APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

# B. Tech. Syllabus

## S7 and S8

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU411 | Engine and Driveline Design | 3-1-0 - 4 | 2016 |

**Prerequisite :** ME316 Principle of machine design

**Course Objectives**

- To study the design aspects of various components of an automobile.
- To know the selection criteria of various standard parts.

**Syllabus**

Design of IC engine components: cylinder, piston, piston rings, connecting rod, crank shaft, fly wheel-. Bearings: Theories of Lubrication- journal bearing, ball and roller bearings Design of Clutches & brakes - Design of gears- design of gear box.

**Expected outcome**.

- The students will be able to design the components of an automobile engine

**Design Data Hand books permitted in the examination:**

1. Mahadevan, Design Data Book, CBS Pub.
2. PSG Tech., Machine Design Data Handbook.

**Text Books:**

1. Sadhu Singh, Machine Design, Khanna Publishers.
2. Sharma S. C. and D. K. Aggarwal, Machine Design, S.K. Kataria and Sons.

**References:**

1. Giri N.K., Automobile Mechanics, Khanna Publishers, New Delhi.
2. Heldt P. M., Automotive Chassis, Chillon Book Co., 1952.
3. Heldt P. M., Torque Converters, Chillon Book Co., 1952.
4. Shigley J. E., Machine Design, McGraw Hill Book Co.
5. Spotts M. F., Design of Machine Elements, Prentice Hall of India.
6. V B Bhandari, Design of machine Elements, McGraw Hill Education (India) Pvt. Ltd.

**Course Plan**

| Module | Contents | Hours | Sem Exam Marks |
|---|---|---|---|
| I | Design of IC engine components: Design of cylinder, Selection of materials for cylinders. Design of piston, piston rings, Materials for connecting rod, connecting rod design, Design of Crank shaft, Design of fly wheel- turning moment diagram, functions of flywheel, fluctuations of energy, Fluctuation of speed, size of the flywheel. | 9 | 15% |
| II | Bearings: Types of lubrication, Classification of bearings, Journal bearings, Mechanisms of film lubrication, Theories of Lubrication, viscosity, bearing modulus, coefficient of friction, Petroff's equation and bearing characteristic number, minimum oil film thickness, heat dissipation of bearings, bearing materials. | 9 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Rolling contact bearings:- ball and roller bearings, types, mechanics of rolling friction, bearing life, static and dynamic load rating, equivalent bearing load, Selection of ball and roller bearings. | 9 | 15% |
| IV | Design of Clutches: Design of single plate, multi plate, centrifugal and cone clutches Energy dissipation in clutches, torque carrying capacity of clutches. Materials for clutch liners, design of clutch components. | 9 | 15% |

| SECOND INTERNAL EXAMINATION | | | |
|---|---|---|---|
| **V** | Design of internal expanding shoe brakes, Design of disc brakes, heat rejected during braking, torque transmitted by leading and trailing shoes during braking, braking force, weight shifted during braking. | 10 | 20% |
| **VI** | Design of gears: Classification of Gears, Nomenclature, Lewis equation and Lewis form factor, working stresses in gear teeth, dynamic load on gear teeth, wear load, Design of spur gear, helical gear, bevel gear and worm gear, AGMA standards. Analysis of forces on spur, helical, bevel and worm gears<br>Design of Gear box: Structure and ray diagram (up to 6 speeds). | 10 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**
3 questions uniformly covering modules I and II. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part B**
3 questions uniformly covering modules III and IV. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part C**
3 questions uniformly covering modules V and VI. Each question carries 20 marks
Students will have to answer any two questions out of 3 (2X20 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P –Credits | Year of Introduction |
|---|---|---|---|
| AU403 | VEHICLE DYNAMICS | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To familiarize the students with vibrating systems
- To understand the characteristics of the tires.
- To know about the stability and handling characteristics of vehicles at different tracks.

**Syllabus**

Stability of vehicles-Braking requirements-Road Loads-Over steer, under steer, steady state cornering-Suspension-Tires-Performance of road vehicles-Classification of vibration-aerodynamic forces

**Expected outcome**.

- The students will be able to solve simple design problems based on the vehicle stability and various design parameter based problems.

