SYLLABUS

(With effect from 2013-2014)
Out Come Based Education

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2013–14)
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ

VII and VIII Semester
Bachelor Degree
in
Automobile Engineering

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)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

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 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.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of 2013-14.Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project is included in all undergraduate programs.

Sri.B.Dinesh Prabhu
Deputy Dean (Academic)
Associate Professor,
Dept. of Automobile Engg

Dr.P S Puttaswamy
Dean (Academic)
Professor,
Dept. of Mechanical Engg

P.E.S.COLLEGE OF ENGINEERING, MANDYA-57140
(An Autonomous Institution under VTU, Belagavi)

Vision

"An institution of high repute, imparting quality education to develop innovative and Humane engineers"

Mission

"Committed to develop students potential through high quality teaching- learning processes and state of the art infrastructure"

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

Outstanding department, exploring new technologies through continuous learning, research and innovation towards developing competent automobile engineers.

Mission

Committed to**,**

- *Impart knowledge in basic and applied areas*
- *Provide Teaching and Learning ambience in emerging areas with state of art infrastructure*
- *Enhance institute – industry interaction for developing centres of excellence.*
- *Develop students with excellent analytical skills and technical expertise*
- *Create environment on research and innovation for faculty and students.*
- *Committed to deliver interpersonal communication ,team work and engineers with high ethics*

Programme Education Objctives (PEOs)

- **PEO1:** Excel in professional career by acquiring knowledge in Basic sciences and Automobile engineering.
- **PEO2**: Expertise in Thermal, Design and Dynamics, Production, Automotive Electronics, Alternative Fuels and Vehicle Pollution Control with a focus on research and innovation.
- **PEO3**: Ability of problem solving by adopting analytical, numerical and experimental skills with Social Responsibility and societal impact.
- **PEO 4**: Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt Innovative Technologies by engaging in life- long learning principles.

Program Outcomes (PO's)

The graduates of Automobile Engineering of PESCE will be able to:

a. **AUPO1**:Demonstrate basic knowledge in mathematics, basic science, materials and environmental science and engineering to identify, formulate and solve Automobile engineering problems
b. **AUPO2** :Design and conduct experiments, as well as to analyze and interpret the results
c. **AUPO3**:Design and analyse Automotive Systems, thermal systems or processes, Dynamics, and Vehicle Pollution Control for desired Automobile specifications
d. **AUPO4** :Function on multidisciplinary teams with sound communication skills
e. **AUPO5** : Self-learn to acquire and apply allied knowledge and update the same by engaging in life-long learning, practice profession with ethics and promote entrepreneurship
f. **AUPO6**: Apply engineering solutions in global, economic, environmental, and societal context.

P.E.S. COLLEGE OF ENGINEERING, MANDYA
(An Autonomous Institution)
SCHEME OF TEACHING AND EXAMINATION FROM THE YEAR 2013-14 (NEW SCHEME)

VII SEMESTER B.E. AUTOMOBILE ENGINEERING

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Hours/week Pattern L:T:P:H	Total Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total	
1	P13AU71	Earthmoving Equipments & Tractors	Auto	4:0:0:4	4	50	50	100	3
2	P13AU72	Aero Dynamics And Vehicle body Engineering	Auto	2:2:0:4	3	50	50	100	3
3	P13AU73	Vehicle transport Management	Auto	4:0:0:4	4	50	50	100	3
4	P13AU74	Automotive Air pollution & Control	Auto	4:0:0:4	4	50	50	100	3
5	P13AU75	Elective – II Group- B	Auto	4:0:0:4	4	50	50	100	3
6	P13AU76	Elective – III Group - C	Auto	4:0:0:4	4	50	50	100	3
7	P13AUL77	Advanced Engine Testing Lab	Auto	0:1:2:3	1.5	50	50	100	3
8	P13AUL78	Modeling and Analysis Lab	Auto	0:1:2:3	1.5	50	50	100	3
				Total	26	400	400	800	

Elective – II Group- B		
SL. No.	**Subject Code**	**Subject**
1	P13AU751	Statistical Quality Control
2	P13AU752	Automotive Air Conditioning
3	P13AU753	Control Engineering
4	P13AU754	Two and Three wheeled Vehicles

