SYLLABUS

(WITH EFFECT FROM 2015 -16)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2015–16)

VII to VIII Semester

Bachelor Degree

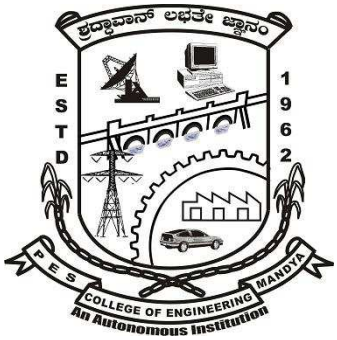
in

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.P S Puttaswamy)
Dean (Academic)
Professor
Dept. of Electrical & Electronics Engg.

P.E.S. College of Engineering

VISION

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

MISSION

PEM1: Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching -learning practices

PEM2: Impart engineering and managerial skills through competent and committed faculty using Outcome Based Educational curriculum

PEM3: Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs

PEM4: 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 traiinings 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.

Scheme of Teaching And Examination **VII Semester B.E.**

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Hrs/ Week Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P15AU 71	Hybrid Vehicles	AU	4:0:0:4	4	50	50	100
2	P15AU 72	Vehicle body Engineering and safety	AU	4:0:0:4	4	50	50	100
3	P15AU 73	Vehicle dynamics	AU	4:1:0:5	4	50	50	100
4	P15AU 74X	Elective – IV :	AU	4:0:0:4	3	50	50	100
5	P15AU 75X	Open Elective – I :	AU	4:0:0:4	3	50	50	100
6	P15AU L76	Automotive Testing and Servicing Lab	AU	1:0:2:3	1.5	50	50	100
7	P15AU L77	Diagnosis and Reconditioning Lab	AU	1:0:2:3	1.5	50	50	100
8	P15AU78	Project Work Phase-I	AU	0:0:4:2	2	-	50	50
Total					23	350	400	750

List of Electives

	Elective-4				**Open Elective-1**
Sl. No	**Course Code**	**Course Title**	**Sl No**	**Course Code**	**Course Code**
1	P15AU741	Road Transport management	1	P15AU751	Automotive Mechanics-I
2	P15AU742	Statistical Quality Control and Reliability	2	P15AU752	Fleet operations
3	P15AU743	Finite Element Analysis			
4	P15AU744	Tyre Technology			

Scheme of Teaching And Examination **VIII Semester B.E.**

	Subject Code	Title of the Subject	Teaching Dept.	Hrs/ Week Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P15AU 81	Automotive air Pollution and control	AUTO	4:0:0:4	3	50	50	100
2	P15AU 82X	**Elective-V**	AUTO	4:0:0:4	3	50	50	100
3	P15AU 83X	**Elective –VI:**	AUTO	4:0:0:4	3	50	50	100
4	P15AU 84X	**Open Elective –II:**	AUTO	4:0:0:4	3	50	50	100
5	P15AU 85	Project Work Phase-II	AUTO	0:0:16:16	8	50	100	150
6	P15AU 86	Internship	AUTO	0:0:2:2	2	50	--	50
Total					22	300	300	650

List of Electives

Elective-5			**Elective-6**			**Open Elective-2**		
Sl No	Course Code	Course Title	Sl No	Course Code	Course Title	Sl No	Course Code	Course Title
1	P15AU821	Alternative Energy Sources for Automobiles	1	P15AU831	Earthmoving equipments and Tractors	1	P15AU841	Automotive Mechanics-II
2	P15AU822	Engineering economics and cost estimation	2	P15AU832	Advanced Engine Technology	2	P15AU842	Automotive Air pollution and control
3	P15AU823	Control Engineering	3	P15AU833	Automotive embedded systems			
4	P15AU824	Automotive Vehicle Driving stability System	4	P15AU834	Tribology			

Course title: Hybrid Vehicles			
Course code: P15AU71	Semester: VII	L – T – P -H:4-0-0-4	Credits: 4
Contact period-lecturer: 52hrs.	Exam:3 hrs	Weightage:CIE:50%; SEE:50%	

Prerequisites:

The student should have undergone the course on conventional vehicles propulsion and design

Relevance of the Course: This course will help the students to learn more about hybrid vehicle. At the end of the course student will understand and learn about performance of hybrid vehicle, Architecture, Specification, battery and very importantly Fuel cell.

Course Learning Objectives (CLOs)

This Course aims to

1. Analyze the performance of a hybrid vehicle , understand the different architecture
2. Describe the operating principle and properties for the most common types of electrical motors in hybrid technology
3. Analyze hybrid power plant specifications
4. Understanding the energy storage system
5. Describe the operating principle for fuel cells and energy storage elements.

Course content

Unit - I

Performance characteristics of road vehicles, calculation of road load, predicting fuel economy, and grid connected hybrids.

Hybrid architecture**:** series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-mild hybrid, power assist, dual mode, power split, power split with shift, continuously variable transmission (CVT). Wheel motors. Different hybrid vehicles on the road; at least three modes. **11 Hrs**

Unit – II

Propulsion methods**:** dc motors-series wound, shunt wound. Compound wound and separately excited motors ac motors - induction, synchronous, brushless dc motor, switched reluctance motors. Motors used in above three vehicles. **10 Hrs**

Unit - III

Hybrid power plant specifications**:** grade and cruise targets. Launching and boosting, braking and energy recuperation drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements.

Sizing the drive system**:** matching electric drive and ice, sizing the propulsion motor, sizing power electronics. **10 Hrs**

Unit - IV

Energy storage technology**:** battery basics, lead-acid battery, different types of batteries, battery parameters. Use of batteries in hybrid vehicles battery used in above vehicles.

10 Hrs

Unit – V

Fuel cells: fuel cell characteristics, fuel cell types – alkaline fuel cell, proton exchange membrane, direct methanol fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell,

solid oxide fuel cell, hydrogen storage systems, reformers, fuel cell ev, super and ultra capacitors, flywheels. **11 Hrs**

Textbooks:

1. Dr Mike Westbrook, M H Westbrook, British library cataloguing in publication data, UK, ISBN 85296 0131.
2. Robin hardy, Iqbal Husain, The electric car: development & future of battery, hybrid & fuel-cell cars Electric and hybrid vehicles -, CRC press, ISBN 0-8493-1466-6.
3. John M. Miller, Propulsion systems for hybrid vehicles -, Institute of electrical engineers, London, ISBN 0 863413366.

Reference books:

1. Energy technology analysis prospects for hydrogen and fuel cells, international energy agency, France.
2. Hamid A Taliyat, Gerald B kliman, Mercel Dekker , Hand book of electric motors - inc., US, ISBN 0-8247-4105-6.

Course Outcomes (CO)

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

1. **Analyze** the performance of a hybrid vehicle , understand the different architecture
2. **Describe** the operating principle and properties for the most common types of electrical motors in hybrid technology
3. **Analyze** hybrid power plant specifications
4. **Understanding** the energy storage system
5. **Describe** the operating principle for fuel cells and energy storage elements.

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 performance of a hybrid vehicle , understand the different architecture	3	2	1	-	-	2	2	-	-	-	-	2	3	1	1
2	**Describe** the operating principle and properties for the most common types of electrical motors in hybrid technology	3	2	1	-	-	2	2	-	-	-	-	2	3	1	1
3	**Analyzing** hybrid power plant specifications	3	2	1	-	-	2	2	-	-	-	-	2	2	1	1
4	**Understanding** energy storage system	3	-	1	-	-	2	2	-	-	-	-	2	3	1	1
5	**Describe** the operating principle for fuel cells and energy storage elements.	3	3	1	-	-	2	2	-	-	-	-	2	3	1	1

Course Title: Vehicle Body Engineering& safety			
Course Code: P15AU72	Semester: VII	L:T:P:H -4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Course Learning Objectives (CLOs)

This Course aims to

1. Explain the various constructional styles and shapes with respect to visibility, safety and interiors of car and bus bodies
2. Analyze the appropriate materials for body construction in view of safety, durability and aesthetics
3. Analyze the Aerodynamics profile of automobile body for optimum performance
4. Discuss the various requirements of automobile safety for passenger vehicles
5. Discuss the stress induced in vehicles for different load conditions the crash worthiness of vehicles

Course Content

UNIT- I

CAR BODY AND BUS BODY DETAILS Types of car bodies Constructional details of a passenger car. Visibility: Regulation, Driver's visibility, Methods of improving visibility.

CLASSIFICATION OF BUS BODIES – Based on distance traveled, Based on capacity of the bus and based on style & shape. Types of metal section used in the construction and regulations. Construction of conventional and integral type buses& comparison. Different types of seating arrangement Commercial vehicle body layouts & types **12 Hrs**

UNIT -II

BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Body trim items-body mechanisms. corrosion: Anticorrosion methods, Modern painting process procedure-paint problems. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service. **10 Hrs**

UNIT -III

AERODYNAMICS Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Testing with wind tunnel balance (scale models). **10Hrs.**

UNIT -IV

DESIGN OF AUTOMOTIVE BODY AND SAFETY Introduction to automotive safety systems - Design of the body for safety - engine location - concept of crumble zone - safety sandwich construction - deformation behavior of vehicle body - speed and acceleration characteristics of passenger compartment on impact. Collapsible steering column, tiltable steering wheel, air bags. **10 Hrs.**

UNIT –V

Load Distribution: Types of load carrying structures -closed, integral, open, flat types. Calculation of loading cases- static, asymmetric, vertical loads. Load distribution, stress analysis of structure, body shell analysis.

CRASH WORTHINESS Definition – Requirements – Tests – component, sled and full-scale barrier impacts-Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety. **10 Hrs.**

Text Book

1. Heinz Heisler, "Advanced Vehicle Technology", 2 nd edition, Butterworth – Heinemann, 2002.
2. Wolf-Heinrich Hucho, "Aerodynamics of road vehicles", 4th edition, 2000.
3. Vivek D. "Ergonomics in the Automotive Design Process" Bhise publisher CRC press, Taylor and Francis group.