**Text Book:**

1. Giri N.K, Automobile Mechanics, 8/e, Khanna Publishers
2. Rao V. Dukkipati, Jian Pang, "Road Vehicle Dynamics problems and solution", SAE, 2010

**References**

1. David Corolla, 'Automotive Engineering', 'Powertrain, chassis system and Vehicle Body', Butterworth Heinmann, 2009
2. G. Giles, 'Steering, Suspension and Tires, Illiffe Books Ltd., 1968.
3. J. Y. Wong, 'Theory of Ground Vehicles', John Wiley and Sons Inc., New York
4. JazarR N, Vehicle Dynamics, Springer Verlag, New York, 2014
5. W. Steeds, Mechanics of road vehicles, Wildlife book Ltd, London 1990.

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Classification of vibration, Specification and Vibration, Vibration System and human comforts, Modal Analysis, One DOF, Two DOF, Free and Forced Vibration, Damped Vibration, Magnification and Transmissibility, Vibration Absorber. Performance of road vehicles: Tractive resistance, tractive effort, power required for propulsion, grade ability, drawbar pull and the problems related to these terms. Road performance curves- acceleration, gradability and drawbar pull, acceleration time and Elasticity. | 7 | 15% |
| II | Tires: tire dynamics Ride characteristics, Behavior while Cornering, Slip angle, Cornering force, Power consumed by Tire, Oversteer, under steer, steady state cornering, aligning moment-combined braking and Cornering, effect of camber & transient effects in cornering. Tire vibrations | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Suspension: Vehicle dynamics and suspension | 7 | 15% |

| | | | |
|---|---|---|---|
| | requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system, Roll axis and the vehicle under the action of side forces. | | |
| **IV** | Stability of vehicles: Load distribution (Three wheeled and four wheeled vehicles), Calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road. Gyroscopic effects, weight transfer during acceleration, Cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles. Braking requirements, stopping distance, braking efficiency, work done in braking, tire adhesion. | 7 | 20% |
| **VI** | Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**
3 questions uniformly covering modules I and II. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part B**
3 questions uniformly covering modules III and IV. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part C**
3 questions uniformly covering modules V and VI. Each question carries 20 marks
Students will have to answer any two questions out of 3 (2X20 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU413 | Automotive Mechatronics | 3-0-0 - 3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To study about fundamentals of Mechatronics.
- To know about the implementation of Mechatronics in automobiles.
- To familiarize various sensors, microprocessor control systems and Engine management system.

**Syllabus**

Sensors – Encoders - Resolvers and synchros - Piezoelectric sensors. - Acoustic Emission sensors - vibration sensors – Actuators - Micro Electro Mechanical Systems (MEMS) - Application of sensors in Automobiles - Fundamentals of Automotive Electronics and Microprocessor control system - Engine Management systems

**Expected outcome**.

The students will be

i. able to understand the fundamentals of Mechatronics and its implementation in automobile

ii. familiar with the various Microprocessor control systems and engine management systems used in automobiles.

**Text Books:**


1. Denton. (2004) Automotive Electrical and Electronic Systems, Burlington, MA01803, Elsevier Butterworth-Heinemann.
2. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi, 2008.
4. Robert Bosch "Diesel Engine Management" SAE Publications, 2006.
5. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.
6. Ronald K. Jurgen , Electronic Engine Control Technologies, 2nd Edition- -SAE International


**References:**


1. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmer Publishers.
2. Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Limited, New Delhi, 2007.
3. Bosch Hand Book, 3rd Edition, SAE, 1993.
4. David G. Aldatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill Inc., USA, 2003.
5. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
6. Ljubo Vlacic, Michel Parent & Furnio Harshima, —Intelligent Vehicle Technologies: Theory and Applications‖, Butterworth-Heinemann publications, 2001
7. Robert Bosch GmbH , Automotive Electrics & Electronics, , 5/e, Springer Verlag
8. Ronald K. Jurgen. (1999) Automotive Electronics Handbook, McGraw-Hill Inc.,
9. Tom Denton, Automotive Electronics, SAE
10. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS, John Wiley & Sons, 2006:
11. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **Sem. Exam Marks** |
| **I** | Introduction to Mechatronics: Sensors - Characteristics - Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors. Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. | 7 | 15% |
| **II** | Actuators: Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, process control valves. Rotary actuators. Development of simple hydraulic and pneumatic circuits using standard Symbols. Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope. | 7 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Application of sensors in Automobiles: Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors. | 7 | 15% |
| **IV** | Fundamentals of Automotive Electronics and Microprocessor control system: Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI enignes and in the other parts of the automobile. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Engine Management system I : Three way catalytic converter, conversion effciency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control. | 8 | 20% |
| **VI** | Engine Management system II: Electronic ignition systems and spark timing control. Closed loop control of knock. Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves | 8 | 20% |
| **END SEMESTER EXAM** | | | |

## Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU407 | ADVANCED IC ENGINES | 3-0-0-3 | 2016 |

**Prerequisite: NIL**

**Course Objectives**

- To impart the basic concepts of non-conventional IC Engines
- To know the new concepts of automotive engine combustion technologies
- To discuss about future engine technologies

**Syllabus**

Types of engines -Dual fuel engine concepts and significance-Multi fuel engines-Lean burn engines - Gas turbine plants -Stratified charge combustion in direct injection SI engines -HCCI and CAI engines

**Expected outcome**.

- The students will become aware of the latest developments and advancement in the field of IC engines.

**Text Books:**

1. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume 1- gasoline and gas engines, Wood head publishing, 2009
2. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume 2- diesel engines, Wood head publishing, 2009

**Reference books**

3. H Zhao , HCCI and CAI Engines for the Automotive Industry ,Woodhead publishing
4. Derek Dunn -Rankin, Lean Combustion: Technology and Control , Academic press, 2007
5. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, Dhanpat Rai Publications
6. V Ganesan, *Internal Combustion Engine* Tata Mc Graw Hill Publishing Company Ltd., New Delhi 2006.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Types of engines - Wankel engine - Stirling engine - free piston engine. – light duty DI diesel engines (HSDI), high pressure pump technology, multiple injection diesel combustion | 7 | 15% |
| II | Dual fuel engine concepts and significance, factors affecting combustion in dual fuel engines, performance of dual fuel engines. Multi fuel engines, characteristics of multi fuel engines, performance of multi fuel engines. Concept and working of flexi fuel vehicles (FFV). | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Lean burn engines – fundamentals of lean combustion – burning in flames – auto ignitive burning – flame stabilization – lean burn SI engines – engine combustion and emissions – lean limit operations | 8 | 20% |
| IV | Gas turbine plants – Open and closed cycles – thermodynamic cycles – regeneration – re heating – inter cooling – efficiency and performance of gas turbines – Gas turbine as automotive engine – | 6 | 10% |

| | | | |
|---|---|---|---|
| | Limitations of gas turbine in automotive sector. Comparison of gas turbine Vs. I.C engine. Condition for perfect reheating and inter cooling. simple problems | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Stratified charge combustion in direct injection SI engines – thermodynamic and combustion process – production engines with stratification – future trends – Turbo charged direct injection SI engines – problems and challenges – advantages – future trends<br>Direct injection gasoline engines with auto ignition combustion – principles and approaches – operation and control – development of practical engines – future trends. Direct injection natural gas engines – technologies – potential applications – strength and weakness – future trends | 7 | 20% |
| **VI** | HCCI and CAI engines – fundamentals – effect of use of exhaust gas dilution – approaches to CAI/HCCI – Two stroke CAI engines – principles – control – potential applications – four stroke gasoline and diesel HCCI engines – HCCI fuel requirements – low temperature and premixed combustion with late injection – NADI concept of HCCI –CAI control and CAI/SI switching | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU415 | Automotive Pollution & Control | 3-0-0 - 3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge on automotive pollution control.
- To know about formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI
- To introduce measurement standards, instruments for pollution measurement and emission standards

**Syllabus**

Automotive Pollutants- Engine Combustion and Pollutant Formation - Test procedures – Test cycles – NDIR Emission Standards - Mandatory Tests for Emission measurement- Emission Control Efforts - Test Procedure & Instrumentation for Emission Measurement - Measurements of visible emissions – Comparison methods & Obscure methods

**Expected outcome**.

The students will

i. get knowledge on automotive pollution formation and control techniques
ii. be able to know about the measurement standards, measuring instruments and emission standards

**Text Books:**

1. Amitosh De, "Automobile Engineering", Galgotia Publications Pvt. Ltd., 2004
2. B.P. Pundir, "Engine Emissions", Narosa Publishing House, 2010.
3. Heywood. J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1995
4. K.K. Ramalingam, "Automobile Engineering", Scitech Publications Pvt. Ltd., 2005
5. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill Co., 2004.