Elective – III Group- C		
SL. No.	**Subject Code**	**Subject**
1	P13AU761	Non Destructive Testing
2	P13AU762	Engg. Economics and Cost Estimation
3	P13AU763	Gas turbine
4	P13AU764	Vehicle Dynamics

VIII SEMESTER B.E. AUTOMOBILE ENGINEERING

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Hours/week Pattern L:T: P:H	Total Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total	
1	P13AU81	Alternative Energy sources for Automotive Vehicles	Auto	2:2:0:4	3	50	50	100	3
2	P13AU82	Hybrid Vehicles	Auto	2:2:0:4	3	50	50	100	3
3	P13AU83	Elective – IV Group-D	Auto	2:2:0:4	3	50	50	100	3
4	P13AU84	Elective – V Group-E	Auto	2:2:0:4	3	50	50	100	3
5	P13AU85	Project Work	Auto	-	10	100	100	200	3
6	P13AU86	Seminar on Current Technology	Auto	0:0:2:2	0	50	-	50	--
				Total	22	350	300	650	

Elective – IV Group- D		
SL. No.	**Subject Code**	**Subject**
1	P13AU831	Advanced I C engines
2	P13AU832	Hydraulics and Pneumatics
3	P13AU833	Theory of Elasticity
4	P13AU834	Computational Fluid Dynamics

Elective – V Group- E		
SL. No.	**Subject Code**	**Subject**
1	P13AU841	Manufacture of Automotive components
2	P13AU842	Tribology
3	P13AU843	Total Quality Management
4	P13AU844	Industrial Robotics

Evaluation Scheme							
Scheme	**Weightage**	**Marks**	**Event Break Up**				
CIE	50%	50	**Test I**	**Test II**	**Quiz I**	**Quiz II**	**Assignment**
			35	35	5	5	10
SEE	50%	100	**Questions to Set: 10**		**Questions to Answer: 5**		

Course Title: Earthmoving Equipments & Tractors			
Course Code: P13AU71	**Semester: VII**	**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

Course Learning Objectives (CLOs):

This Course aims to

a) Explain constructional details, working and application of various earth moving equipments. (L2)
b) Differentiate and Explain different systems used in wheeled and tracked vehicles like steering, braking and final drive systems(L4)
c) Explain the different components of hydraulic system and advantages of use of depth and draft control.(L2)
d) Calculating the production cost for different earth moving equipments (L5)
e) Explain the different maintenance and safety methods used in earth moving equipments (L2)

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 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 **10hrs**

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

a) Explain constructional details, working and application of various earth moving equipments. (L2)
b) Differentiate and Explain different systems used in wheeled and tracked vehicles like steering, braking and final drive systems(L4)
c) Explain the different components of hydraulic system and advantages of use of depth and draft control.(L2)
d) Calculating the production cost for different earth moving equipments (L5)
e) Explain the different maintenance and safety methods used in earth moving equipments (L2)

Course Title: Aero Dynamics and Vehicle Body Engineering			
Course Code: P13AU72	**Semester: VII**	**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 Automobile Engg. Material Science, and Basics of Electrical & Electronics

Course Learning Objectives (CLOs)

This Course aims to

1. To learn the basics of vehicle body design , classifications of coach work, styling forms , types of vehicles
2. To understand the noise controls, and techniques
3. To study the body materials
4. To learn about vehicle stability and load distribution
5. To study the safety factors

Relevance of the Course

The Objective of this course gives History view of the vehicle body, material, safety, stability, load distribution, noise and controls

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. Safety: Safety aspects in design. Painting process of passenger car body. 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. 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. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service- corrosion: Anticorrosion methods, Modern painting process procedure-paint problems. 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). 10 Hrs.

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. To Explain the basics of vehicle body design , classifications of coach work, styling forms , types of vehicles
2. To Explain the noise controls, and techniques
3. To study the body materials
4. To Describe and Explain vehicle stability and load distribution
5. Describe and Explain the Vehicle safety factors

Course Title: Vehicle Transport Management			
Course Code: P13AU73	**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:
Subject requires student to know about, Public Transportation and its benefits

Course Learning Objectives (CLOs)