References

1. John Fenton, "Vehicle Body layout and analysis", Mechanical Engineering Publication Ltd., 1984
2. Hand book on vehicle body design – SAE publication
3. Vehicle Safety 2002, Cornwell press, Town Bridge, UK, ISBN 1356 -1448.
4. Redesign of bus bodies – part I & part II – CIRT, Pune (Report), 1983
5. Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 1987

Course Outcomes

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

1. **Explain** the various constructional styles and shapes with respect to visibility, safety and interiors of car and bus bodies
2. **Analyze** the appropriate materials for body construction in view of safety, durability and aesthetics
3. **Analyze** the Aerodynamics profile of automobile body for optimum performance
4. **Discuss** the various requirements of automobile safety for passenger vehicles
5. **Discuss** the stress induced in vehicles for different load conditions the crash worthiness of vehicles

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 constructional styles and shapes with respect to visibility, safety and interiors of car and bus bodies	2	2	-	-	-	-	2	-	-	-	-	2	3	-	-
2	**Analyze** the appropriate materials for body construction in view of safety, durability and aesthetics	3	3	2	-	-	-	2	-	-	-	-	2	3	2	-
3	**Analyze** the Aerodynamics profile of automobile body for optimum performance	3	3	2	-	-	-	2	-	-	-	-	2	3	2	-
4	**Discuss** the various requirements of automobile safety for passenger vehicles	3	2	2	-	-	-	2	-	-	-	-	2	2	2	-
5	**Discuss** the stress induced in vehicles for different load conditions the crash worthiness of vehicles	3	3	2	-	-	-	2	-	-	-	-	2	3	3	-

Course Title: Vehicle Dynamics			
Course Code: P15AU73	Semester: VII	L:T:P:H -4:1:0:5	Credits:4
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisite: Subject requires student to know about, Mechanical Vibration, Automotive Technology, Theory of Machine

Relevance of the Course:

Vehicle Dynamics is a course in B.E (Automobile) program that helps in understanding the performance (Braking and acceleration), handling (cornering) and ride (vibration) characteristics of a ground vehicle.

Further this course also helps to understand driver-vehicle-ground system.

Course Learning Objectives (CLOs)

This Course aims to

1. Explain tyre forces and moment, summarize the construction of tyres(L1,L2)
2. Solve, illustrate stability of vehicle at different condition(L2,L3)
3. Describe, explain stability of vehicle during braking(L2,L3)
4. Describe, explain solve the stability of vehicle during steering(L2,L3)
5. Explain, solve the stability condition of vehicle during vertical vibration(L1,L2,L3)

Course Content

Unit-I

Introduction: introduction to vehicle dynamics, the driver-vehicle-ground system, SAE vehicle coordinate system.

Tire fundamentals: desirable tire properties, tire force and movements, rolling resistance of tier, factors affecting the rolling resistance of tire. Tire construction, Bias-ply tire, and radial –ply tire, hydro planning, specification of tire, factors affecting tire life.

Acceleration performance: power for propulsion, air resistance, rolling resistance, grade resistance, traction and traction effort, road performance curve, calculation of equivalent weight, Numerical problems. **10 Hrs.**

Unit-II

Vehicle stability: stability on level ground, front wheel driven vehicle, rear wheel driven vehicle, four wheel driven vehicle, vehicle taking turn on level ground, stability on inclined ground, stability of vehicle running on a banked track, determination of centre of gravity of a vehicle, transverse weight shift due to drive torque, effect of C.G position on maximum achievable acceleration, stability of two and three wheeler vehicles and Numerical problems. **10 Hrs.**

Unit-III

Braking system and performance: braking requirements, construction and comparison of drum brake and disc brake, Energy of motion and frictional force, brake balance, stopping distance, brake fade, work done in brakes, braking efficiency, load transfer during braking, brake applied to rear wheels, brakes applied to front wheel, brake applied to four wheels,

brake proportioning, conditions for wheel lockup, antilock brake system., Numerical problems. **10 Hrs.**

Unit-IV

Handling characteristics of road vehicles: steering geometry, effect of camber, kingpin inclination, castor, toe-in, toe-out, condition for true rolling, turning circle radius.
Ackerman linkage geometry – analytical and graphical solution, four wheel steering.
Cornering properties of tiers – cornering force, slip angle, self aligning torque,
Steady state handling characteristics: fundamental equation, neutral steer, under steer, over steer, steady state response to steering input, yaw velocity response, lateral acceleration response, curvature response, testing of handling characteristics and Numerical problems.

11 Hrs.

Unit-V

Vehicle ride characteristics: vehicle vibration and human comfort, vehicle ride models, two – degrees of freedom vehicle model for sprung and unsprung mass, two degrees of freedom vehicle model for pitch and bounce, introduction to random vibration, frequency response function, evolution of vehicle vibration.
Aerodynamics: mechanics of air flow around vehicles, pressure distribution on a vehicle, aerodynamics forces and moments. Effect of shape, angle of attack, operation parameters on drag and lift, aerodynamic aids. **11 Hrs.**

Text Books:

1. J.Y.Wong, "Theory of Ground Vehicles", Wiley publications-2008. ISBN: 978-0-470-17038-0

References:

1. Thomas D. Gillespie, "Fundamentals of Vehicle DynamicsSAE -2018. ISBN-13: 978-1560911999 ISBN-10: 1560911999
2. N.K.Giri, "Automobile Mechanics" Khanna publications-2014. ISBN 10: 8174092161 / ISBN 13: 9788174092168
3. Reza N.Jazar, "Vehicle Dynamics" springer publications-2014. ISBN: 978-1-4614-8544-5

Course Outcome:

After Learning all the units of the Course, the student is able to

6. Explain tyre forces and moment, summarize the construction of tyres(L1,L2)
7. Solve, illustrate stability of vehicle at different condition(L2,L3)
8. Describe, explain stability of vehicle during braking(L2,L3)
9. Describe, explain solve the stability of vehicle during steering(L2,L3)
10. Explain, solve the stability condition of vehicle during vertical vibration(L1,L2,L3)

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 tyre forces and moment, summarize the construction of tyres	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
2	Solve, illustrate stability of vehicle at different condition	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
3	Describe, explain stability of vehicle during braking	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
4	Describe, explain solve the stability of vehicle during steering	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
5	Explain, solve the stability condition of vehicle during vertical vibration	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-

Course Title: Road Transport Management			
Course Code: P15AU741	Semester: VII	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 student awareness about Public Transportation and Indian Motor vehicle act

Course Learning Objectives

After learning all the units of the course, the student is able to understand about operation, administration and management of Public service – Road transport Vehicles such as,

- Evolution
- Infrastructure and Maintenance
- Various forms of ownership,
- Administrative organization and management
- New Route Planning for a public service -road transport through estimation of weekday travelers.
- Influence of Timings, Bus working & Schedules on administration of public transport.
- Motor Vehicles act.
- Various Fare collection systems & Fare structures.
- Operating costs for individual and group of vehicles
- Different types of vehicles
- Duties and responsibilities of Public relations divisions
- Causes and Prevention of accidents.
- Design and Future of road transport vehicles.

Relevance of the Course

Road Transport Management is a foundation course in BE (automobile engineering) program that helps for the understanding, Public Transportation using automobiles, the basic principles of operation of Public Transportation and its Management

Further this course also helps to understand different types of, automobiles, Infrastructure, Maintenance, ownerships, Organizations and Management, estimations of traffic volume, Fare collection systems & Fare structures, Operating costs, future Vehicle design for Public Transportation.

Course Content

UNIT-I

Introduction, The Infrastructure: Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies.

The infrastructure road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, ,location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.

Maintenance - preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities, documentation, analysis & corrective maintenance schedules

SSC: Road, Highway network, traffic control. **10 Hrs**

UNIT-II

Organization and Management: Forms of ownership, Administrative organization, municipal undertaking, company undertaking, traffic, secretarial and engineering deportments,

Management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training,

Drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.

SSC: staff administration: industrial relation, administration, recruitment and training,

10 Hrs

UNIT-III

Route planning, Timings**, Bus working and schedules** source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency

Timings, Bus workings and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements **Motor vehicle act 1988.**

SSC: Co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements **Motor vehicle act 1988.**

11 Hrs

UNIT-IV

Fare collections & Fare structure: Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bell graphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, verometer, one-man operation, two stream boarding, pre paid tickets, lensonparason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control.

Fare structure: Basis of fares, historical background, effects of competition and control,

Calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.

Operating cost and types of vehicles: Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car.

SSC: 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car. **11 Hrs**

UNIT-V

Public relations divisions: Dissemination of information, maintaining goodwill- handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles- facilities for visitors- forms of publicity - importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity.

Prevention of accidents: Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.

Vehicle design, the future Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization.

The future: a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid, battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus

SSC: Importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity. **10 Hrs**

Text books:

1. L D.Kitchen, Bus operation , Iliffe& Sons , London
2. Rex W. Faulks, Bus& coach operation , Butterworth Version Of 1988, London ISBN-13: 978-0408028103 ISBN-10: 0408028106

Reference books:

1. Compendium of transport terms - CIRT, Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. R.J. Eaton, The elements of transportation

Course Outcomes

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

CO1. **Define** with reference to the basics of road transport & its functioning, public relations, fares, prevention of accidents, motor vehicle act and the public service vehicles for the future **– L1**

CO2. **Explain** about the evolution, infrastructure, operation, administration, organization & management and maintenance of public road transport system **– L2**

CO3. **Solve** problems pertaining to estimating traffic volumes for new route and calculation of Operating costs **– L3**

CO4. **Analyze and Compare** the graphs created regarding fare structures, Operating costs and operation of road transport vehicles.**– L4**

CO5. **Analyze** the flowcharts showing the relationships of various sections in hierarchy of administrative organization of public road transport system **– 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	**Define** with reference to the basics of road transport & its functioning, public relations, fares, prevention of accidents, motor vehicle act and the public service vehicles for the future **– L1**	3	-	-	-	-	2	2	1	-	2	-	2	3	-	-
2	**Explain** about the evolution, infrastructure, operation, administration, organization & management and maintenance of public road transport system **– L2**	3	-	-	-	-	2	2	1	-	2	-	2	3	-	-
3	**Solve** problems pertaining to estimating traffic volumes for new route and calculation of Operating costs **– L3**	3	3	2	-	-	2	2	-	-	2	-	2	3	-	-
4	**Analyze and Compare** the graphs created regarding fare structures, Operating costs and operation of road transport vehicles. **– L4**	3	-	-	-	-	2	2	-	-	2	-	2	3	-	-
5	**Analyze** the flowcharts showing the relationships of various sections in hierarchy of administrative organization of public road transport system **– L4**	3	-	-	-	-	2	2	-	-	2	-	2	3	-	-

Course Title: Statical Quality Control			
Course Code: P13AU742	Semester: VII	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		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, 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: 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, 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 chart for variables, 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, 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: Finite Element Methods			
Course Code: P15AU743	Semester: VII	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 to provide an introductory approach to finite element method as a basic numerical tool for solving mechanical engineering problems.

