the mathematical and physical principles of Elasticity, with different solution strategies while applying them to practical cases.

Course Content

UNIT-I

Stress Analysis: Introduction to the general theory of elasticity, assumptions and applications of linear elasticity. Stress tensors, state of stress at a point, principal stresses, direction cosines, stress invariants, equilibrium equations,

SSC: Mohr's stress circle and construction of Mohr Circle for 2D stress systems. **10Hrs**

UNIT-II

Strain Analysis: Deformation, strain-displacement relation, strain components, the state of strain at a point, principal strains, strain invariants, Equations of Compatibility for Strain,

SSC: cubical dilation. **08 Hrs**

UNIT-III

Stress–Strain Relations: Generalized Hooke's law in terms of engineering constants. Existence and uniqueness of solution, Saint Venant's principle, principle of superposition, Prandtl's membrane analogy, Kirchoff's law, Fundamental boundary value problems, Inverse and Semi-inverse method of solving elasticity problems. General case of Plane stress and Plane strain, transformation of compatibility condition from strain component to stress components.

SSC: Relation between plane stress and plane strain. **10 Hrs**

UNIT-IV

2D Problems in Cartesian Coordinates: Airy stress function, stress function for plane stress and plane strain case. Investigation for simple beam problems. Bending of narrow cantilever under end load, simply supported beam with uniform load by the use of polynomials. **Torsion** of circular and elliptical bars, stress function.

SSC: torsion of thin walled and multiple cell closed sections. **12 Hrs**

UNIT-V

Unit-5: General Equations in Cylindrical coordinate: Thick cylinder under uniform internal and / or external pressure, shrink fit.

Thermal Stresses: Thermo elastic stress strain relationship, equations of equilibrium.

SSC: Thermal stresses in thin circular disks and in long circular cylinder. **12 Hrs**

Text Books

1. Timoshenko and Goodier **"Theory of Elasticity"**, McGraw Hill Book Company.
2. L S Srinath **"Advanced Mechanics of Solids"** McGraw Hill Book Company. 2010

References

1. Sadhu Singh, **"Theory of Elasticity"** Khanna publisher, 2012
2. Wang. C. T. **"Applied Elasticity"**
3. T.G.Sitharam. Govindraju, **"Applied Elasticity"** Interline publishing. 2008
4. Arthur P Boresi and Richard J Schmidt **Advanced Mechanics of Materials**.

Course Outcomes

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

1. **Describe** and **calculate** the state of stress at a point and principal stresses and **construct** the Mohr's circle.
2. **Determine** state of a strain at a point and principal strains.
3. **Discuss** the stress and strain relations.
4. **Compute** and **analyze** bending and shear stresses and deflections induced in beams and torsional stresses of thin walled and multiple cell closed sections.
5. **Determine** stresses in thin and thick cylinders and **analyze** stress concentration.

Course Articulation Matrix

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

Sl. No	Course Outcome	Program Outcomes												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Describe** and **calculate** the state of stress at a point and principal	**2**	**2**	**1**		**2**	**2**							**2**		
2	**Determine** state of a strain at a point and principal strains.	**2**	**2**				**2**							**2**		
3	**Discuss** the stress and strain relations.	**2**	**2**		**2**									**2**		
4	**Compute** and **analyze** bending and shear stresses and deflections induced in beams and torsional stresses of thin	**2**	**2**	**1**	**2**									**2**		
5.	**Determine** stresses in thin and thick cylinders **analyze** stress concentration	**2**	**2**	**1**	**2**									**2**		

Course Title: Non Destructive Testing			
CourseCode:P17AU653	Semester: 6	L:T:P:H- 4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites:- Subject requires student to know about Various, Manufacturing methods, Testing methods and Applications

Relevance of the course

NDT is a foundation course in BE (automobile engineering) program that helps for the understanding of NDT is used in a variety of settings that covers a wide range of industrial activity, with new NDT methods and applications, being continuously developed. Non-destructive testing methods are routinely applied in industries where a failure of a component would cause significant hazard or economic loss, such as in transportation, pressure vessels, building structures, piping, and hoisting equipment.