**References:**

1. Automobiles and Pollution SAE Transaction, 1995
2. Obert,E.F., "Internal Combustion Engines", Intext Educational Publishers, 1973.
3. SAE Transactions, "Vehicle Emission", 3 volumes, 1982.
4. Taylor,C.F., "Internal Combustion Engines", MIT Press, 1972.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction: General Scenario on automotive Pollution, Pollutants-sources-formation-effects on human beings and environment, Green house gases and global warming, , Engine Combustion and Pollutant Formation: HC, CO, NOx, Particulate Matters, Aldehyde emissions, Vehicle population assessment in metropolitan cities and contribution to pollution | 7 | 15% |
| II | Emissions in SI Engines: Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke formation in SI Engines- effect of operating variables on emission formation. | 7 | 15% |
| FIRST INTERNAL EXAMINATION | | | |

| | | | |
|---|---|---|---|
| **III** | Emissions in CI Engines - Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines | 7 | 15% |
| **IV** | Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle – FTP Test cycle - NDIR<br>Emission Standards : Driving Cycles, ECE, EUDC, Bharat Stages & Euro emission standards, Evaluation of Emission Standards – Mandatory Tests for Emission measurement | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Emission Control Efforts, Design changes, optimization of operating factors, Fuel modification, Control of Crankcase emission, Evaporative emission, SCR –Canisters, Fumigation – Particulate Trap – CCS, Exhaust emission - exhaust gas recirculation, air injector PCV system, thermal reactors, catalytic converters | 8 | 20% |
| **VI** | Test Procedure & Instrumentation for Emission Measurement: Measurements of invisible emissions -ORSAT apparatus, NDIR analyzer, Flame ionization detectors, Chemiluminescent analyzer, Gas analyzer, Gas Chromatograph. Measurements of visible emissions – Comparison methods & Obscure methods - Smoke meters, | 8 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU469 | Earth Moving Equipment | 3-0-0 - 3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart the working and operational features of various Earth moving equipments.

**Syllabus**

Power plants for earth moving equipment - Performance characteristics - Land Clearing Machines - Earth Moving Machines - Power and capacity of earth moving machines - Scrapers and Graders - Shovels and Ditchers - Construction & Industrial Equipment

**Expected outcome**.

- The students will get an idea of types, features, working principle and applications of various earth moving machines

**Text Books:**

1. Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGraw Hill Publishing company Ltd.
2. Herbert L. Nichols and David Day , Moving The Earth: The Workbook of Excavation , Sixth Edition, McGraw Hill Book Co..
3. Nakra C.P., "Farm machines and equipments" Dhanpat Rai Publishing company Pvt. Ltd.
4. Abrosimov.K. Bran berg.A and Katayer.K., "Road making machinery", MIR Publishers, Moscow, 1971.

**References:**

1. SAE Handbook Vol. III., Society of Automotive Engineers, 1997
2. Wong.J.T., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.
3. Satyanarayana. B., "Construction planning and equipment", Standard publishers and distributors, New Delhi, 1985.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction: Power plants, chassis and transmission, Multiaxle vehicles. Heavy duty petrol engines and high speed diesel engines, air cooled and water cooled engines and air filters as in off highway vehicles. | 7 | 15% |
| II | Performance characteristics of vehicles, resistance to digging and motion. Land Clearing Machines: Construction and working of Bush cutter, stampers, | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Earth Moving Machines:. Crawler track, running and steering gears, scrapers, drag and self powered types - Dump trucks and dumpers | 7 | 15% |
| IV | Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines, | 7 | 15% |
| | **SECOND INTERNAL EXAMINATION** | | |

| | | | |
|---|---|---|---|
| **V** | Shovels and Ditchers: Power shovel, revolving and stripper shovels – drag lines - ditchers - Capacity of shovels. Tree dozer, Rippers | 7 | 20% |
| **VI** | Construction & Industrial Equipments: Construction and operational aspects of mobile cranes, road rollers, elevators / Man lifters, Fork Lifters. Bulldozers, cable and hydraulic dozers | 7 | 20% |
| **END SEMESTER EXAM** | | | |



**Question Paper Pattern**

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| **451 | Seminar and Project Preliminary | 0-1-4-2 | 2016 |
| Prerequisite : Nil | | | |

**Course Objectives**

- To develop skills in doing literature survey, technical presentation and report preparation.
- To enable project identification and execution of preliminary works on final semester project

**Course Plan**

**Seminar:** Each student shall identify a topic of current relevance in his/her branch of engineering, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare own report and present in the class.