This Course aims to

1. Recognize Historical background, Explain about the Infrastructure of Public transport and Summarize about the Maintenance of public transport vehicles (L1,L2)
2. Classify and Compare various forms of ownership, Administrative organization and management and Summarize about the crew duties and training (L2)
3. Solve, Illustrate and interpret the estimation of weekday travelers and Differentiate between Timings, Bus working and Schedules (L2,L3)
4. Classify and Compare various Fare collection systems & Fare structures. Calculate Operating costs and Compare different types of public transport vehicles (L2,L3)
5. Explain the duties and responsibilities of Public relations divisions; summarize the causes of accidents and Prevention of accidents. Classify and Compare various Vehicle design, Interpret the potential in the future (L2)

Relevance of the Course

Vehicle 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 **10hrs**

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. **10hrs**

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. 11hrs**

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, lenson parason 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. **11hrs**

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 **10hrs**

Text books:

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

Reference books:

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

Course Outcomes

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

1. Recognize Historical background, Explain about the Infrastructure of Public transport and Summarize about the Maintenance of public transport vehicles (L1,L2)
2. Classify and Compare various forms of ownership, Administrative organization and management and Summarize about the crew duties and training (L2)
3. Solve, Illustrate and interpret the estimation of weekday travelers and Differentiate between Timings, Bus working and Schedules (L2,L3)
4. Classify and Compare various Fare collection systems & Fare structures. Calculate Operating costs and Compare different types of public transport vehicles (L2,L3)
5. Explain the duties and responsibilities of Public relations divisions; summarize the causes of accidents and Prevention of accidents. Classify and Compare various Vehicle design, Interpret the potential in the future (L2)

Course Title: Automotive Air Pollution & Control			
Course Code: P13AU74	**Semester:** VII	**L:T:P:H** -4:0:0:4	**Credits:**4
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 (CLOs):

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

1. Explain the current Indian and European emission standards.(L2)
2. Explain the mechanism of formation of HC,CO, particulate and Knox from SI and CI engines (L2)
3. Describe about different pollution control techniques used in SI and CI engines(L 2)
4. Determine the HC, CO, Nox and particulate using different gas analyzers (L5)
5. Describe about various post combustion treatments used in SI and CI engine (L2)
6. 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 Contents

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 II

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, multivalve, engine load, engine speed, optimization of operating factors and Exhaust gas recirculation, fuel injection variables , electronic fuel injection systems and turbo charging.

11 hrs

Unit III

INFLUENCE OF FUEL PROPERTIES & EFFECT OF AIR POLLUTION

Motor gasoline properties, effect of gasoline properties on emissions and reformulated gasoline. 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 IV

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**

Unit V

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**

Text books:

1. SAE Transactions, Vehicle emission, 1982 (3 volumes).
2. Heywood. J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1995. 7 Automobiles and Pollution SAE Transaction, 1995
3. *B P Pundir, Engine Emissions, nar0sa publishing house, N Delhi, 2011*

Reference:

1 Springer and Patterson, Engine Emission, Plenum Press, 1990
2 Ganesan. V., Internal Combustion Engines, Tata McGraw Hill Co., 1994.
3 Obert. E.F., Internal Combustion Engines, 1982. Intext Educational Publishers
4 Taylor. C.F., Internal Combustion Engines, MIT Press, 1972.

Course Outcomes

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

1. Explain the current Indian and European emission standards.(L2)
2. Explain the mechanism of formation of HC,CO, particulate and Nox from SI and CI engines (L2)
3. Describe about different pollution control techniques used in SI and CI engines(L 2)
4. Determine the HC, CO, Nox and particulate using different gas analyzers (L5)
5. Describe about various post combustion treatments used in SI and CI engine (L2)
6. Analyze the effect of fuel properties on emission and Analyze the effect of pollution on human, plant and animals (L4)

Course Title: Statically Quality Control			
Course Code: P13AU751	**Semester: VII**	**L:T:P:H -4:0:0:4**	**Credits: 4**
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 Define pattern making. Classification, tools used and describe construction of pattern making. Explain foundry sands, sand preparation and testing.
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. Classify furnaces. Describe working and construction features of electric arc furnace and Cupola.
4. Discuss the concept of acceptance sampling, differentiate between acceptance sampling and 100%
   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: Hypergeometric, Bi-nominal, Poisson and Normal distributions, Numerical Problems. 1**1 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.