Course Content

UNIT-I

Introduction to ND testing: selection of ND methods, visual inspection, leaks testing, liquid penetration inspection, its advantages and limitations.

Magnetic particle inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids – steps in inspection – application and limitation.

SSC: Applications & limitations of various methods of ND testing and Magnetic particle inspection **11 Hrs**

UNIT-II

Eddy current inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method.

Microwave inspection: Microwave holography.

SSC: Applications & limitations of Eddy current inspection and Microwave inspection **11 Hrs**

UNIT-III

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. Inspection methods pulse echo A, B, C scans transmission, resonance techniques transducer elements, couplets, search units, contact types and immersion types inspection standard-standard reference blocks, inspection of products like casting, extrusions, rolled product, weld set.

SSC: Applications & limitations of Ultrasonic inspection **10 Hrs**

UNIT-IV

Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radio graphic films, scenes and filters, image intensifiers, techniques charts, industrial radiography, image quality, radiography sensitivity, Penera motors, electron, neural radiology, application of ICT. Thermal inspection principles, equipment inspection methods.

SSC: Applications & limitations of Radiography inspection **10 Hrs**

UNIT-V

Optical Holography: Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: systems and techniques applications. Indian Standard for NDT.

SSC: Applications & limitations of Optical Holography **10 Hrs**

Text Books:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, **"Practical Non-destructive Testing**",
2. Mcgonnagle JJ **"Non Destructive testing**" – Garden and reach, New York

Reference Books:

1. **"Non destructive Evolution and quality control"** volume 17 of metals hand book 9 edition, Asia internal 1989
2. Davis H.E Troxel G.E Wiskovil C.T **"Testing Instruction of Engineering Materials"**McGrew hill.

Course Outcomes

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

1. Analyze ND testing; visual inspection, leaks testing, liquid penetration inspection and magnetic particle inspection. Examine application and limitation.
2. Analyze Eddy current inspection, microwave inspection and microwave holography. Examine applications and limitations
3. Analyze Ultrasonic inspection. Examine applications and limitations
4. Analyze Radiography inspection and Thermal inspection. Examine applications and limitations
5. Analyze Optical and Acoustical holography. Examine applications, limitations and Indian Standard for NDT

Course Articulation Matrix

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

SL. NO.	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Analyze ND testing; visual inspection, leaks testing, liquid penetration inspection and magnetic particle inspection. Examine application and limitation.	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
2	Analyze Eddy current inspection, microwave inspection and microwave holography. Examine applications and limitations	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
3	Analyze Ultrasonic inspection. Examine applications and limitations	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
4	Analyze Radiography inspection and Thermal inspection. Examine applications and limitations	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1
5	Analyze Optical and Acoustical holography. Examine applications, limitations and Indian Standard for NDT	3	3	1	-	1	1	1	-	-	-	-	2	3	2	1

Course Title: Automotive Air Conditioning			
Course Code: P17AU654	Semester: 6	L:T:P:H- 4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs., Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisites:

At the end of the course, the students will be able to understand the components of the automotive air-conditioning and their functions and the latest developments in this field.

Course Learning Objectives (Clos)

This Course aims to

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

Relevance of the Course

1. The subject AUTOMOTIVE AIR CONDITIONING is an Elective course in BE (Automobile Engineering) program that helps for the understanding, Basics of air conditioning system heater system and Refrigerants and also it's Classification.
2. Further this course aims at developing and understanding the components of the automotive air-conditioning and their functions, conventional and modern refrigerants for automotive applications, the air control, handling and the latest developments in automotive field.

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,

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

UNIT-III

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

SSC: Handling refrigerants **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.

SSC: Testing the air control and handling systems. **10 Hrs**

UNIT-V

AIR CONDITI0NING SERVICE Causes of air conditioner failure - Trouble shooting of air controlling system - Air conditioner maintenance and service - Servicing heater system.
SSC: Removing and replacing components – leak testing - Compressor service. **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

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

Course Title: Operations Research			
Course Code:P17AU661	Semester: 6	L:T:P:H- 4:0:0:4	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, queing 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, degeneracy. **11Hrs**

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.