Course Learning Objectives (CLOs)

This Course aims to

1. **Explain** the concept of finite element method as well as finite element discretization process. **Apply** Gauss elimination algorithm to **solve** linear algebraic equations and Gauss quadrature technique for numerical integration.
2. **Develop** interpolation models for different types of elements that satisfy convergence criteria and geometric isotropy. **Use** isoparametric concept in the finite element analysis.
3. **Formulate** element stiffness matrices and load vectors for different elements by **applying** variational principle.
4. **Use** developed finite element models in the **determination** of stresses, strains and reactions of axially loaded bars, trusses and transversely loaded beams.
5. **Formulate** finite element equations for heat transfer problems using Variational and Galerkin techniques and **apply** these models to conduction and convection heat transfer problems.

Course Content

Unit -1

INTRODUCTION TO FEM: Need for use of FEM, Advantages and disadvantages of FEM, Engineering Applications of FEM, Steps involved in FEM, Discretization process – types of elements (1D,2D,3D), size of the elements, location of nodes, node numbering scheme, Method of solution of linear algebraic equations – Gauss elimination method. Numerical integration by Gaussian quadrature (one point and two point formula). Basic elastic equations – body force and traction force, strain-displacement relations. Principle of minimum potential energy and derivation of potential energy functional for a 3D elastic body, concept of plane stress and plane strain and their stress-strain relations. **10 Hrs**

Unit -2:

INTERPOLATION MODELS: Displacement function, selection of the order of displacement function, convergence criteria, geometric isotropy, Pascal's triangle for 2D polynomial, Different co-ordinate systems used in FEM, Interpolation or shape functions for 1D linear and quadratic bar elements and 2D linear triangular (CST) element in cartesian and natural co-ordinate systems. Lagrangian polynomial – Shape functions for linear quadrilateral element (QUAD 4) and quadratic quadrilateral element (9-noded), Iso-parametric, sub-parametric and super-parametric elements, Concept of Jacobian matrix, Jacobian matrix for CST **12 Hrs**

Unit -3:

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

Treatment of boundary conditions- elimination and penalty methods. Analysis of axially loaded uniformly tapered and stepped bars. **10 Hrs**

Unit -4:

ANALYSIS OF PLANE TRUSSES AND BEAMS: Local and global coordinate systems, stiffness matrix for plane truss element, analysis of truss members. Hermite shape function for beam element in Cartesian coordinates, Stiffness matrix and load vector for beam element, element shear force and bending moment, analysis of beams. **10 Hrs**

Unit -5

ANALYSIS OF HEAT TRANSFER PROBLEMS: Steady state heat transfer, 1D heat conduction- governing equation, boundary conditions, one-dimensional element, Galerkin's approach to heat conduction, heat flux boundary condition. 1D heat transfer in thin fins- Formulation of equations. Simple numerical of 1D heat transfer problems on composite walls and fins with conduction and convection. **10 Hrs**

Text Books:

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

References:

1. The FEM its basics and fundamentals: O.C.Zienkiewicz, Elsevier, 6e.2005. ISBN: 9780080472775
2. J.N.Reddy, Finite Element Method: McGraw –Hill International Edition.2004
3. Daryl. L. Logon, Finite Element Methods: Thomson Learning 6rd edition.2017 ISBN13: 9781305635111 ISBN10: 1305635116
4. David V. Hutton , Fundamentals of Finite Element Analysis:–Tata McGraw Hill Publishing Co. Ltd, New Delhi.2003

Course Outcomes

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

1. **Explain** the concept of finite element method as well as finite element discretization process. **Apply** Gauss elimination algorithm to **solve** linear algebraic equations and Gauss quadrature technique for numerical integration.
2. **Develop** interpolation models for different types of elements that satisfy convergence criteria and geometric isotropy. **Use** isoparametric concept in the finite element analysis.
3. **Formulate** element stiffness matrices and load vectors for different elements by **applying** variational principle.
4. **Use** developed finite element models in the **determination** of stresses, strains and reactions of axially loaded bars, trusses and transversely loaded beams.
5. **Formulate** finite element equations for heat transfer problems using Variational and Galerkin techniques and **apply** these models to conduction and convection heat transfer problems.

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 concept of finite element method as well as finite element discretization process. **Apply** Gauss elimination algorithm to **solve** linear algebraic equations and Gauss quadrature technique for numerical integration.	3	-	-	-	-	-	-	-	-	3	-	-	2	-	1
2	**Develop** interpolation models for different types of elements that satisfy convergence criteria and geometric isotropy. **Use** isoparametric concept in the finite element analysis.	3	3	-	-	-	-	-	-	-	-	-	-	2	-	1
3	**Formulate** element stiffness matrices and load vectors for different elements by **applying** variational principle.	3	3	-	-	-	-	-	-	-	-	-	-	2	-	1
4	**Use** developed finite element models in the **determination** of stresses, strains and reactions of axially loaded bars, trusses and transversely loaded beams.	3	3	-	-	-	-	-	-	-	-	-	-	2	-	1
5	**Formulate** finite element equations for heat transfer problems using Variational and Galerkin techniques and **apply** these models to conduction and convection heat transfer problems.	3	3	-	-	-	-	-	-	-	-	-	-	2	-	1

Course Title:- Tyre Technology			
Course Code: P15AU744	Semester: VII	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

PURPOSE

To learn about design and fabrication of tyres.

Course Learning Objectives (CLOs)

This Course aims to

1. To understand various components used and their function of tyres.
2. To design and suitable compounding formulation for various tyre components
3. To know the building & curing of tyres.

Course content

INTRODUCTION TO BASICS OF TYRES

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres - Major departments of a Tyre Industry – An explanation of their function and relation to other departments. Factors influencing the performance of tyre: Compound design, degree of mixing :(open mill & internal mixing), parameters (temperature, time, speed), degree of vulcanization - Testing and dispatch of mixes, Basic quality control and mill room control Laboratory. **5 Hrs**

UNIT I

FABRIC PREPARATION Fabrics of the Tyre Industry: Cotton, Rayon, Nylon & steel cords – manufacture, construction – styles and presentations. Bonding methods: – Fabric bonding, necessities of stronger fabrics leading to bonding methods developments. Wet &dry bonding systems: – dip and hot stretch process for Nylon. REL-VP latex systems: – parameters for dip & hot stretch process for Nylon. Modified surface treatment needed for polyesters & glass fabric - Metal coating for steel cord. Recent developments in Radical Tyre fabrics – Aromatic Nylon (Kevlar) and other special fabric reinforcement systems and their use - Testing of dipped fabrics 'U', 'H' and other tests. Dip pick up and the relation to adhesion etc. **8 Hrs**

UNIT II

CALENDERING Calendering process: 3 and 4 roll calendars. Skimming & fractioning process preparation of bead wrapper and chaffer-on fabrics on 3 roll calendars. Topping process on calendar - Limitation of 3 roll calenders and advantages of 4 roll calendars-process control aspects – economics - Relation between ends per in chand calendering process. Inner, outer and breaker fabrics. Compound fabric ratios and compound design consideration for different styles of fabrics - Defects of calendered fabrics and their remedies. Parameters for scrap control in fabric processes in the tyre industry requirement of total quality control involving fabric supplier's dipping, calendering and bias cutting operations. Economics of fabric usage. **8 Hrs**

UNIT III

THREAD EXTRUSION AND BEAD CONSTRUCTION Basic concepts of Extrusion. Die swell & shrinkage phenomenon – effect of compounding parameters on these phenomenon. Die design and theoretical calculation of tread weight. Effect of viscosity & temperature on extrusion. Dimensions and weight control extusion operation parameters like feeding rate, screw speed, take off conveyor speed on tread extrusion. Extruded tread profile –critical dimensions. Duel extruder – Cap & base concept relation to tyre wear parameters like tread wear heat buildup etc.Cross head extruder wire coating process - Bias cutting and pocket making: Biasangle specification and the significance Horizontal and vertical laying of coated wore. Apex preparation on extruder and profile calender Bead wrapping and flipping operations. Single and double bead concept and preliminary calculation of bead safety factors. Width and angle adjustments splicing and identification. Biasplies pocket 3-3-2 4-4-2 ply constructions Defects of pockets wrong identification over splicing wrinkles, parallel plies etc. **8 Hrs**

UNIT IV

TYRE BUILDING Tyre building inputs: Inner liners, plies, beads, tread, side wall and gum strips –their inspection Drum inspection for drum set, drum circumference Significance of parameters for tyre building. Size making on finished tyre and the relation to building specifications. Tyre building specifications sequence of building. Intermittent consolidation, use of various cements and gum strips. Importance of the state of the Art Technology. Appraisal of Tyre building as mostcrucial operation correlation of some of the cured tyre & service returned tyres to the lack of building skill. Green tyre inspection procedures weight tolerance techno-commercial importance of green tyre weight. Green tyre storage considerations. **8 Hrs**

UNIT V

GREEN TYRE PREPARATION & CURING Internal and External painting – Awling – Bagging in case of Air bag cure Bag-o-matic and Air bag curing – mold lubrication- Bladder assembly bead curing rings– Dimension criticality Services to the Bag-o-matic presses Curing cycle –shaping – HPS, and hot water circulation. Dome steam cold water & vacuum cycles. Determination of optimum cure of tyres by thermocouple built tyres. Economics of curing post cure inflation of Nylon tyres, cured tyre inspection. Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fast wears, poor retreading Bead/casing failures. Hot and cold process, retreading concept of total price/km run increasing competition and future trends in the industry and open house discussion.

8 Hrs

Text Book

1. Tom French, Tyre technology, The University of Michigan, 1989.

References

1. Blow. C. M, Rubber Technology and Manufacture, Butterworth- Heinemann,London, 1982. ISBN 10: 0408005874 ISBN 13: 9780408005876
2. Maurice Morton, "Rubber Technology", Springer, 3rd edition, 1987. ISBN-13: 978-0412539503 ISBN-10: 0412539500
3. Claude Hepburn, "Rubber Technology and Manufacture", Third Edition,2005. ISBN-13: 978-0750610780 ISBN-10: 0750610786
4. Kovac. F. J, "Tyre Technology", Good Year Tire & Rubber Company, 5th edition 1978.