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

Text Book

1. ***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 100% inspection, producers risk and consumers risk, OC curves.
5. **Describe** concept and meaning of reliability, reliability prediction, system reliability, redundancy and its uses, problem solving

Course Title: Automotive Air Conditioning			
Course Code: P13AU752	**Semester: VII**	**L:T:P:H -4:0:0:4**	**Credits: 4**
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

Prerequisites:

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

Course learning Objectives (CLOs)

This Course aims to

6. Learn the Basic air conditioning system.
7. Explain the concepts of Air conditioning and heating.
8. Interpret about the conventional and modern refrigerants for automotive applications.
9. Summarize about the air control, handling, trouble shooting and servicing.

Relevance of the Course

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

Course Content

Unit – I

AIRCONDITIONING FUNDAMENTALS Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator. **12 hrs**

UNIT-II

AIR CONDITIONER HEATING SYSTEM Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection **10 Hrs**.

UNIT-III

REFRIGERANTS Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential aspects. Handling refrigerants **10 Hrs**

UNIT-IV

AIR ROUTING AND TEMPERATURE CONTROL Objectives, evaporator airflow through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems. **10 Hrs**

UNIT-V

AIR CONDITI0NING SERVICE Causes of air conditioner failure - Trouble shooting of air controlling system - Air conditioner maintenance and service - Servicing heater system. Removing and replacing components – leak testing - Compressor service. **10 Hrs**

TEXT BOOK:

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

REFERENCES:

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

Course Outcomes

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

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

Course Title: Control Engineering			
Course Code: P13AU753	**Semester: VII**	**L:T:P:H -4:0:0:4**	**Credits:**
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		**Weightage:CIE:50%; SEE:50%**	

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

Course objective: The course aims at strengthening the ability of students in design and analysis of linear continues-time control systems to improve their static and transient behaviour.

Course Learning Objectives (CLOs)

This Course aims 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 Title: Two and Three Wheeled Vehicles			
Course Code: P13AU754	**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: To be an Automobile engineer, the student needs to have a basic knowledge of the automobile engineering, auxiliary systems of automobiles and two and three wheeled vehicles. The subject of two and three wheeled vehicles involves the study of different types and arrangement of engine, cooling and lubrication systems, chassis and suspension systems, maintenance of vehicles and case studies.

Course Learning Objectives (CLOs)

This Course aims to

1. Know different types of two wheeler and three wheeler
2. Know types of Lubrication and Cooling System used in two and three wheelers
3. Know Motor cycle power train, motor cycle clutches, construction and operation of clutches, clutch linkage
4. Know Front forks, fork type and spring type suspension systems used in two and three wheelers
5. Understand the importance of decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules

Relevance of the Course

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

Course Content

Unit I

INTRODUCTION

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

The Power Unit: Types of engines for two wheelers, merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes, merits and demerits, scavenging efficiency. Scavenging pumps. Rotary valve engine. Power plant for electric bikes.

10 hrs

Unit-II

FUELS, LUBRICATION AND COOLING SYSTEM

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

MOTOR CYCLE TRANSMISSION SYSTEM: Motor cycle drives, chain drive, shaft drive. Motor cycle power train, motor cycle clutches, construction and operation of clutches, clutch linkage. Gears and gear ratios, gear box types, Construction and working gear shifting arrangements. 10 hrs

Unit-III

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

MOTOR CYCLE BRAKES and wheels: Front and rear braking systems**, ,** friction in motor cycle brakes, disc and drum brakes, merits and demerits, Types of wheels, load on wheels, construction, operation and materials for wheels, wheel designation. 12 hrs

Unit-IV

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

MAINTENANCE: Importance of maintenance, Decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules, trouble diagnosis charts, safety precautions, Lubrication charts 10hrs

Unit-V

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

Case study of Indian models of three wheelers, Front mounted engine and rear mounted engine types, Auto rickshaws, and pickup van, and trailer, Bijili electric vehicles 10 hrs

Text Book:

1. William H. Crouse and Donald L.Anglin “Motor Cycle Mechanics”- TATA McGraw-Hill
2. P.E.IRVING “Motor Cycle engines”, Temple Press Book, London,1992
3. Motor Cycles --Michel M Griffin

Reference Books:

1. The Cycle Motor Manual - Temple Press Ltd, london1990
2. Bryaut R. V. Vespa Maintenance and Repair Series -
3. Marshall Cavendish, Encyclopaedia of Motor Cycling 20 Volumes –, New York and London, 1989

COURSE OUTCOMES:

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

1. Explain different types of two wheelers and three wheelers
2. Explain types of Lubrication and Cooling System used in two and three wheelers
3. Explain motor cycle power train, motor cycle clutches, construction and operation of clutches, clutch linkage
4. Explain suspension systems used in two and three wheelers
5. Explain the importance of decarburizing procedure for engine and silencer, periodic
6. Inspection, maintenance schedules.
7. Work on the given assignment and to get firsthand information and also be able to present and Submit a brief report

Course Title: Non Destructive Testing			
Course Code: P13AU761	**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:- Subject requires student to know about Various, Manufacturing methods, Testing methods and Applications

Course Learning Objectives (Clos)

This Course aims to

1. Interpret and Describe about ND testing visual inspection, leaks testing, liquid penetration inspection and Magnetic particle inspection.(L2)
2. Interpret and Explain about Eddy current inspection, Microwave inspection and Microwave holography, applications and limitations.(L2)
3. Describe and Compare about Ultrasonic inspection, pulse echo A, B, C scans transmission.(L2)
4. Interpret and Describe about Radiography inspection and Thermal inspection.(L2)
5. Interpret and Explain about Optical Holography, Acoustical Holography and Indian Standard for NDT.(L2)

Relevance of the Course

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

Course Content

UNIT-I

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

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

11 Hrs

UNIT-II

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

Microwave inspection: Microwave holography, applications and limitations. **11 Hrs**

UNIT-III

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. Inspection methods pulse echo A, B, C scans transmission, resonance techniques transducer elements, couplets, search units, contact types and immersion types inspection standard-standard reference blocks, inspection of products like casting, extrusions, rolled product, weld set. **10 Hrs**

UNIT-IV

Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radio graphic films, scenes and filters, image intensifiers, techniques charts, industrial radiography, image quality, radiography sensitivity, Penera motors, electron, neural radiology, application of ICT. Thermal inspection principles, equipment inspection methods applications. **10 Hrs**

UNIT-V

Optical Holography: Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: systems and techniques applications. Indian Standard for NDT. **10 Hrs**

Text Books:

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

Reference Books:

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

Course Outcomes

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

1. Interpret and Describe about ND testing visual inspection, leaks testing, liquid penetration inspection and Magnetic particle inspection
2. Interpret and Explain about Eddy current inspection, Microwave inspection and Microwave holography, applications and limitations.\
3. Describe and Compare about Ultrasonic inspection, pulse echo A, B, C scans transmission
4. Interpret and Describe about Radiography inspection and Thermal inspection.
5. Interpret and Explain about Optical Holography, Acoustical Holography and Indian Standard for NDT

Course Title: Engineering. Economics and Cost Estimation			
Course Code: P13AU762	**Semester: VII**	**L:T:P:H -4:0:0:4**	**Credit: 4**
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(Clos)

The Course aims 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, labour 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. **10hrs**

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 . **10hrs**

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. **12hrs**

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. **10hrs**

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. **10hrs**

Text books

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

References

1. Engineering Economics: Thuesen Prentice Hall
2. Engineering Economics: Ritz Grant & Ireson Ranald Press Co.
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 Title: Gas Turbine			
Course Code: P13AU763	**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: Thermodynamics, Fluid Mechanics

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

Course Learning Objectives (Clos)

The Course aims to:-

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

Course Content

Unit -I:

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

Performance of actual gas turbine cycle: Efficiency of compressor and turbine, Pressure or flow losses, Heat exchanger effectiveness, Effect of varying mass flow, Loss due to incomplete combustion, Mechanical loss, Effect of variable specific heat, Calculation of fuel consumption and cycle efficiency, Poly tropic efficiency, Performance of actual cycle, Jet propulsion, Specific thrust of the turbo-jet engine, Thermal efficiency of turbo jet engine, Propulsive efficiency, Effect of forward speed, Effect of altitude, Numerical examples. **10 Hrs**

Unit- II

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

Axial flow compressor: Introduction, Description, Performance analysis. Momentum or filament analysis –Special velocity diagram, Symmetric stage, Non-symmetric axial inflow, Non-symmetric axial out flow, Actual energy transfer. Airfoil analysis - One dimensional ideal incompressible flow, Two dimensional flows with friction. Blading efficiency – Losses in terms of air angles and drag coefficient. Coefficient of performance- flow coefficient, Pressure coefficient, Work coefficient. Blade loading, Cascade characteristic, Blade angles, Reynolds and Mach number effects. Three dimensional flow analysis- Radial equilibrium theory, free vortex blades, Constant reaction blades, Forced vortex or solid rotation blades, the general design. Three dimensional blade losses, Compressor stall and surge, overall performance, Compressor characteristics. Numerical examples **12Hrs**