**Project preliminary:**

Identify suitable project relevant to the branch of study. Form project team ( not exceeding four students). The students can do the project individually also. Identify a project supervisor. Present the project proposal before the assessment board (excluding the external expert) and get it approved by the board.

The preliminary work to be completed: (1) Literature survey (2) Formulation of objectives (3) Formulation of hypothesis/design/methodology (4) Formulation of work plan (5) Seeking funds (6) Preparation of preliminary report

***Note:*** The same project should be continued in the eighth semester by the same project team.

**Expected outcome**.

The students will be able to

i. Analyse a current topic of professional interest and present it before an audience
ii. Identify an engineering problem, analyse it and propose a work plan to solve it.

**Evaluation**

Seminar : **50 marks**

(Distribution of marks for the seminar is as follows: i. Presentation : 40% ii. Ability to answer questions : 30% & iii. Report : 30%)

Project preliminary : **50 marks**( Progress evaluation by the supervisor : 40% and progress evaluation by the assessment board excluding external expert : 60%. Two progress evaluations, mid semester and end semester, are mandatory.)

*Note:* All evaluations are mandatory for course completion and for awarding the final grade.

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| **AU433** | **Automotive Mechatronics Lab** | **0-0-3- 1** | **2016** |

**Prerequisite :** AU413 Automotive mechatronics

**Course Objectives**

- To understand the working of sensors and electronic components in an automobile
- To know how to control them using PLC / microcontrollers and software

**List of exercises/experiments:** (Minimum 12 are mandatory)

1. Design and execution of pick and place
2. Design and execution of water level control
3. Design and execution of air pressure control
4. Study of characteristics of P-I controller
5. Comparison of the characteristics of RTD and thermocouple
6. Stepper motor interfacing with microcontroller (i) full step resolution (ii) half step resolution
7. Computerised data logging system with control for process variables like pressure and temperature
8. Design and execution of seven segment display module
9. Simulation of basic hydraulic, pneumatic and electric circuits using software
10. Circuits with multiple cylinder sequences in electro pneumatic system
11. Direct operation of double acting cylinder
12. Designing a circuit for speed control of double acting cylinder meter by employing 4/2 dc solenoid valve
13. Design of a simple pneumatic direct control circuit to open and close the gate of a factory by operating a push button valve
14. PLC-Simple ladder programming using PLC trainer kit
15. Arduino programming

**Expected outcome** .

- At the end of the program the students will be familiar with the implementation of the knowledge of Mechatronics in automobile field.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU406 | Modern Automotive Technology | 3-0-0- 3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To broaden the understanding of vehicle aerodynamics
- To familiarize the application of computational fluid dynamics in aerodynamics study
- To introduce the use of wind tunnels in testing the vehicles.

**Syllabus**

Vehicle aerodynamics - Introduction and scope - Aerodynamic drag of cars- flow field around car - strategies for aerodynamic development - low drag profiles - shape optimization of cars Wind tunnels - introduction -simulation - measurement techniques - road testing methods. Application of CFD – Boundary layer methods – Numerical modelling of fluid flow around vehicle body - dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

**Expected outcome**.

- The students will be able to appreciate the use of wind tunnels, the different testing techniques and CFD for aerodynamic design of vehicle.

**Text Books:**

1. Hucho.W.H., " Aerodynamic of Road vehicles ", Butterworths Co. Ltd., 1997.
2. Pope. A., " Wind Tunnel Testing ", John Wiley & Sons, 2nd Edn, New York, 1974.
3. R.McCallen, Browand, Ross, "The Aerodynamics of Heavy Vehicles", Springer, 2004
4. W.H. Hucho, 'Aerodynamics of Road Vehicles', SAE Publications, 4th edition 1998.