Course Outcomes (CO)

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

CO1. Explain the types of tyres and discuss the fabric preparation in the tyre Industry

CO2. Discuss the calendaring process and parameters for scrap control in fabric processes

CO3. Explain the thread extrusion, bead construction and effect of viscosity and temperature on extrusion

CO4. Describe the tyre building process

CO5. Explain the green tyre preparation, curing, inspection and retreading

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 types of tyres and discuss the fabric preparation in the tyre Industry	3	2	1										2		1
2	Discuss the calendaring process and parameters for scrap control in fabric processes	3	2	1										2		1
3	Explain the thread extrusion, bead construction and effect of viscosity and temperature on extrusion	3	2	1										2		
4	Describe the tyre building process	3	2	1										2		
5	Explain the green tyre preparation, curing, inspection and retreading	3	2	1										2		1

Course Title: Automotive Mechanics - I			
Course Code: P15AU751	Semester: VII	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

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

Course Learning Objectives (CLO)

At the end of the course the student should able to

a) Explain the combustion and working of IC engines

b) explain the different ways of fuel supplyied to SI and CI engines

c)explain the different ignition system and super charging systems

d) Explain about necessity of lubrication and cooling in IC engines and different methods

e) measure and analyse different engine parameters

Course content

UNIT I

Introduction to IC engines:

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

10 Hrs

UNIT _II

Fuel supply system in SI and CI engines, principle of carburetion , simple carburetor, essential parts of carburetor, automobile carburetors, petrol injection system, multipoint injection system, Diesel fuel supply system, different types of fuel injection systems like inline injection, distributor ,CRDI. **11Hrs**

UNIT III

Ignition system, super charging and turbo charging:

Introduction, battery ignition, magneto ignition, modern ignition system, spark advance mechanism,

supercharging, objects of supercharging, super charging limits for SI and CI engines, methods of supercharging and turbo charging **11Hrs**

UNIT IV

lubrication and cooling systems

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

Function of lubrication, lubrication systems, properties of lubricants, SAE rating of lubricants

10Hrs

UNIT V

Engine testing and performance parameters Engine power, engine efficiencies, brake power measurements (dynamometers) **10Hrs**

Text Books

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

References

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

Course Outcomes (CO)

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

CO1. Understand the basic principles of working of SI and CI engines
CO2. Identify the different methods of fuel supply systems in SI and CI engines
CO3. Understand the basic principles of ignition system, supercharging and turbo charging
CO4. Understand the necessity of cooling and lubrication in IC engines and different types
CO5. Determine the IC engines power and efficiencies

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

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

Course Title: Fleet operations` - Open Elective			
Course Code: P15AU752	Semester: VII	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 student awareness about Public Transportation and Indian Motor vehicle act

Course Learning Objectives

After learning all the units of the course, the student is able to understand about operation, administration and management of Public service – Road transport Vehicles such as,

- Evolution
- Infrastructure and Maintenance
- Various forms of ownership,
- Administrative organization and management
- New Route Planning for a public service -road transport through estimation of weekday travelers.
- Influence of Timings, Bus working & Schedules on administration of public transport.
- Motor Vehicles act.
- Various Fare collection systems & Fare structures.
- Operating costs for individual and group of vehicles
- Different types of vehicles
- Duties and responsibilities of Public relations divisions
- Causes and Prevention of accidents.
- Design and Future of road transport vehicles.

Relevance of the Course

Road Transport Management is a foundation course in BE (automobile engineering) program that helps for the understanding, Public Transportation using automobiles, the basic principles of operation of Public Transportation and its Management

Further this course also helps to understand different types of, automobiles, Infrastructure, Maintenance, ownerships, Organizations and Management, estimations of traffic volume, Fare collection systems & Fare structures, Operating costs, future Vehicle design for Public Transportation.

Course Content

UNIT-I

Introduction, The Infrastructure: Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies.

The infrastructure road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, ,location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.

Maintenance - preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities, documentation, analysis & corrective maintenance schedules

SSC: Road, Highway network, traffic control. **10 Hrs**

UNIT-II

Organization and Management: Forms of ownership, Administrative organization, municipal undertaking, company undertaking, traffic, secretarial and engineering deportments,

Management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training,

Drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.

SSC: staff administration: industrial relation, administration, recruitment and training,

10 Hrs

UNIT-III

Route planning, Timings**, Bus working and schedules** source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency

Timings, Bus workings and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements **Motor vehicle act 1988.**

SSC: Co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements **Motor vehicle act 1988.**

11 Hrs

UNIT-IV

Fare collections & Fare structure: Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bell graphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, verometer, one-man operation, two stream boarding, pre paid tickets, lensonparason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control.

Fare structure: Basis of fares, historical background, effects of competition and control,

Calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.

Operating cost and types of vehicles: Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car.

SSC: 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car. **11 Hrs**

UNIT-V

Public relations divisions: Dissemination of information, maintaining goodwill- handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles- facilities for visitors- forms of publicity - importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity.

Prevention of accidents: Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.

Vehicle design, the future Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization.

The future: a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid, battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus

SSC: Importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity. **10 Hrs**

Text books:

3. L D.Kitchen, Bus operation , Iliffe & Sons , London
4. Rex W. Faulks, Bus& coach operation , Butterworth Version Of 1988, London ISBN-13: 978-0408028103 ISBN-10: 0408028106

Reference books:

4. Compendium of transport terms - CIRT, Pune
5. M.V. Act 1988 - Central Law Agency, Allahabad
6. R.J. Eaton,The elements of transportation

Course Outcomes

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

CO1. **Define** with reference tothe basics of road transport & its functioning, public relations, fares, prevention of accidents, motor vehicle act and the public service vehicles for the future **– L1**

CO2. **Explain** about the evolution, infrastructure, operation, administration, organization & management and maintenance of public road transport system **– L2**

CO3. **Solve** problems pertaining to estimating traffic volumes for new route and calculation of Operating costs **– L3**

CO4. **Analyze and Compare** the graphs created regarding fare structures, Operating costs and operation of road transport vehicles.**– L4**

CO5. **Analyze** the flowcharts showing the relationships of various sections in hierarchy of administrative organization of public road transport system **– 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	**Define** with reference to the basics of road transport & its functioning, public relations, fares, prevention of accidents, motor vehicle act and the public service vehicles for the future **– L1**	3	-	-	-	-	2	2	1	-	2	-	2	3	-	-
2	**Explain** about the evolution, infrastructure, operation, administration, organization & management and maintenance of public road transport system **– L2**	3	-	-	-	-	2	2	1	-	2	-	2	3	-	-
3	**Solve** problems pertaining to estimating traffic volumes for new route and calculation of Operating costs **– L3**	3	3	2	-	-	2	2	-	-	2	-	2	3	-	-
4	**Analyze and Compare** the graphs created regarding fare structures, Operating costs and operation of road transport vehicles. **– L4**	3	-	-	-	-	2	2	-	-	2	-	2	3	-	-
5	**Analyze** the flowcharts showing the relationships of various sections in hierarchy of administrative organization of public road transport system **– L4**	3	-	-	-	-	2	2	-	-	2	-	2	3	-	-

Course Title: Advanced Engine Testing and Servicing Lab			
Course Code: P13AUL76	Semester: VII	L:T:P:H -1:0:2:3	Credits:1.5
Contact Period-Lecturer: 39Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Subject requires student to know about IC engines performance characteristics

Measurement of power, fuel consumption, air consumption and emission etc. Different dynamo meters and their working

Relevance of the course:

Advanced engine testing lab is a course deals with conduct a test on any given engine and analyze the performance of the engine and also analyze the performance of the engine by varying the different parameters and also using different alternate fuels and it is hoped that through this programme student will gain sufficient knowledge to make them employable in any automotive industries

Course content

1. Conduct performance test on single cylinder SI engine
2. Conduct performance test on multi cylinder SI engine
3. Conduct performance test on single cylinder CI engine
4. Conduct performance test on multi cylinder CI engine
5. Conduct Morse test on SI engine to find FP, IP, indicated thermal efficiency and mechanical efficiency
6. Conduct Morse test on CI engine to find FP, IP, indicated thermal efficiency and mechanical efficiency
7. Study of engine performance using alternate fuels like alcohol, bio diesel and LPG
8. Performance test on MPFI engine
9. Test the performance of single cylinder CI engine by varying compression ratio
10. Optimizing the performance of SI engine by varying the ignition timing
11. Diagnose the engine using engine analyzer
12. Conduct performance test on universal test rig

Text books

1. Dr. N K Giri, automobile mechanics, khanna publishers, eight edition , 2014 ISBN 10: 8174092161 / ISBN 13: 9788174092168
2. Dr v Ganeshan , Internal combustion engines, Mc Graw hill, publication , fourth edition 2013 ISBN 10: 1259006190 / ISBN 13: 9781259006197
3. Auto lab manuals

Course outcomes

1. **Conduct** performance test on any given engine, and evaluate performance characteristics
2. **Analyze** the engine performance using alternative fuels
3. **Conduct** experiment to understand the effect of compression ratio on performance of the engine
4. **Optimize** the performance of the engine by varying the ignition timing, Diagnose the engine problem using engine analyzer

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	**Conduct** performance test on any given engine, and evaluate performance characteristics	3	3	2	2	2	2	1	-	2	2	-	2	3	2	2
2	**Analyze** the engine performance using alternative fuels	3	3	-	2	-	-	1	-	1	-	-	1	3		2
3	**Conduct** experiment to understand the effect of compression ratio on performance of the engine	3	3	-	2	-	-	-	-	1	-	-	1	3	-	-
4	**Optimize** the performance of the engine by varying the ignition timing, Diagnose the engine problem using engine analyzer	3	3	-	2	-	-	-	-	1	-	-	1	3	-	-

Course Title: Diagnosis And Reconditioning Lab			
Course Code: P15AUL77	Semester: VII	L:T:P:H- 1:0:2:3	Credits: 1.5
Contact period: Lecture: 39 Hrs. Exam 3 Hrs.	Weightage : CIE:50%; SEE:50%		

Prerequisites:

The student should have undergone the course on: Auxiliary systems of Automotive vehicle and different operation in various machines and use of different measuring instruments.

Course Content

PART-A

1. Inspection of vehicles and preparation of test charts.
2. Tuning of Engines: Check for ignition timing, valve tappet clearance, Radiator flushing and check for leaks ete.,
3. Study and practice on :
   - Connecting rod alignment
   - Cylinder reboring machine
   - Valve refacing machine
   - Nozzle grinding machine
   - Brake drum skimming machine
4. Servicing of components like FIP, Carburetor, Fuel pump, Exhaust pipes and Silencer, Lubricating system, Air compressor, shock absorber, Calibrations of FIP.

Part – B

1. Study and practice of wheel alignment (Mechanical and computerized) and wheel balancing
2. Testing of Two wheeled vehicles on chassis dynamometer
3. Study of tyre retreading and vulcanizing
4. Study and practice on body repairs – tinkering and painting
5. Head light focusing test and visibility test
6. Students have to visit at least three different automotive industries in which at least one automotive manufacturing unit. Report to be submitted on Industrial visit.