Unit -III

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

Regenerator: Introduction, Types of regenerator, Heat transfer in direct type exchangers- Exchanger heat transfer effectiveness, Number of exchanger heat transfer units, Capacity ratio, Relation between NTU and Stanton number, Relations between NTU and effectiveness(no derivation), Effect of flow arrangement, Effect of $C_{min}/C_{max}<1$ for regenerator, Log mean rate equation compared to effectiveness –NTU approach. Rotary heat exchanger- Effect of Mateix speed, Effect of longitudinal conduction, Core pressure drop. Some economics approach of heat exchanger design. Numerical examples **10 Hrs**

Unit-IV

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

Unit -V

Performance of Gas turbine power plant: Non dimensional representation of compressor and turbine performance, Performance characteristics of compressor and turbines compressors, Matching of compressor and turbine in a self driving system, Equilibrium running of simple jet and propeller turbine engines, Simple jet unit, nozzle characteristic, Effect of adding a propelling nozzle to the compressor turbine combination, Variation of thrust with forward speed and rpm, Variation of specific fuel consumption with forward speed and rpm, Discussion on the equilibrium running diagram ,Propeller turbine engines(turboprop), Combined turbines.

Environmental consideration: Air pollution, Aircraft emission standards, Stationary engine emission standards, NO_x formation, NO_x reduction in stationary engines, Noise, Noise standards, Noise reduction. **10 Hrs**

Text books

1. P.R. Khajuria.and S. P. Dubey, Gas Turbines and Propulsive System, Dhanpat Rai Publication, 2012, ISBN: 9788189928483
2. V Ganeshan, Gas Turbines MCgraw –Hill Publication, 3rd Edition, 2010, ISBN: 9780070681927

References

1. H. I. H Saravanamutt, GFC Rogers, H Cohen, Gas Turbine Theory, Pearson Education, 5th Edition, 2001, ISBN: 9788178085340
2. S. M. Yahya, Turbines Compressor and Fans, , Tata MCgraw-Hill Publication, 4th Edition , 29 October 2010, ISBN: 9780070707023

Course Outcomes

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

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

Course Title: Vehicle Dynamics			
Course Code: P13AU764	**Semester: VII**	**L:T:P:H -4:0:0:4**	**Credits:4**
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		**Weightage:CIE:50%; SEE:50%**	

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

Course Learning Objectives (CLO's):

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

1. Identify, describe mechanics of pneumatic tiers
   Explain performance of vehicle during acceleration at different road and operating conditions.
2. Describe stability of vehicle when the vehicle is moving on level ground and inclined ground.
3. Explain performance of vehicles during braking at different road and operating conditions.
4. Explain steering geometry, effect of steering geometry on handling characteristics, steady state handling characteristics.
5. Describe cause of vibration in vehicles, different mathematical model for vertical vibration of a vehicle.
6. Explain different aerodynamic forces and movements, various parameters affecting these forces and movements.

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 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. "Theory of Ground Vehicles", by J.Y.Wong, Wiley publications-2004.

References:

1. "Fundamentals of Vehicle Dynamics" by Thomas D. Gillespie, SAE -2008.
2. "Automobile Mechanics" by N.K.Giri, Khanna publications-2011.
3. "Vehicle Dynamics" by Reza N.Jazar, springer publications-2009.

Course Outcome:

After Learning all the units of the Course, the student is able 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 Title: Advanced Engine Testing Lab			
Course Code: P13AUL77	**Semester: VII**	**L:T:P:H -0:0:3:3**	**Credits:1.5**
Contact Period-Lecturer: 36Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

Pre requistes: 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

Course Learning Objectives (CLO):

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

a) ***Conduct*** *performance test on any given engine.*

b) **Calculate** the IHP,FHP, indicated thermal efficiency and mechanical efficiency of an SI engine and CI engines by conducting morse test.

c) **Analyze** the engine performance using alternative fuels.

d) **Explain** the effect of compression ratio on performance of the engine.