SSC: travelling salesman problem**.** **10Hrs**

UNIT-III

Sequencing: Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs n machines without passing sequence. 2 jobs n machines with passing. Graphical solutions

Queuing Theory, Queuing system and their characteristics.

SSC: The M/M/1 Queuing system, Steady state performance, analysis of M/M/1 queuing model. **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. **10Hrs**

UNIT-V

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

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

SSC: Economic order quantity (EOQ) **10Hrs**

Text Books:

1. S.D.Sharma, "Operation Research", Kedaranath&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 Program Outcomes (POs) and Program Specific Outcomes (PSOs)

SL. NO.	Statement	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	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	-	-

Course Title: Two And Three Wheeled Vehicles			
Course Code: P17AU662	Semester: 6	L:T:P:H-4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs., 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 three wheeler
2. Know types of Lubrication and Cooling System used in two and three wheelers
3. Know Motor cycle power train, motor cycle clutches, construction and operation of clutches, clutch linkage
4. Know Front forks, fork type and spring type suspension systems used in two and three wheelers
5. Understand the importance of decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules

Relevance of the Course

1. The course aims at developing the understand of various two and three wheeled vehicles and its systems
2. Get expertise in the selection of two and three wheeled vehicles oriented towards making students to diagnose the problems in their vehicles and maintenance of vehicles

Course Content

UNIT I

INTRODUCTION

History of two wheeled vehicles, classification of two wheeler, definitions and main features of moped, scooter and motor cycle, dirt bike, off road bike, sports bike, frames for two wheelers and three wheelers, manufacturers of two and three wheeled vehicles in India, lay out of different three wheelers.

The Power Unit: Types of engines for two wheelers, merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes, merits and demerits, scavenging efficiency, Scavenging pumps. Engine components, reed and rotary valve engine.

SSC: Power plant for electric bikes. **10Hrs**

UNIT-II

FUELS, LUBRICATION AND COOLING SYSTEM

Layout of fuel supply system, fuel tank construction, carburettor types, construction, working and adjustments. Types of cooling systems, advantages of air cooling system. Lubrication types, Lubrication of parts, grades of lubricating oils

MOTOR CYCLE TRANSMISSION SYSTEM: Motor cycle drives, chain drive, shaft drive. Motor cycle power train, motor cycle clutches, construction and operation of clutches, clutch linkage. Gears and gear ratios, gear box types,

SSC: Construction and working gear shifting arrangements. **10Hrs**

UNIT-III

FRAMES AND SUSPENSION: Types and constructional details of two wheeler frames, advantages and disadvantages and limitations, Frame materials, loads on frames, front fork , suspension systems, fork type and spring type, shock absorber construction and working, panel meters and handle bars.

MOTOR CYCLE BRAKES and wheels: Front and rear braking systems**, ,** friction in motor cycle brakes, disc and drum brakes, merits and demerits, Types of wheels, load on wheels, construction,

SSC: Operation and materials for wheels, wheel designation. **12Hrs**

UNIT-IV

Electrical System: Types of ignition system, their working principles, wiring diagram for Indian vehicles, spark plug, plug construction, indicators and gauges used in two wheelers, lighting systems

MAINTENANCE: Importance of maintenance, Preventive and brake down maintenance, decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules,

SSC: Trouble diagnosis charts, safety precautions, Lubrication charts **10Hrs**

UNIT-V

Case studies of two wheeler and three wheelers: Case study of major Indian models of motor cycles, scooters and Mopeds, Electric two wheelers

Case study of Indian models of three wheelers.

SSC: Front mounted engine and rear mounted engine types, Auto rickshaws, and pickup van, and trailer, **10 Hrs**

Text Book:

1. Dhruv U Panchal, "**Two and three wheeler Technology**", PHI learning Pvt. Ltd., Aug 2015
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, london1990
3. Michel M Griffin, Motor Cycles from inside and outside, Prenticehall inc, New Jersey, 1998
4. Service manuals of manufacturers of Indian two and three wheelers

Course Outcomes:

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

1. Discuss different two wheelers and three wheelers and their specification
2. Describe different Lubrication and Cooling System used in two and three wheelers
3. Discuss different power train, clutches and brake systems used in two and three wheelers and explain their construction and working principle
4. Discuss different types of frames and suspension and explain their constructional details used in two and three wheelers
5. Explain the electrical and lighting system of two and three wheelers and explain the importance maintenance and periodic maintenance Schedule.