Course outcomes (COs)

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

1. **Calculation** of reboring ,brake drum skimming, valve refacing, connecting rod alignment tests and **conducting** experiments
2. **Practically** involving in different operation in **calibration** of FIP
3. **Practically** involving in principle and different operation of wheel alignment and wheel balancing
4. **Practically** involving in different operation in body repair and painting
5. To **visit** different automotive industries

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	**Calculation** of reboring ,brake drum skimming, valve refacing, connecting rod alignment tests and **conducting** experiments	2	2	2	2	2	-	-	-	2	2	2	2	3	2	2
2	**Practically** involving in different operation in **calibration** of FIP	3	2	-	-	1	-	-	-	-	-	2	-	3	-	-
3	**Practically** involving in principle and different operation of wheel alignment and wheel balancing	3	2	-	-	2	-	-	-	-	-	2	-	3	-	-
4	**Practically** involving in different operation in body repair and painting	3	2	-	-	1	-	-	-	-	-	2	-	3	-	-
5	To **visit** different automotive industries	3	2	-	-	1	-	-	-	-	-	2	-	3	-	-

VIII Semester

Course Title: Automotive Air Pollution & Control			
Course Code: P15AU81	Semester: VIII	L:T:P:H -4:0:0:4	Credits:3
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites:

Subject requires student to know about Students must have the back ground knowledge of combustion in S I engines and combustion in C I engine and also about measurement technology

Course Learning Objectives (CLO):

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

a) **Explain** the current Indian and European emission standards.(L2)
b) **Explain t**he mechanism of formation of HC,CO, particulate and Nox from SI and CI engines (L2)
c) D**escribe** about different pollution control techniques used in SI and CI engines(L 2)
d) **Determine** the HC, CO, NOx and particulate using different gas analyzers (L5)
e) **Describe** about various post combustion treatments used in SI and CI engine (L2)
f) **Analyze** the effect of fuel properties on emission and **Analyze** the effect of pollution on human, plant and animals (L4)

Relevance of the course

Automotive air pollution and control is a course deals with the different ways of pollutant formation and factors influencing and measures to reduce pollutants from SI and CI engines. Also deals with different methods of post combustion treatments and instruments used to measure pollutants and it is hoped that through this programme student will gain sufficient knowledge to make them employable in transport departments like Road transport corporations, R.T.O etc and other vehicle manufacturing industries

Course Content

UNIT-1

MECHANISM OF POLLUTANT FORMATION IN ENGINESI

Introduction, **NITROGEN OXIDES:** kinetics of NO formation in SI and CI engines, Formation of NO_2

CORBONMONOXIDE:

UNBURNED HYDROCARBON EMISSIONS: Back ground, HC emissions from spark ignition engines, HC emission mechanisms in diesel engines Crankcase emissions, piston ring blow by, evaporative emissions

PARTICULATE EMISSIONS: Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation. **11 Hrs**

UNIT-2

POLLUTION CONTROL TECHNIQUES:

SI engine emission control technology: engine design parameters like, compression ratio, cylinder size, equivalence ratio, ignition timing, residual gas dilution, engine speed, coolant

temperature, combustion chamber shape, fueling system, variable valve timing and lift, variable swept volume and lean burn strategies.

positive crankcase ventilation system, evaporative emission control and exhaust gas recirculation **CI engine emission control technology**: Design changes, compression ratio, in-cylinder air swirl, multivalves, engine load, engine speed, optimization of operating factors and Exhaust gas recirculation, fuel injection variables , electronic fuel injection systems and turbocharging. **11 Hrs**

UNIT-3

INFLUENCE OF FUEL PROPERTIES &EFFECT OF AIR POLLUTION

Motor gasolene properties, effect of gasolene properties on emissions and reformulated gasolene. Diesel Fuel properties, effect of diesel fuel properties on emissions, effect of Alternative Fuels and lubricants on emissions.

Effect of air pollution: on Human Health, on animals and on plants

Sampling procedures, combustion gas sampling, particulate sampling and sampling methods **10 Hrs**

UNIT- 4

INSTRUMENTATION FOR POLLUTION MEASUREMENTS

NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NO_x, Orsat apparatus, Smoke measurement, comparison method, obscuration method, ringelmann chart, Continuous filter type smoke meter,Bosch smoke meter, Hartridge smoke meter

Test cycles for light, medium and heavy duty vehicles engines

Emission standard for motor cycles, light duty and heavy duty vehicles **10 Hrs**

UNIT- 5

POST COMBUSTION TREATMENTS

Available options, physical conditions &exhaust gas compositions before treatment,

SI engines : Thermal Reactors, catalytic exhaust after treatment catalyst, catalyst substrate, types of catalytic converter , oxidation and reducing catalytic converters and three way catalysts CI engines: catalytic exhaust gas after treatment, diesel oxidation catalysts, NOx storage reduction catalyst, selective catalytic reduction ,Installation of catalyst in exhaust lines, catalyst poisoning, catalyst light-off, particulate traps, Diesel Trap oxidizer.

10 Hrs

Text Books

1. Automobiles and pollution, SAE transactions 1995
2. John B heywood,Internal combustion engine fundamentals,Mc Graw Hill CO 2014
3. Engine emissions, B P Pundir, Narosa publishing house, New Delhi, 2011

References:

1. V Ganesan, Internal combustion engines, Tata McGrawHill CO, 2015
2. Internal combustion engines, E F Obert

Course outcome

CO1. Distinguish between the different pollutants from SI and CI engines and their formation mechanism
CO2. Identify and analyze the different design parameters to control pollution from SI and CI engines
CO3. Interpret the different fuel properties on emission and also effect of automotive pollution on human, animals and plants
CO4. Distinguish between different methods of post combustion treatments
CO5. Measure pollutants emitted from SI and CI engines using different instruments

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	**Conduct** performance test on any given engine, and evaluate performance characteristics	2			2		2			2			2			
2	**Analyze** the engine performance using alternative fuels	2	2		2	2		2		2	2	2	2			
3	**Conduct** experiment to understand the effect of compression ratio on performance of the engine	2	2		2	2		2	2			2	2			
4	**Optimize** the performance of the engine by varying the ignition timing, Diagnose the engine problem using engine analyzer				2			2	2							

Course title: Alternative Energy Sources for Automobiles			
Course code: P15AU821	Semester: VIII	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 engineering chemistry, Automobile engineering and theory of fuels and combustion.

Relevance of the course

The subject **alternative energy sources for automobiles** is a core course in BE (automobile engineering) program that helps to understanding the various alternative fuels/energy sources for I.C. engines.

Further this course aims at developing and understanding future trends and development, including hydrogen as an internal combustion engine fuel.

Course Learning Objectives (CLO):

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

1. **Identify** Non-conventional Energy Sources Analyze solar energy, and wind energy, Examine applications and limitations
2. **Analyze** Gaseous alternative fuels
3. **Analyze** biomass energy, Examine applications and limitations
4. **Analyze** Synthetic Alternative fuels, Examine applications and limitations
5. **Analyze** Reformulated conventional fuels, Future Alternative Fuels and alternative power trains, Examine applications and limitations

Course content

UNIT-1:

Introduction

Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, Technological up gradation required, Implementation barriers for alternative fuels, stakeholders of alternative fuels, roadmap for alternative fuels.

Solar energy and Wind energy

Introduction to solar energy, solar energy collectors, solar energy storage system, P. V. effect solar cells and characteristics, application of solar energy for automobiles.

Introduction to wind energy, principle of wind energy conversion, types of wind machines, applications of wind energy. Site selection considerations, Advantages and disadvantages of WEC systems. **11 Hrs**

UNIT-II:

Gaseous alternative fuels.

Introduction,history,properties,production,storage,transportation,advantages,disadvantages and applications of hydrogen, liquid hydrogen(LH_2), compressed natural gas(CNG), liquefied natural gas(LNG), adsorbed natural gas, liquefied petroleum gas(LPG) and landfill gas(LFG).

10 Hrs

UNIT-III:

Biomass Energy

Introduction, history, properties, production, storage, transportation, advantages, disadvantages and applications of Biogas or Bio methane, classification of biogas plants. Methanol, ethanol, butanol, straight vegetable oil (SVO) and biodiesel.

10 Hrs

UNIT-IV:

Synthetic Alternative fuels

Introduction, history, properties, production, storage, transportation, advantages, disadvantages and applications of HCNG and hythane, Di-Methyl Ether(DME), Diethyl Ether(DEE), Biomass to Liquid(BTL), Gas to Liquid(GTL), Coal to Liquid(CTL), Syngas, Producer gas or wood gas, P-series, Eco-Friendly Plastic Fuel(EPF), Wood Pyrolysis Oil(WPO), Magnegas and Tyre Pyrolysis Oil (TPO). **10 Hrs**

UNIT-V:

Reformulated conventional fuels Introduction, history, properties, production, advantages, disadvantages and applications of coal water slurry (CWS), Reformulated Gasoline (RFG), Emulsified fuels and Hydrogen-enriched gasoline.

Future Alternative Fuels: Pulverized Metal Fuel (PMF), Ammonia, Liquid-Nitrogen, Boron, and Compressed Air.

Introduction to alternative power trains: Introduction, components of an EV, EV batteries, chargers, drives, transmission, controllers and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology, Applications of DFT. Duel fuel engine operation, Advantages and disadvantages of duel fuel technology. **11 Hrs**

Text Books

1. S.S. Thipse "Alternative Fuels", JAICO Publishing House, 2010. • **ISBN-10:** 8184950780 **ISBN-13:** 978-8184950786
2. G.D. Rai "Non-Conventional Energy Sources" Khanna Publishing New Delhi. 2011

References

1. M. Poulton- "Alternative fuels for vehicle book "1994. **ISBN-10:** 1562522256 **ISBN-13:** 978-1562522254
2. Richard L. Bechtold-"Automotive Fuels Guide Book", SAE Publications, 1997.
3. T.N. Veziroglu-"Alternative energy sources", McGraw Hill Publications.
4. A Primer on Hybrid Electric vehicles.

Course Outcomes

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

1. **Identify** Non-conventional Energy Sources Analyze solar energy, and wind energy, Examine applications and limitations
2. **Analyze** Gaseous alternative fuels
3. **Analyze** biomass energy, Examine applications and limitations
4. **Analyze** Synthetic Alternative fuels, Examine applications and limitations
5. **Analyze** Reformulated conventional fuels, Future Alternative Fuels and alternative power trains, Examine applications and limitations

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** Non-conventional Energy Sources Analyze solar energy, and wind energy, Examine applications and limitations	3	3	3	-	-	2	2	-	-	-	-	2	3	2	1
2	**Analyze** Gaseous alternative fuels	3	3	3	-	-	2	2	-	-	-	-	2	3	2	1
3	**Analyze** biomass energy, Examine applications and limitations	3	3	3	-	-	2	2	-	-	-	-	2	3	2	1
4	**Analyze** Synthetic Alternative fuels, Examine applications and limitations	3	3	3	-	-	2	2	-	-	-	-	2	3	2	1
5	**Analyze** Reformulated conventional fuels, Future Alternative Fuels and alternative power trains, Examine applications and limitations	3	3	3	-	-	2	2	-	-	-	-	2	3	2	1

Course Title: Engineering. Economics and Cost Estimation			
Course Code: P15AU822	Semester: VIII	L:T:P:H -4:0:0:4	Credit: 3
Contact Period-Lecturer: 52Hrs Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: The course aims at enabling students to analyze cost/revenue data and carry out economic analysis in the decision making process to justify or reject alternatives/projects on economic basis.