e) **Optimize** the performance of the engine by varying the ignition timing

f) ***Diagnose*** *the engine problem using engine analyzer*

Relevance of the course:

Advanced engine testing lab is a course deals with conduct a test on any given engine and analyse the performance of the engine and also analyse 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

- Optimizing the performance of SI engine by varying the ignition timing
- Diagnose the engine using engine analyzer

Text books

1. Dr. N K Giri, automobile mechanics, khanna publishers, eight edition , 2014
2. Dr v Ganeshan , Internal combustion engines, Mc Graw hill, publication , fourth edition 2012
3. Auto lab manuals

Course out comes

a) **Conduct** performance test on any given engine.

b) **Calculate** the IHP, FHP, indicated thermal efficiency and mechanical efficiency of an SI engine and CI engines by conducting morse test.

c) **Analyze** the engine performance using alternative fuels.

d) **Explain** the effect of compression ratio on performance of the engine.
e) **Optimize** the performance of the engine by varying the ignition timing
f) Diagnose the engine problem using engine analyzer

Scheme of evaluation

CIE Scheme

Assessment	Weightage in Marks
TEST 1	25
RECORD & Attendance	25
Total	**50**

SEE Scheme

Semester End Examination (SEE) is a practical examination of three hours duration of 50 marks.

Sl. No.	**Marks allotment**		
1	Procedure **and** Conduction	ONE Question from Chapter 1to 5	20 Marks
		ONE Question Chapter 6 to 11	20 Marks
2	Viva		10 Marks
Total Marks			50 Marks

Course Title: Modeling and Analysis lab			
Course Code: P13AUL78	**Semester: VII**	**L:T:P:H -0:0:3:3**	**Credits:1.5**
Contact Period-Lecturer: 39Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

***Prerequisites*:**

Subject requires student to know about

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

Course Learning Objective (CLO):

This Course aims to,

- **Interpret, Solve** and **Static Analysis** of Bars, Trusses, Beams, Rectangular Plates(L2,L3,L4)
- **Interpret, Solve** and Thermal, Fluid flow **analysis**(L2,L3,L4)
- **Interpret, Solve** and **Dynamic Analysis** of bars and beams(L2,L3,L4)
- **Analyze**, Simulation of Turning and Milling operations (L4)
- **Analyze,** Turning and Milling operations Using CNC part programming (L4)

Relevance of the Course:

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

Course Content

PART-A

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

Study of FEA packages, Modeling, Static and Dynamic analysis

1) STATIC ANALYSIS *Planned Hours: 21* **hrs**

a) Bars subjected to axial loads for Constant cross section, Tapered cross section and stepped bars

b) Trusses – Simple trusses

c) Beams – Cantilever and simply supported beams subjected to point load, UDL, UVL and moments

d) Analysis of Rectangular Plates (with and without holes) subjected to axial and bending loads.

e) Thermal analysis – 2D problems (thermal and heat transfer) with conduction and convection boundary conditions

f) Fluid flow analysis – simple 2D problems Verification of Results of conventional problems

2) DYNAMIC ANALYSIS *Planned Hours: 9* **hrs**

a) Harmonic analysis of bars and beams

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

PART-B

II SIMULATION AND PART PROGRAMMING (simple exercises) *Planned Hours: 9* **hrs**

a. Simulation of Turning and Milling operations (Master cam/ Solid cam/ Edge cam etc.)

b. CNC part programming - Turning and Milling operations (G and M codes)

Course Outcomes (CO):

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

- **Interpret, Solve** and **Static Analysis** of Bars, Trusses, Beams, Rectangular Plates
- **Interpret, Solve** and Thermal, Fluid flow **analysis**
- **Interpret, Solve** and **Dynamic Analysis** of bars and beams
- **Analyze**, Simulation of Turning and Milling operations
- **Analyze,** Turning and Milling operations Using CNC part programming

A. Evaluation Scheme

CIE Scheme

Assessment	Weightage in Marks
TEST 1	20
TEST 2	20
RECORD & Attendance	10
Total	**50**

SEE Scheme

Semester End Examination (SEE) is a practical examination of three hours duration of 50 marks.

Sl. No.	Marks allotment		
1	Procedure **and** Conduction	ONE Question from Part A	25 Marks
		ONE Question from Part B	15 Marks
2	Viva		10 Marks
Total Marks			50 Marks