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	Discuss different two wheelers and three wheelers and their	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	Describe different Lubrication and Cooling System used in two and three wheelers	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	Discuss different power train, clutches and brake systems used in two and three wheelers and explain their construction and working principle	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	Discuss different types of frames and suspension and explain their constructional details used in two and three wheelers	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
5	Explain the electrical and lighting system of two and three wheelers and explain the importance maintenance and periodic maintenance Schedule.	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-

Course Title: Total Quality Management			
Course Code:P17AU663	Semester:6	L – T – P–H : 4–0–0–4	Credits: 3
Contact Period - Lecture: 52HrsExam:3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: Basic knowledge of Management & Entrepreneurship, supply chain management and Quality concepts.

Course Learning Objectives:

This Course aims the students, should be able to:

1. Understand Evolution and principles of TQM.[L1]
2. Understand management thinking process, models and tools for continuous improvement.[L2]
3. Know the General guidelines and steps for proactive improvement to develop new product. [L1]
4. Understand involvement of higher, middle and lower management for quality improvement.[L2]
5. Understand strategic planning in hosing management.[L2]
6. Know Regional and nationwide networking in TQM.[L1]

Relevance of the Course:

Total Quality Management is a subject which deals with the concept of,

1. Evolution and principles of TQM,
2. models and tools for continuous improvement,
3. Importance of Reactive and Proactive improvement,
4. Principles of Team and Teamwork,
5. Importance of Societal networking, a TQM model for skill development ,

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; stheory of TQC.

Evolution of Quality Concepts and Methods: Quality concepts. Development of four fitness's, evolution of methodology, evolution of company integration, quality of conformance versus quality of design from deviations to weaknesses to opportunities.

SSC: Future fitness's, four revolutions in management thinking and four level of practice.

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.

SSC: QC tools; Identifying the problem, standard steps and tools, seven steps case study, seven QC tools. **10Hrs**

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.

SSC: Applying proactive improvement to develop new products- three stages and nine steps. **10Hrs**

UNIT – IV

Total Participation: Teamwork skill. 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.

SSC: Phase-in, orientation phase, alignment phase, evolution of the parallel organization. **10Hrs**

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.

SSC: TQM as learning system, keeping pace with the need for skill, a 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), 2001.
2. N Logothetis, "**Management for Total Quality t**", Prentice Hall of India, New Delhi.1994.

Reference Books:

1. N.V.R Naidu, K.M.Babu, Rajendra "Total Quality Management"- N.V.R Naidu, K.M.Babu, Rajendra,", New Age International (P) Limited, 2013
2. Kesavan R, Total Quality Management I K International Publishing house Pvt. Ltd, 2008

Course Outcomes

1. Ability to discuss the Evaluation of Quality Guru's approaches and Quality methods.
2. Ability to explain concepts of focus on customers and continuous improvements with QC tools.
3. Ability to explain concepts of reactive improvement &Proactive improvements with case studies.
4. Ability to understand the involvement of different levels of management in TQM.
5. Ability to explain objectives and phases in hosing management.

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	Ability to discuss the Evaluation of Quality Guru's approaches and Quality methods.	2	2	1	-	-	-	-	-	-	-	2	2	1	-	-
2	Ability to explain concepts of focus on customers and continuous improvements with QC tools	2	2	-	-	-	-	-	-	-	-	-	2	1	-	-
3	Ability to explain concepts of reactive improvement &Proactive improvements with case studies.	2	2	1	-	-	-	-	-	-	-	2	2	1	-	-
4	Ability to understand the involvement of different levels of management in TQM.	3	2	1	-	-	-	-	-	-	-	2	2	1	-	-
5	Ability to explain objectives and phases in hosing management.	3	1	1	-	-	-	-	-	-	-	2	2	1	-	-

Course Title: Statistical Quality Control and Reliability			
Course Code: P17AU664	Semester: 06	L-T-P-H : 4:0:0:4	Credit: 03
Contact Period: Lecture: 52 Hrs Exam: 3 Hrs		Weightage: CIE 50%, SEE: 50%	

Prerequisites: This course enables the students to understand the basic concepts and various available statistical tools of quality monitoring. It will also present the theory and methods of quality monitoring including process capability, control charts, acceptance sampling, quality engineering, and quality design.