Course Learning Objectives (CLO):

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

1. Understand the basic concept and terminology used in engineering economics- goods, wants and wealth etc. Taxation system.
2. Understand different types of interest rates causes for charging interest, interest factor for single payment, uniform series payment, arithmetic gradient. Evaluate alternatives based on PW method, annual worth method, rate of returns method for the purpose of investment
3. Define depreciation, cause of depreciation and Calculate depreciation by different methods Perform replacement analysis without- considering money value, considering money value, individual replacement and group replacement.
4. Estimate the cost of given component by reading the drawing and performing cost accounting and break even analysis.
5. Estimate costing, break even analysis and minimum cost analysis, material cost, labor cost, sunk cost, marginal cost, Allocation of Overheads by Different Methods, Man Hour Rate and Machine Hour Rate.

Course Content

Unit -I

INTRODUCTION: Definition and Meaning of Economic Terms, Goods, Classification of Goods, Wants, Characteristics and Classification of Wants, Wealth, Classification of Wealth, Demand, Equilibrium Demand Theory, Law of Demand, Price Elasticity of Demand, Supply, Law of Supply, Utility, Total and Marginal Utility, Types of Wages, Taxation, Principle of Taxation, Characteristics of a good Taxation System, Kind of Taxes and their Merits and Demerits. **10 Hrs**

Unit -II

INTEREST: Simple and Compound interest. Interest Formulae and Numericals. COMPARISON OF ALTERNATIVES: Present worth method, Equivalent Annual cost method and Rate of Return method, Numerical Problems **10 Hrs**

Unit- III

DEPRECIATION: Causes of Depreciation, Methods of Calculating Depreciation, Straight Line Method, Sinking Funds Method, Sum of the Year Digits Methods, Declining Balance, Numerical Problems. REPLACEMENT ANALYSIS: Basic reasons of Replacement, Present Asset and its Replacement, Consideration Leading to Replacement, Installation and Removal Cost, Numerical Problems. **12 Hrs**

Unit - IV

ESTIMATION OF MATERIAL COST: Definition of Estimating, Importance of Estimating, Aims of Estimating, Qualities of an Estimator, Functions of an Estimator, Errors in Estimating, Mensuration Procedure for Estimation, Estimating the Weight of Raw Materials & Material Cost, Numerical Problems. **10 Hrs**

Unit -V

COSTS & COST ACCOUNTING: First Cost, Fixed Cost, Variable Cost, Incremental Cost, Sunk Cost and Marginal Cost, Break Even Analysis & Minimum Cost Analysis, Material Cost, Labour cost, Allocation of Overheads by Different Methods, Man Hour Rate, Machine Hour Rate, Numerical Problems. **10 Hrs**

Text books

1. Engineering Economics: TARACHAND
2. Industrial Management Engg & Economics: Banga & Sharma.

References

1. Engineering Economics: Thuesen Prentice Hall 9th edition 2001
2. Engineering Economics: Ritz Grant & Ireson Ranald Press Co. 4th edition 2011
3. Mechanical Estimating & Costing: Kannapan Augutine & Paramdhaman Tata McGraw Hill.
4. Engineering Economics Horengren

Course Outcomes

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

1. Understand the basic concept and terminology used in engineering economics- goods, wants and wealth etc. Taxation system.
2. Understand different types of interest rates causes for charging interest, interest factor for single payment, uniform series payment, arithmetic gradient. Evaluate alternatives based on PW method, annual worth method, rate of returns method for the purpose of investment
3. Define depreciation, cause of depreciation and Calculate depreciation by different methods Perform replacement analysis without- considering money value, considering money value, individual replacement and group replacement.
4. Estimate the cost of given component by reading the drawing and performing cost accounting and break even analysis.
5. Estimate costing, break even analysis and minimum cost analysis, material cost, labor cost, sunk cost, marginal cost, Allocation of Overheads by Different Methods, Man Hour Rate and Machine Hour Rate.

Course Articulation Matrix

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

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Understand the basic concept and terminology used in engineering economics- goods, wants and wealth etc. Taxation system.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
2	Understand different types of interest rates causes for charging interest, interest factor for single payment, uniform series payment, arithmetic gradient. Evaluate alternatives based on PW method, annual worth method, rate of returns method for the purpose of investment	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
3	Define depreciation, cause of depreciation and Calculate depreciation by different methods Perform replacement analysis without-considering money value, considering money value, individual replacement and group replacement.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
4	Estimate the cost of given component by reading the drawing and performing cost accounting and break even analysis.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
5	Estimate costing, break even analysis and minimum cost analysis, material cost, labor cost, sunk cost, marginal cost, Allocation of Overheads by Different Methods, Man Hour Rate and Machine Hour Rate.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Course Title: Control Engineering			
Course Code: P15AU823	Semester: VIII	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: - Engineering Mathematics II, Engineering Mathematics III, Mechanical Vibrations

Course Learning Objectives (CLO):

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

1. Identify and classify the different types of control systems. Develop mathematical model for the mechanical, electrical, servo mechanism and hydraulic systems.
2. Represent the systems consisting of number of components in the form of block diagrams and signal flow graphs and Develop mathematical models using reduction technique of these block diagrams and signal flow graphs.
3. Obtain the time response and steady-state error of the system. Determine stability of the various control systems by applying Routh's stability criterion.
4. Obtain frequency response and Determine stability of control system applying Nyquist stability criterion and using Bode plot.
5. Construct root loci from open loop transfer functions of control systems and Analyze the behavior of roots with system gain. Analyze complex systems having multi inputs and multi outputs using state-space method.

Course Content

Unit - I

Introduction and Mathematical Models of Physical Systems: Concept of automatic controls, open and closed loop control systems, concepts of feedback control systems, requirement of an ideal control system. Examples of control systems - Speed control system, Human body temperature control system, Home heating system, Traffic control system, Liquid level control system. Definition of Laplace transformation, Transfer function models, mathematical models of mechanical systems, models of electrical circuits, models of DC and AC motors, models of hydraulic systems and models of thermal systems. Analogous Systems- Force-voltage analogy and force-current analogy. **10 hrs**

Unit- II

Block Diagrams & Signal Flow Graphs and Time Response Analysis: Transfer functions definition, block representation of system elements, reduction of block diagrams with single and multiple inputs. Signal flow graphs- Signal flow graph terminology, signal flow graph from block diagram, Manson's gain formula. **10 hrs**

Unit -III

Time Response Analyses: Time response analysis - Introduction, transient and steady state response of control system, standard test inputs – step, ramp, parabolic and impulse inputs. First order system response to step and ramp inputs, concepts of time constant and its importance in speed of response. Second order system response to step input, transient response specifications. Stability definition, mathematical concept of stability, characteristic root locations and stability, Routh's stability criterion, special cases of Routh's criterion.

Steady-state error analysis- control system type, steady-state error constants- static position error constant, static velocity error constant and static acceleration error. **10 hrs**

Unit - IV

Frequency Response Analysis: Polar plots, relative stability- concepts phase margin and gain margin. Nyquist Stability Criterion, Stability analysis using Nyquist plot. Frequency response analysis using bode plot: Bode attenuation diagrams, stability analysis using Bode plots.

12 hrs

Unit -V

Root Locus and State-Space Analyses: Root locus analysis- Introduction, definition of root loci, general rules for constructing root loci, root locus analysis of control systems. State-space analysis- introduction, definitions, state-space equations, transformation matrix, controllability and observability. **10 hrs**

Text books

1. Katsuhiko Ogata, **Modern Control Engineering,** Phi Learning Pvt Ltd, 5th Edition, 2010, ISBN: 9788120340107.
2. Rao V Dukkipati, **Control Systems,** Narosa Publishing House, 2008, ISBN: 978-8173195549.
3. Joseph J. Distefano, Allen R. Stubberud and Avan J. Williams, **Feedback and Control Systems**, Schaum's Outlines series, Tata McGraw Hill, New Delhi, 2nd Edition, 2003, ISBN: 978-0070582880.

References

1. J. Nagarath & M. Gopal, **Control systems,** New age International publishers, 4th Edition, 2006, ISBN: 978-8122417753.
2. F. Golnaraghi and B.C. Kuo, **Automatic Control Systems**, John Wiley & Sons, 9th Edition, 2009, ISBN: 978-0470048962.
3. **Control Systems:** Ashfaq Husain and Haroon Ashfaq, Dhanpat Rai & Co., 2015, ISBN: 978-8177000276.

Course Outcomes

1. Identify and classify the different types of control systems. Develop mathematical model for the mechanical, electrical, servo mechanism and hydraulic systems.
2. Represent the systems consisting of number of components in the form of block diagrams and signal flow graphs and Develop mathematical models using reduction technique of these block diagrams and signal flow graphs.
3. Obtain the time response and steady-state error of the system. Determine stability of the various control systems by applying Routh's stability criterion.
4. Obtain frequency response and Determine stability of control system applying Nyquist stability criterion and using Bode plot.
5. Construct root loci from open loop transfer functions of control systems and Analyze the behavior of roots with system gain. Analyze complex systems having multi inputs and multi outputs using state-space method.

Course Articulation Matrix

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

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Identify and classify the different types of control systems. Develop mathematical model for the mechanical, electrical, servo mechanism and hydraulic systems.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
2	Represent the systems consisting of number of components in the form of block diagrams and signal flow graphs and Develop mathematical models using reduction technique of these block diagrams and signal flow graphs.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
3	Obtain the time response and steady-state error of the system. Determine stability of the various control systems by applying Routh's stability criterion.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
4	Obtain frequency response and Determine stability of control system applying Nyquist stability criterion and using Bode plot.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
5	Construct root loci from open loop transfer functions of control systems and Analyze the behavior of roots with system gain. Analyze complex systems having multi inputs and multi outputs using state-space method.	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Course Title: Automotive Vehicle Driving Stability Systems			
Course Code: P15AU824	Semester: VIII	L:T:P:H:4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Course Content

Unit -1

Motor-vehicle safety: Safety systems, Basics of vehicle operation

Basics of vehicle operation: Tires, Forces acting on a vehicle, Dynamics of linear motion, Dynamics of lateral motion. **10 Hrs**

Unit-2

Antilock Braking System (ABS): System overview, Requirements placed on AB, Dynamics of a braked wheel, ABS control loop, Typical control cycles

Automatic brake functions: Overview, Standard function, Additional functions **10 Hrs**

Unit -3

Electronic Stability Program : Requirements, Task and method of operation, maneuvers, Closed loop control system and controlled variables.