**References:**

1. Automotive Aerodynamic : Update SP-706, SAE, 1987.
2. Smits, Lim, "Flow Visualization: Techniques and Examples", 2nd Edition,
3. Vehicle Aerodynamic, SP-1145, SAE, 1996
4. Yomi Obidi, 'Theory and Applications of Aerodynamics for Ground Vehicles', SAE Publications, 2014

**Course Plan**

| Module | Contents | Hours | End Sem. Exam. Marks |
|---|---|---|---|
| I | uction scope - historical development trends - fundamental of fluid mechanics - flow phenomenon related to vehicles -external & internal flow problem - resistance to vehicle motion - performance – fuel consumption and performance – potential of vehicle aerodynamics., engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine. | 7 | 15% |
| II | Aerodynamic drag of cars- cars as a bluff body - flow field around car - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - startegies for aerodynamic development - low drag profiles. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Shape optimization of cars front end modification - front and rear wind shield angle - boat tailing - hatch back, fast back and square back -dust flow patterns at the rear - effects of gap configuration - effect of fasteners. | 7 | 15% |

| | | | |
|---|---|---|---|
| **IV** | Wind tunnels for automotive aerodynamic introduction - principle of wind tunnel technology - limitation of simulation - stress with scale models – full scale wind tunnels - measurement techniques - equipment and transducers - road testing methods – numerical | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Application of CFD: Methods to solve Navier–Stokes equation – Forces acting in a fluid element –Compressibility effects in a flow field – Inviscid flow – Governing equations – Irrotation flow field and consequences – Potential flows – Boundary layer methods – Numerical modelling of fluid flow around vehicle body. | 8 | 20% |
| **VI** | Vehicle handling the origin of forces and moments on a vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments - characteristics of forces and moments - dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles. | 8 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU410 | Vehicle Transport and Fleet Management | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To give the basic idea on the vehicle transport system and the control of fleet.
- To get basic idea to implement effective and efficient transport system.

**Syllabus**

Mass transport system - Bus depot organisation structure -Route planning and Scheduling: Vehicle maintenance, supply management and budget - Fleet Management, Data Processing and Fare Structure - Motor vehicle act

**Expected outcome.**

Upon completion of the course, students will

- Be able to understand the structure of management system in the transportation.
- Get the basic knowledge about the various motor vehicle regulations and acts.

**Text Books:**

1. Kadiyali.L.R., " Traffic engineering and Transport Planning ".
2. John Dolu, "Fleet management ", McGraw-Hill Co., 1984.

**References:**

1. Goverment Publication, "The Motor vehicle Act ", 1989.
2. Kitchin.L.D., " Bus operation ", llliffe and Sons Ltd., London, III Edition, 1992.
3. Rev. W. Faulks -Road and Coach Operation

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction to Mass transport system - Modes of transport, types of transport- Organization and management- Forms of ownership, principle of transport, management, internal organization, centralized & decentralized . Transport organization structure, operations, General set up, transport industry, government / (STU) State Government Undertakings and private Bus transport organizations. | 7 | 15% |
| II | Bus depot organisation structure. Truck fleet operator's organization. Economics of Road Transport: Theory of fares and cost of services, fare charging, costing and statistics of operating cost - Driver checklist - Lists for driver and mechanic - Trip leasing. Vehicle schedule, booking and reservation, statistical records and shipment centre, recording of goods transport. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Route planning and Scheduling: Sources of traffic, town planning, turning points, stopping places, survey of rout, factors affecting frequency, direction of traffic flow, estimated traffic possibility. time table layout, use of flat graph method, preparation of vehicle and crew schedules, duty roaster, use of vehicle running numbers, determination of vehicle efficiency, checking efficiency of crew, duty arrangements, duty of drivers and conductors. | 7 | 15% |