Course Learning Objectives (CLOs)

This Course aims to

1. Explain the basic concepts of quality, optimum quality, quality control necessity and objectives of quality control and SPC
2. Explain measure of central tendency and measure of dispersion, various types of probabilities distribution, to solve numerical problem using statistical technique
3. Perform mathematical calculations using data collected and to plot a suitable control chart for further analysis and compute Cp and Cpk.
4. Discuss the concept of acceptance sampling; differentiate between acceptance sampling and l00% inspection, producers risk and consumer's risk, OC curves.
5. Describe concept and meaning of reliability, reliability prediction, system reliability, redundancy and its uses, problem solving.

Course Content

Unit -1

INTRODUCTION : Basic concepts of quality, Meaning and definition of quality, quality control, objectives of quality control, Quality Characteristics, Quality Costs, Quality of Design, Quality of conformance, optimum quality, Statistical quality control, objectives of Statistical quality control,

SSC: Concepts in quality management, quality measurement. **11 Hrs**

Unit – II

BASIC STATISTICAL CONCEPTS: Concept of variation and its types, Variables and Attributes., Frequency distribution and its graphical representation- Frequency Polygon, Histogram, and Ogive, Central tendency and Measures of dispersion- Mean, Median, Mode, Range, and Standard deviation, Numerical Problems

PROBABILITY AND PROBABILITY DISTRIBUTIONS: Theory of Probability Types of Probability distributions:

SSC: Hyper geometric, Bi-nominal, Poisson and Normal distributions, Numerical Problems. **11 Hrs**

Unit – III

CONTROL CHARTS FOR VARIABLES: Theory and definition of control chart, control charts for X – bar and R charts, Type I and Type II errors, Numerical Problems PROCESS **CAPABILITY**: Methods of calculating process capability,

SSC: Natural Tolerance limits, and process capability index C_P, C_{pk}. Numerical problems. **10 Hrs**

Unit – IV

CONTROL CHARTS FOR ATTRIBUTES: Control charts for defects and defectives –p, np, c, and u charts and their applications, differences between control charts for variables.

SSC: Differences between p chart and c chart. Numerical Problems. **10 Hrs**

Unit – V

ACCEPTANCE SAMPLING: Basis concepts, Sampling by attributes, single, double and multiple sampling plans, use of sampling table, Sequential sampling plan.

SSC: Construction and use of Operating Characteristic curves, Numerical problems **10 Hrs**

Text Book

E.L. Grant and R.S. Leavenworth, Statistical Quality Control: Tata Mc Graw –Hill publishing Co. Ltd. New Delhi

References:

1. R.C.Gupta, Statistical Quality Control, Khanna Publishers, Delhi
2. Montgomery Douglas C, Introduction to statistical Quality Control:., John Wiley and Sons, Inc., Hoboken.
3. Juran Banks, Quality Planning & Analysis:, Tata McGraw Hill

Course Outcomes

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

1. **Explain** the basic concepts of quality, optimum quality, quality control necessity and objectives of quality control and SPC
2. **Explain** measure of central tendency and measure of dispersion, various types of probabilities distribution, to solve numerical problem using statistical technique
3. **Perform** mathematical calculations using data collected and to plot a suitable control chart for further analysis and compute Cp and Cpk.
4. **Discuss** the concept of acceptance sampling; differentiate between acceptance sampling and l00% inspection, producers risk and consumer's risk, OC curves.
5. **Describe** concept and meaning of reliability, reliability prediction, system reliability, redundancy and its uses, problem solving.