Hydraulic modulator: Development history, Design, Pressure modulation. **12 Hrs**

Unit-4

Traction Control System: Function description, Structure of traction control system(TCS), Typical control situation, Traction control system for four wheel drive vehicle.

10 Hrs

Unit -5

Sensors: Automotive applications, Wheel speed sensors, Hall-effect acceleration sensor, Micromechanical yaw- rate sensors, Steering-wheel-angle sensors. **10 Hrs**

Publisher and year of Publication

Text books:

1. Automotive technology by JACK ERJAVEL
2. Automotive electrical and Autotronics by ROBERT BOSCH

Reference:

1. Basic Principles of Automotive control engineering
2. Single track model
3. Directional stability
4. Miniatures
5. Development of hydraulic modulator

Course Title: Earthmoving Equipments & Tractors			
Course Code: P15AU831	Semester: VIII	L:T:P:H -4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites:

1. Subject requires student to know about
2. Basic automotive systems like
3. Engines, transmission and final drives
4. Brakes, steering, and suspension
5. Basic hydraulics

Relevance of the course

Earth moving equipment and tractors is a course deals with the different systems used in EME and tractors and it is hoped that through this programme student will gain sufficient knowledge to make them employable in tractors and earth moving equipment manufacturing industries

Course Learning Objectives (CLO):

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

1. **Explain** the construction, working principle and operation of different earth moving equipments and determine the operating capacity
2. **Discuss** different undercarriage and suspension systems used in earthmoving equipment and their advantages and limitations
3. **Describe** different transmission systems and final drive systems, their construction and working principle used in earth moving equipments
4. **Explain** the construction, working and selection of different types of pumps, valves and actuators used in hydraulic system
5. **Discuss** different steering and brake systems used in off and on high way vehicles and Explain their construction and working principle

Course Content

Unit I

EQUIPMENTS, OPERATION& SELECTION: Different types of earth moving equipments and their applications. Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments and Methods of calculating operating capacity **10 Hrs**

Unit-II

UNDER CARRIAGE AND SUSPENSION: Tyre and tracked vehicles , advantages and disadvantages, under carriage components like , tracks, roller frames, drive sprockets, track rollers, track chains and track shoes.

SUSPENSION: rubber spring suspension and air spring suspension. Earth moving equipments maintenance and advantages, safety methods for earth moving equipments.

10 Hrs

Unit -III

TRANSMISSIONS AND FINAL DRIVES: Splitter and range change gear boxes, Twin& triple counter shaft transmissions, transfer box power take-off (PTO) constructional and working principles, FINALDRIVES: types of reductions like, single reduction, double reduction final drives,

Planetary final drives, inboard epicyclic double reduction final drive and two speed axles and PTO shaft. **12 Hrs**

UNIT-IV

HYDRAULICS: introduction, Basic components of hydraulic systems, construction and working of different types of positive displacement type and non positive displacement type of pumps hydraulic circuits.

HYDRAULIC VALVES: pressure control valves, flow control valves, directional control valves and limited travel valves, hydraulic motors and hydraulic cylinders. Depth & draft control systems. **10 Hrs**

UNIT -V

STEERING AND BRAKES: Power steering types like, linkage type power steering, semi integral power steering & integral power steering.

STEERING OF TRACKED VEHICLES: Skid steering, articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system.

BRAKES: Types of brakes like, disc brake, engine brakes, retarders (exhaust compression retarder, hydraulic type retarder and engine compressed air type retarder) etc. **10 Hrs**

Text Books:

1. Erich J.schulz, Diesel equipment- volume I and II
2. S.C. Sharma, Construction equipment and its management
3. Heinz Heisler Advanced vehicle technology,

Reference Books:

1. Donald R. Hunt and L. W.Garner Farm machinery and mechanism
2. J.Y.Wong John Wiley and sons Theory of ground vehicles
3. Herbert Nicholas, Moving the earth
4. Jagman Singh, On and with the earth, W.Newman and Co. Culkatta

Course Outcomes

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

1. **Explain** the construction, working principle and operation of different earth moving equipments and determine the operating capacity
2. **Discuss** different undercarriage and suspension systems used in earthmoving equipment and their advantages and limitations
3. **Describe** different transmission systems and final drive systems, their construction and working principle used in earth moving equipments
4. **Explain** the construction, working and selection of different types of pumps, valves and actuators used in hydraulic system
5. **Discuss** different steering and brake systems used in off and on high way vehicles and Explain their construction and working principle

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 construction, working principle and operation of different earth moving equipments and determine the operating capacity	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	**Discuss** different undercarriage and suspension systems used in earthmoving equipment and their advantages and limitations	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
3	**Describe** different transmission systems and final drive systems, their construction and working principle used in earth moving equipments	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	**Explain** the construction, working and selection of different types of pumps, valves and actuators used in hydraulic system	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
5	**Discuss** different steering and brake systems used in off and on high way vehicles and Explain their construction and working principle	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

Course title:–Advanced Engine Technology			
Course code: P15AU832	Semester: VIII	L – T – P -H:4-0-0-4	Credits:3
Contact period-lecturer: 52hrs. Exam:3 hrs		Weightage:CIE:50%; SEE:50%	

Pre requisites

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

Course Learning Objectives (CLO):

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

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

Course content

Unit-I

Combustion in spark ignition engines: stages of combustion in SI engines, essential features of process, thermodynamic analysis of SI engine combustion, flame structure & speed, cyclic variation in combustion, partial burning and misfire, causes of cycle-by-cycle and cylinder-cylinder variation, spark ignition fundamentals, abnormal combustion: knock fundamentals & surface ignition. **12 Hrs**

Unit-II

Combustion in compression ignition engines:

Introduction, stages of combustion in CI engines, methods of generating swirl in CI engines, DI and IDI engines, types of direct combustion systems, comparison of different combustion systems, combustion in direct injection multi spray systems, analysis of cylinder pressure data, fuel spray behavior, atomization, spray penetration, droplet size, spray evaporation, ignition delay, brief introduction of auto-ignition fundamentals, mixing-controlled combustion. **10 Hrs**

Unit-III

Advances in air and fuel supply system: Introduction to valve operating mechanism, valve rotators, variable valve timing technologies, VTEC technology, cam less engines, hydraulic operated tappets, turbo compound turbochargers, single stage injector, two stage injector, electronically controlled fuel injection system **10 Hrs**

Unit-IV

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

UNIT – V

Non conventional engines: free piston engine, homogeneous charge compression ignition engine, lean burn engines, sterling engine, stratified charge engine, variable compression ratio engine, wankel engine and gas turbine engine **10 Hrs**

Text books:

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

References:

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

Course outcomes

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

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

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Explain** the combustion process in SI engines	2	2					2					2	2	2	2
2	**Explain** the combustion process in CI engines	2	2					2					2	2	2	2
3	**Identify** the advanced technology used in air and fuel supply systems	2	2						2	2	2		2	3	3	3
4	**Identify** the advanced technology used in cooling , lubrication and ignition	2	2						2	2	2		2	3	3	3
5	**Discuss** about the non conventional engines	2	2						2	2	2		2	3	3	3

Course Title: Automotive Embedded System			
Course Code: P15AU833	Semester: VIII	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:_%	

Course Content

UNIT: 1

ELECTRONICS IN THE AUTOMOBILE: Introduction- Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR, ESP, passive safety systems: Restraint systems and their associated sensors in an automobile. Powertrain Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems navigation systems multimedia systems, cross application technologies. 42V vehicle power supply system. **11Hrs**

UNIT: 2

DRIVE BY WIRE: Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-by wire, gas-by-wire, power-by-wire, shift by wire. Future of Automotive Electronics **10Hrs**

UNIT: 3

HARDWARE MODULES: Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering vehicle speed sensors and destination sensors, Attitude sensor, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, solenoids, stepper motors, relays **11Hrs**

UNIT : 4

ELECTRONIC IGNITION SYSTEMS: Electronic ignition systems. Types of solid state ignition systems and their principle of operation Digital engine control system. Open loop and closed loop control system, Engine cranking and warm up control.
Acceleration enrichment. Deceleration learning and ideal speed control, Distributor less ignition – Integrated engine control system, Exhaust emission control engineering **10 Hrs**

UNIT: 5

AUTOMOTIVE EMBEDDED SYSTEM: Automotive Embedded systems. PIC, Free scale microcontroller based system. Recent advances like GLS, GPSS, GMS. Multiprocessor communication using CAN bus. Case study- cruise control of car. Artificial Intelligence and engine management. **10 Hrs**

Student Learning Outcomes:

1. Design and develop automotive embedded systems.
2. Analyze various embedded products used in automotive industry.
3. Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive applications
4. Will be able to interface devices and build a complete system

Text & References:

1. "Embedded System Design: A unified Hardware / Software Introduction" – Frank Valid and Tony Givargis, Wiley India Publishers. 2011
2. "A Practical Introduction to Hardware/Software Co-Design"- Patrick R. Schaumont, Springer Publishers. 2008

Course title: Tribology			
Course code: P15AU834	Semester: VIII	L – T – P -H:4-0-0-4	Credits:3
Contact Period-Lecturer: 52hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites Engineering mathematics ii, fluid mechanics

Course learning objectives (CLOs): the course aims at strengthening the capability of students to integrate friction, wear and lubrication theories in design, manufacturing and operation of sustainable machine elements and their maintenance.

Course content

Unit -I

Introduction to Tribology: introduction to Tribology, friction, laws of friction, friction theories, surface contaminants and frictional heating. Wear- classification of wear, mechanisms of wear, basic wear testing methods- pin on disc wear tester and dry sand rubber wheel abrasion tester, wear resistant materials.