| | | | |
|---|---|---|---|
| **IV** | Vehicle maintenance, supply management and budget: Scheduled and unscheduled maintenance - Planning and scope - Evaluation of PMI programme – Work scheduling - Overtime - Breakdown analysis - Control of repair backlogs - Cost of options. Cost of inventory - Balancing inventory cost against downtime - Parts control - Bin tag systems – Time management - Time record keeping - Budget activity - Capital expenditures - Classification of vehicle expenses. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Fleet Management, Data Processing And Fare Structure : Fleet management and data processing - Data processing systems - Software Model – Computer controlling of fleet activity - Energy management, Basis of fares, effect of competition and control, calculating average charge, zone systems, straight and tapered scales fare structure - Methods of fare collection - Preparation of fare table. | 8 | 20% |
| **VI** | Motor vehicle act: Importance of motor vehicle act, Schedules and sections - Registration of motor vehicles - Licensing of drivers - Control of permits - Limits of speed - traffic signs - Constructional regulations - types of driving licenses, procedure for obtaining driving license, registration of vehicle, types of permits, procedure for obtaining permits, third party insurance,Insurance & Finance Classes/types of insurance. Pollution Under control certification agency, Authority & procedure for PUC certification agency. | 8 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU474 | Electric and Hybrid Vehicles | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart basic knowledge about components and working of electric and hybrid vehicles.
- To understand the fundamental concepts, principles and analysis of hybrid and electric vehicles.

**Syllabus**

Hybrid and Electric Vehicles - Energy regeneration in Electric and hybrid vehicles - Electric vehicles control system - Braking system in Hybrid and electric vehicles- Performance of electric vehicles- Testing of electric vehicles- Basic concept of electric traction, introduction to various electric drive- Introduction to electric components used in electric vehicles -Principles of Hybrid Electric Drive train - Energy Management Strategies in hybrid and electric vehicles- Energy Storage

**Expected outcome.**

The students will be able to understand the various systems in electric and hybrid vehicles.

**Text Books:**


1. Basu .S, *"Recent Trends in Fuel cell Science and Technology"*, Anamaya Publishers, New Delhi.,2007.
2. Electric and hybrid electric vehicles and fuel cell technology, SAE
3. Viswanathan, B. and Aulice Scibioh, M., *"Fuel Cells Principles and Applications"*, Universities Press (India) Pvt. Ltd., Hyderabad, 2006.


**References:**


1. Ali Emadi, Mehrdad Ehsani, John M. Muller, "*Vehicular Electric Power Systems"*, Marcel Dekker, Inc., 2004.
2. Chris Mi, M A Masrur, D W Gao, " *Hybrid Electric Vehicles – Principles and applications with practical perspectives*," Wiley, 2011.
3. Iqbal Husain, "*Electric and Hybrid Vehicles: Design Fundamentals"*, CRC Press, 2003
4. Larminie, J. and Dicks, A., "*Fuel Cell Systems Explained"* John Wiley & Sons, Ltd., New York, 2001.


Course Plan

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction to Hybrid and Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. | 7 | 15% |
| II | Energy regeneration in Electric and hybrid vehicles. Methods of regeneration. Flywheel based energy storage. Hybridization of different energy storage devices. Electric vehicles control system. Braking system in Hybrid and electric vehicles. Performance of electric vehicles- acceleration, coasting, moving up and down a hill. | 7 | 15% |

| | | | |
|---|---|---|---|
| | Testing of electric vehicles. Various strategies for improving vehicle energy/fuel efficiency | | |
| FIRST INTERNAL EXAMINATION | | | |
| III | Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Introduction to electric components used in electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. Electric Heavy Duty Vehicles, Fuel cell Heavy duty vehicles. | 7 | 15% |
| IV | Principles of Hybrid Electric Drive trains, Architectures – Electrical distribution, Hybrid control Strategies – Parallel Hybrid, Series Hybrid - Lightly Hybridized vehicles, Low –Voltage Storage System, Low –Voltage main system with High voltage bus for propulsion. Heavy Vehicles Hybrid. Sizing the drive system. | 7 | 15% |
| SECOND INTERNAL EXAMINATION | | | |
| V | Energy Management Strategies in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Matching the electric machine and the internal combustion engine, Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems. | 7 | 20% |
| VI | Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage - Characteristics analysis, Structures, Operations and properties of Fuel cells – Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, and Molten Carbonate Fuel Cell. | 7 | 20% |
| END SEMESTER EXAM | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course Code | Course Name | L-T-P | Credits | Year of Introduction |
|---|---|---|---|---|
| BT362 | Sustainable Energy Processes | 3-0-0 | 3 | 2016 |

**Prerequisite: Nil**

**Course Objectives**

- To introduce the current and potential future energy systems, covering resources, extraction, conversion, and applications, with emphasis on meeting regional and global energy needs in a sustainable manner.