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 concepts of quality, optimum quality, quality control necessity and objectives of quality control and SPC	2	2	-	-	-	2	-	-	-	-	-	-	3	2	-
2	**Explain** measure of central tendency and measure of dispersion, various types of probabilities distribution, to solve numerical problem using statistical technique	2	2	-	-	2	-	-	-	-	-	-	-	3	2	-
3	**Perform** mathematical calculations using data collected and to plot a suitable control chart for further analysis and compute Cp and Cpk.	3	2	-	-	1	-	-	-	-	2	-	-	3	2	-
4	**Discuss** the concept of acceptance sampling; differentiate between acceptance sampling and l00% inspection, producers risk and consumer's risk, OC curves.	2	2	-	-	1	-	-	-	-	2	-	-	3	2	-
5	**Describe** concept and meaning of reliability, reliability prediction, system reliability, redundancy and its uses, problem solving.	2	2	-	-	1	-	-	-	-	2	-	-	3	2	-

Course Title: Automotive Chassis and Transmission Lab			
Course Code: P17AUL67	Semester:6	L:T:P:H-0:0:3:3	Credits:1.5
Contact period : Lecture: 52 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

Relevance of the course:

The automotive chassis and transmission Laboratory is a foundation course in BE (Automobile Engineering) program that builds the program design and implementation competence in student through learning through observation about various chassis and transmission components, its types, materials and functions by practical experience.

The course aims at developing the understanding, of major systems of chassis and transmission components of automobiles through Dismantling and assembling, their basic specifications, Trouble shooting charts and Testing and servicing of electrical components. Further, it also helps them to understand and learn about seating arrangements, seat adjustments mechanisms and mechanisms of door

Course Content

Unit-1 Writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors (two wheeler, four wheeler and heavy vehicle – one each)

Unit-2 Trouble shooting charts for major parts of chassis and transmission components of automobiles like clutch, gear box, differential, brakes, and wheels with tyres, steering system and suspension

Unit-3 Testing and servicing of electrical components like battery, starting system, ignition system, central locking system, lighting system, and alternator. Experiments on microprocessors related to automobiles

Unit-4 Dismantle and assemble of major systems of chassis and transmission components of automobiles (clutch system, Gear boxes, Propeller shaft, Differential, Front and Rear axles, brake system, steering system and suspension system) and identifying remedies (like backlash adjustment, brakes adjustment, bleeding of brakes) for the possible problems based on trouble shooting charts

Unit-5 Sketching of seating arrangements, seats for commercial vehicle and study the comfort levels provided for driver and passengers. Sketching of different mechanisms of door, seat adjustments mechanisms in automobiles.

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, 5th 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.
2. Examine Trouble shooting charts for chassis and transmission components.
3. Analyze by Testing and servicing of electrical components and microprocessors related to automobiles.
4. Examine Dismantled of chassis and transmission components and identify remedies for the possible problems Comparing with trouble shooting charts
5. Analyze door, seating arrangements, seat adjustments mechanisms and comfort levels for driver and passengers.

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	Analyze by Testing and servicing of electrical components and microprocessors related to automobiles.	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1
4	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
5	Analyze door, seating arrangements, seat adjustments mechanisms and comfort levels for driver and passengers.	3	3	-	-	1	2	1	-	1	-	-	2	3	1	1

Course Title: Automotive Electricals and Autotronics Lab			
Course Code: P17AUL68	Semester:6	L:T:P:H-0:0:3:3	Credits:1.5
Contact period : Lecture: 52 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)
i) Jump starters

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. Kirloskar generator performance test for lamp loading

7. Battery charger- front and rear wind shield cleaning

8. Head lamp testing and cleaning system

9. Study of Automotive wiring system

10. Testing of Alternator and starting motors.

<u>Autotronics Lab</u>

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 senor and displaying amount of displacement
6. Interfacing stepper or DC motor and controlling speed and direction of rotation

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	**Identify** 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	**Analyze** the defects in lighting system, wiring and other automotive electrical systems	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	**Understand** and relate interfacing of various devices to microcontroller	3	1	1	-	-	-	-	-	-	-	-	2	3	2	-
4	**Explain** Architecture of microcontroller and to learn programming	3	2	2	-	-	-	-	-	-	-	-	2	3	2	-

Course Title : Mini project			
Course Code : P17AU610	Semester : 6	L:T:P:H -0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr	Weightage: CIE:50%; SEE:50%		

Guidelines proposed for the conduction and evaluation of the **Mini Projects (**One credit courses**)** are as follows-

Mini Projects:

1. To provide 2hrs/week for Mini Projects during VI Sem BE programs.
2. Mini Projects shall comprise of an exercise assigned to a batch of students similar to major projects.
3. The topics may be related to technological, sociological issues.
4. A report (not less than 20 A4 pages) to be submitted, detailing the solution to the problem/concept worked out during the semester.
5. The work may be evaluated for award of Internal Assessment marks (CIE) based on a presentation/demonstration and viva voce, by a committee coordinated by the Course coordinators.