Surface roughness: introduction, standardization of surface roughness, m & e system, centre line average, root mean square roughness, probability distribution function, autocorrelation function. Abott bearing area curve. Surface roughness measurement techniques- stylus method, interferometric method, optical profilometer and pneumatic method. **10 Hrs**

Unit-II

Lubricants and lubrication: types of bearing, lubricants, types of lubricants. Lubrication, types of sliding lubrication-fluid-film lubrication, boundary lubrication and extreme boundary lubrication. Properties of oils and equation of flow- viscosity, Newton's law of viscous flow, effect of temperature on viscosity, viscosity index, effect of pressure on viscosity, viscosity measuring apparatus- u-tube viscometer, say bolt universal viscometer and redwood viscometer. Hagen- poiseuille law, flow through capillary tube, flow between parallel stationary plates. **10 Hrs**

Unit -III

Hydrodynamic lubrication: friction forces and power loss in lightly loaded bearing, coefficient of friction for a lightly loaded bearing (petroff's equation), numerical examples of lightly loaded full-journal bearing, tower's experiments, Reynolds investigations, mechanism of pressure development in an oil film, application of converging oil film in thrust bearing, formation of a converging oil film in a partial and full journal bearings. Reynold s equation in two dimensions. **10 Hrs**

Unit -IV

Idealized hydrodynamic bearings: definition of idealized bearings, idealized plane-slider bearing with a fixed shoe- pressure distribution, load carrying capacity, coefficient of friction. Idealized slider bearing with a pivoted shoe- load carrying capacity, frictional resistance, coefficient of friction, location of the pivot point of a slider bearing with a pivot shoe. Numerical problems. **10 Hrs**

Unit -V

Hydrodynamic journal bearing: idealized journal bearings- infinitely long-full journal bearing- oil film thickness, Sommerfeld substitution, pressure distribution (no derivation), load carrying capacity, Sommerfeld number, viscous friction, modified Sommerfeld solution. Infinitely short-full journal bearing- pressure distribution (no derivation), load capacity and friction force. Numerical problems on idealized hydrodynamic journal bearing.

Hydrostatic lubrication: introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing. Numerical on hydrostatic lubrication. **12 Hrs**

Text books

1. Basu S K., Sengupta S N., Ahuja B. B., Fundamentals of Tribiology, Phi, 1st Edition, 2009, ISBN: 978-8120327238
2. B. C. Mujumdar, Introduction To Tribiology Of Bearings, S.Chand (G/L) & Company Ltd, 2nd Edition, 2010, ISBN: 978-8121929875.
3. E. I. Redzimovskay, Lubrication Of Bearings Theoretical Principles And Design, The Ronald Press Company, 1st Edition, 1959, Asin: B0000egl66.

References

1. Dudley D. Fuller, Theory and Practice of Lubrication for Engineers, John Wiley & Sons; 2nd Edition, 12 September 1984, ISBN: 978-0471047032.
2. Desmond F. Moore, Principles And Applications Of Tribiology, Pergamaon Press, 1st Edition, 1975, ISBN: 9780080179025.
3. Sushil Kumar Srivastava, Tribiology In Industries, S Chand And Company Limited, India, 2004, ISBN: 9788121920452.
4. Prasanta Sahoo, Engineering Tribology, PHI, 2005, ISBN: 978-8120327245.

Course outcomes

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

1. Explain friction, laws of friction and different types of wear in materials undergoing relative motion. Characterize surface texture and determine roughness characteristics using its measuring techniques.
2. Explain the properties of lubricants and classify them. Derive Hagen-poiseuille law.
3. Explain the concept of lightly loaded bearings and derive petroff's equation.
4. Derive expressions for pressure distribution, load carrying capacity, coefficient of friction, frictional resistance in a idealized slider bearing.
5. Derive expressions for pressure distribution, load carrying capacity and oil flow through the hydrodynamic journal bearing and hydrostatic step bearing.

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 friction, laws of friction and different types of wear in materials undergoing relative motion. Characterize surface texture and determine roughness characteristics using its measuring techniques.	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
2	Explain the properties of lubricants and classify them. Derive Hagen-poiseuille law.	3	3	2	-	-	-	-	-	-	-	-	-	2	-	-
3	Explain the concept of lightly loaded bearings and derive petroff's equation.	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
4	Derive expressions for pressure distribution, load carrying capacity, coefficient of friction, frictional resistance in a idealized slider bearing.	3	3	1	-	-	-	-	-	-	-	-	-	2	-	-
5	Derive expressions for pressure distribution, load carrying capacity and oil flow through the hydrodynamic journal bearing and hydrostatic step bearing.	3	3	1	-	-	-	-	-	-	-	-	-	2	-	-

Course Title: Automotive mechanics II			
Course Code: P15AU841	Semester: VIII	L:T:P:H- 4:0:0:4	Credits:3
Contact period : Lecture: 52 Hrs. Exam 3 Hrs.		Weightage : CIE:50%; SEE:50%	

Prerequisite: This subject requires student to know about the back ground knowledge of different types of drives like belt drives, chain drives, and gear drives

Course Learning Objectives (CLO)

At the end of the course the student should 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) Explain the constructional and working principle of different types of gear box
e) Determine the gear ratio, speed of vehicle and number of teeth on driving and driven gears
f) Explain the working of different types of final drives and rear axles
g) Explain the working of different types of steering suspension systems used in automobiles
h) Explain the working of different types of brakes and their operating mechanisms

Course Content

UNIT I

CLUTCHES: Necessity of clutch in an automobile, different types of clutches, friction clutches namely Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, Fluid Coupling ,Torque converters, comparison between fluid coupling and torque converters, single stage , two stage and three stage torque converter, **11 Hrs**

UNIT II

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

11 Hrs

UNIT III

FINAL DRIVES AND REAR AXLE: introduction, single reduction, double reduction and planetary final drives, differential, differential lock, Hotchkiss drive, torque tube drive, construction of rear axle supporting **10Hrs**

UNIT IV

STEERING AND SUSPENSION :Steering mechanisms, steering geometry, steering linkages, steering gears, power steering, s**uspension system:** objects, types of suspension springs, coil springs, shock absorbers, air suspension system, hydrolastic suspension

10Hrs

UNIT V

BRAKES: Necessity, types of brakes, drum brake, disc brake, hydraulic brake, air brake, servo brakes, power brake, vaccume brake, electric brake, ABS **10Hrs**

Text Books:

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

Reference Books:

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

Course Outcomes (CO)

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

1. **Understand** the basic principles of working of clutch and torque converter used in automobile
2. **Identify** the different types of manual and automatic transmission
3. **Understand** the basic principles of steering systems and suspension system
4. **Understand** the necessity of brakes and different types
5. **Understand** the different types of final drives and rear axles

Course Articulation Matrix

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

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Understand** the basic principles of working of clutch and torque converter used in automobile	2	2				2						2	2		
2	**Identify** the different types of manual and automatic transmission	2	2				2						2	2		
3	**Understand** the basic principles of steering systems and suspension system	2	2				2						2	2		
4	**Understand** the different types of final drives and rear axles	2	2				2						2	2		
5	**Understand** the necessity of brakes and different types	2	2				2						2	2		

Course Title: Automotive air pollution and control			
Course Code: P15AU842	Semester: VIII	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 combustion in S I engines and combustion in C I engine and also about measurement technology

Course Learning Objectives (CLO):

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

a) **Explain** the IC engines working principles and combustion theory
b) **Explain t**he combustion in CI engines and mechanism of formation of HC,CO, particulate and Nox from SI and CI engines
c) D**escribe** about different pollution control techniques used in SI and CI engines
d) **Determine** the HC, CO, NOx and particulate using different gas analyzers
e) **Describe** about various post combustion treatments used in SI and CI engine (L2)

Relevance of the course

Automotive air pollution and control is a course deals with the different ways of pollutant formation and factors influencing and measures to reduce pollutants from SI and CI engines. Also deals with different methods of post combustion treatments and instruments used to measure pollutants and it is hoped that through this programme student will gain sufficient knowledge to make them employable in transport departments like Road transport corporations, R.T.O etc and other vehicle manufacturing industries

Course Content

UNIT-1

Internal combustion engines: clasification of IC engines, ottocycle, diesel cycle comparision of ottocycle and diesel cycle, engine performance characteristics

SI engines: combustion in SI engines, stages of combustion in SI engines, abnormal combustion in SI engine, Knock in SI engine, Fuel used in SI engine, and their properties

11 Hrs

UNIT-2

CI engines : combustion in CI engines, stages of combustion in CI engines, Fuel used in CI engine, and their properties

Mechanism of pollutant formation in engines: Introduction, **Nitrogen Oxides:** kinetics of NO formation in SI and CI engines, Formation of NO_2

Carbon Monoxide & Unburned Hydrocarbon Emissions: Back ground, HC emissions from spark ignition engines, HC emission mechanisms in diesel engines Crankcase emissions, piston ring blow by, evaporative emissions

Particulate Emissions: Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation. **11 Hrs**

UNIT-3

Pollution Control Techniques:

SI engine emission control technology: positive crankcase ventilation system, evaporative emission control and exhaust gas recirculation

CI engine emission control technology: Design changes, compression ratio, in-cylinder air swirl, multivalve, engine load, engine speed, optimization of operating factors and Exhaust gas recirculation, fuel injection variables, electronic fuel injection systems and turbo charging. **10 Hrs**

UNIT- 4

Instrumentation for Pollution Measurements

NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NO_x, Orsat apparatus, Smoke measurement, comparison method, obscuration method, ringelmann chart, Continuous filter type smoke meter, Bosch smoke meter, Hartridge smoke meter **10 Hrs**

UNIT- 5

Post Combustion Treatments

Available options, physical conditions &exhaust gas compositions before treatment,

SI engines : Thermal Reactors, catalytic exhaust after treatment catalyst, catalyst substrate, types of catalytic converter , oxidation and reducing catalytic converters and three way catalysts

CI engines : catalytic exhaust gas after treatment, diesel oxidation catalysts **10 Hrs**

Text Books

1. Automobiles and pollution, SAE transactions 1995
2. John B heywood, Internal combustion engine fundamentals, Mc Graw Hill CO 2014
3. Engine emissions, B P Pundir, Narosa publishing house, New Delhi, 2012

References

1. V Ganesan, Internal combustion engines, Tata McGrawHill CO, 2015
2. Internal combustion engines, E F Obert,

Course outcome

1. **Explain** the working principles of SI and CI engines
2. **Identify and analyze** the different design parameters to control pollution from SI and CI engines
3. **Interpret** the different fuel properties on emission and also effect of automotive pollution on human, animals and plants
4. **Distinguish** between different methods of post combustion treatments
5. **Measure** pollutants emitted from SI and CI engines using different instruments

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 working principles of SI and CI engines	2					2	2					2	2		
2	**Identify and analyze** the different design parameters to control pollution from SI and CI engines	2	2	2			2	2					2	2		1
3	**Interpret** the different fuel properties on emission and also effect of automotive pollution on human, animals and plants	2	2				2	2					2	2		1
4	**Distinguish** between different methods of post combustion treatments	2	2				2	2					2	2		1
5	**Measure** pollutants emitted from SI and CI engines using different instruments	2	2				2	2					2	2		1