**Syllabus**

Classification of energy, extraction, conversion, and applications of solar energy, wind energy, ocean energy, biomass energy, fuel cells and hydro-dynamic systems, merits and demerits of various energy systems, energy storage.

**Expected outcome**

Students who successfully complete this course should be able to

i. Identify global and Indian energy sources.
ii. Explain capture, conversion and application of solar and wind energy.
iii. Explain conversion of biomass to energy.
iv. Explain the capture of energy from oceans.
v. Explain fuel cells and energy storage routes.

**Reference Books**


1. Bansal N K, Kleemann M, Michael Meliss, *Renewable Energy Sources & Conversion Technology*, Tata McGraw Hill publishing Company, New Delhi, 1990.
2. Boyle, Godfrey, *Renewable Energy*, 3/e, Oxford University Press, 2012.
3. S P Sukhatme, *Solar Energy - Principles of Thermal Collection and Storage*, 2/e, Tata McGraw- Hill Publishing company, New Delhi,1996.
4. Pramod Jain, *Wind Energy Engineering*, McGraw Hill, 2011.
5. Donald L Klass, *Biomass for Renewable Energy, Fuels and Chemicals*, Academic Press, 1998.


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | **General classification of energy**. Conventional and non-conventional. Renewable and non-renewable. Global and Indian energy sources. Global and Indian energy consumption. Problems of fossil fuels. Environmental aspects of energy utilization. Energy and sustainable development. Energy planning. Renewable energy sources, potentials, achievements and applications. | 7 | 15% |
| II | **Solar energy**. Solar radiation. Solar thermal systems. Flat plate and concentrating collectors. Solar desalination. Solar pond. Solar cookers. Solar dryers. Solar thermal electric power plant. Solar photovoltaic conversion. Semiconductor and thin film technology. Solar cells. Solar photovoltaic power generation. Hybrid systems. Merits and limitations of solar energy. | 7 | 15% |
| **FIRST INTERNAL EXAM** | | | |

| | | | |
|---|---|---|---|
| III | **Wind energy**. Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy. | 7 | 15% |
| IV | **Biomass energy**. Biomass resources, Biomass conversion technologies-direct combustion, pyrolysis, biomass gasification. Biogas production. Biomethanation as an aid to environment improvement. Bioethanol, biodiesel and biobutanol production. Hydrogen as fuel. Biohydrogen production. Storage of hydrogen. | 7 | 15% |
| **SECOND INTERNAL EXAM** | | | |
| V | **Energy from the oceans**. Ocean thermal electric conversion. Tidal energy conversion. Geothermal energy conversion. Hydro power-global and Indian scenario. Positive and negative attributes of hydropower. Electricity from hydropower. Small hydropower. | 7 | 20% |
| VI | **Fuel cells.** Alkaline fuel cells. Phosphoric acid fuel cell. Molten carbonate fuel cell. Solid oxide fuel cell, Solid polymer electrolyte fuel cell. Magneto-hydrodynamic systems. Electric vehicles. Energy storage routes like thermal, chemical, mechanical, electrical storage. Batteries. | 7 | 20% |
| **END SEMESTER EXAMINATION** | | | |

**QUESTION PAPER PATTERN:**

Maximum Marks: 100 Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.

| Course code | Course Name | Credits | Year of Introduction |
|---|---|---|---|
| **492 | PROJECT | 6 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

**Course Plan**

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
Review and finalization of the approach to the problem relating to the assigned topic
Preparing a detailed action plan for conducting the investigation, including team work
Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
Final development of product/process, testing, results, conclusions and future directions
Preparing a paper for Conference presentation/Publication in Journals, if possible
Preparing a report in the standard format for being evaluated by the dept. assessment board
Final project presentation and viva voce by the assessment board including external expert

**Expected outcome**

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
iv. Apply knowledge gained in solving real life engineering problems

**Evaluation**

**Maximum Marks : 100**

| | |
|---|---|
| (i) Two progress assessments | 20% by the faculty supervisor(s) |
| (ii) Final project report | 30% by the assessment board |
| (iii) Project presentation and viva voce | 50% by the assessment board |

*Note:* All the three evaluations are mandatory for course completion and for awarding the final grade.