Course Title : Aptitude and Reasoning Development - EXPERT (ARDE)			
Course Code : P17AU611	Semester : 6	L:T:P:H -0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr	Weightage: CIE:50%; SEE:50%		
Prerequisites: Number system, Concept of percentage, Analytical reasoning-2.			

Course Learning Objectives (CLOS)

This course aims to

1. Explain different types of functions, representation of different functions on the graphs.
2. Describe the properties of quadratic equations and application of quadratic equations.
3. Demonstrates the principle of counting.
4. Differentiates between permutation and combination and solve problems conceptually.
5. Predict the probabilities in different scenarios and its application in our day-to-day life.
6. Evaluate the cause and effect of the statements logically.
7. Recognize different ways in which a statement can be strengthened or weakened.
8. Explain the criticality of data sufficiency chapter. Universal methodology to solve any problem.
9. Analyse the data in a bar graph, pie chart and tabular column and line graph and the combination of these graphs.
10. Compare the data in different format and understand the difference between them

Course Content

UNIT – I

Functions and Quadratic equations:

Functions: Basic methods of representing functions– Analytical representation, tabular representation, graphical representation of functions. Even and odd functions, Inverse of a function, shifting of graph. Representation of standard set of equations. Methodology to tackle inverse functions. Graphical process for solving inequalities, graphical view of logarithmic function.

Quadratic equations: Theory, properties of quadratic equations and their roots, the sign of quadratic equation, Equations in more than one variable. Simultaneous equations, number of solutions of the simultaneous equations. **6 Hrs**

UNIT – II

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. **8 Hrs**

UNIT – III

Analytical reasoning 3: Punchline: Introduction, format of the problem, An analysis, Does a suggested statement qualify as a punchline?. If a given statement fits as a punchline, what is its idea or wavelength?, The complete method of solving a punchline problem, Solved examples, conclusion, Sample company questions.

Strengthening and weakening arguments: Format of the problem, an analysis, Suggested methods, solved examples, conclusion, sample company questions.

Cause and Effect: Cause and Effect—A theoretical discussion, Immediate cause, Principal cause, A quick check– Cause always antecedent. The strategy for solution. **6 Hrs**

UNIT IV

Data Sufficiency: Introduction, answer choices in data sufficiency, tips to solve data sufficiency problems, directions of questions, classification of sections in data sufficiency– Number system, Algebra, series and sequence, logical, geometry and mensuration, arithmetic. **6 Hrs**

UNIT V

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 **6 Hrs**

Reference Books:

1. **"The Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. **CAT Mathematics** by AbhijithGuha. 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.
6. **Analytical reasoning** by M.K Pandey BSC PUBLISHING.CO.PVT.LTD

Course Outcomes (CO)

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

1. Graphically represent the functions and analyze it.
2. Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.
3. Effective solve the problems of permutation and combination.
4. Predict different possibilities by the principle of probability.
5. Interpret the data given in the graphical format and infer the results.
6. Analyze the statement critically and solve the questions from verbal logic section.

A. Course Articulation Matrix (CAM)															
Course Outcome (CO)	**Program Outcome (ABET/NBA-(3a-k))**														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Graphically represent the functions and analyze it.	L5	2	-	-	-	2	-	-	-	-	-	-	-	-	-
Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.	L6	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Effective solve the problems of permutation and combination.	L4	3	-	-	-	2	-	-	-	2	-	-	-	-	-
Predict different possibilities by the principle of probability.	L3	3	-	-	-	-	-	-	-	2	-	-	-	-	-
Interpret the data given in the graphical format and infer the results.	L5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
L- Low, M- Moderate, H-High															