# Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

## Branch- Common to All Discipline

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| **ES301** | **Energy & Environmental Engineering** | **3L-1T-0P** | **4 Credits** |

The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.*

***Module 1: Introduction to Energy Science:***

- Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment; Overview of energy systems, sources, transformations, efficiency, and storage; Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

***Module2*: Ecosystems**

- Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a.)Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

***Module 3*: Biodiversity and its conservation**

- Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

***Module 4:* Environmental Pollution**

- Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides.

***Module 5:*** **Social Issues and the Environment**

- From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns. Case Studies
  Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

***Module 6: Field work***

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

**References:**


1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai,
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)
6. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.
7. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**Electric Vehicles, IV Semester**

**EV402- Internal Combustion Engines**

**Course Objectives:**

After studying this course, students will be able to learn.

- S.I. and C.I. engines of two and four stroke cycles, real cycle analysis.
- Combustion process in SI engines
- Combustion process in CI engines,
- . Classification of IC Engine fuels, its desirable characteristics, fuel rating and alternative fuels available.
- Supercharging & Turbo charging

**Unit 1: Introduction of IC Engine:** Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines .

**Unit 2: Combustion in SI engines:** Flame development and propagation, Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects, abnormal Combustion, effect of engine and fuel variables on abnormal combustion, pre-ignition, its causes and remedy, salient features of various type combustion chambers.

**Unit 3: Combustion in CI Engines:** Various stages of combustion in CI Engines, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers.Fuel injection in CI engine, Working Principle of fuel pump & fuel injectors, types of nozzles. Fuel injection in SI engine (MPFI, TBI,CRDI ), Theory of carburetion, Solex Carburetor, simple problems on carburetion. Fuel metering in CI engines

**Unit 4: Fuel:** Classification of IC Engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen,

LPG, CNG, Biogas etc.), Air requirement, Analysis of combustion products, HHV and LHV of fuels.

**Unit 5: Supercharging & Turbo charging**: Methods of supercharging, & turbo charging Effects of super charging and turbo charging. Engine Modifications for supercharging, supercharging of two stroke engines. microprocessor controlled supercharging. Cooling & lubrication of SI & CI Engines.

**References:**


1. J.B. Heywood. Internal combustion Engines, Wiley

2. Ganeshan V; Internal Combustion engines; TMH

3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai

4. R Yadav, Internal Combustion Engines

5 Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson

6. DomKundwar; Internal Combustion Engines;Dhanpat Rai Publications

7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press

8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave Mc Millan)


**List of Experiments (please expand it);**

1. Determination of Valve timing diagram

2. Load test on Petrol Engine

3. Heat Balance of SI engine

4. Heat Balance of CI Engine

5. Study of Battery Ignition system and Electronic Ignition System

6. Study of Diesel fuel pump

7. Study of Diesel fuel injectors

8. Study of Carburetors

9. Study of Fuel Injection system in SI Engine

10. Study of lubricating system in CI Engine

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**Electric Vehicles, IV Semester**

**EV403- Automobile Engineering**

**Course Objectives:** After studying this course, students will be able to learn.

- The anatomy of the automobile in general
- The location and importance of each part of automobile
- The functioning of the engine and its accessories, gear box, clutch, brakes, steering,
- Axles and wheels, suspension, frame, springs and other connections.
- Effect of automobile emissions on environment and how to control pollution.

**Course Contents**:

**Unit-I: Chassis & Body Engg:**

Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

**Unit-II: Steering System:** front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, conditionfor true rolling motion, centre point steering, directional stability of vehicles, steering gear, powersteering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

**Unit-III: Transmission System:** Function and types of clutches, single plate, multi-plate clutch, roller &spring clutch, clutch lining and bonding, double declutching, types of gear boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.

**Unit-IV: Suspension system** : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energisation, air-bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and materialproperties of tyres& tubes.

**Unit-V: Electrical and Control Systems:** Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers, importance of maintenance, scheduled and scheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

**Unit-VI:Emission standards and pollution control:** Indian standards for automotive vehicles Bharat I, II, III, IV, Euro I to Euro VI norms, fuel quality standards, environmental management systems forautomotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine, efficiency and emission control.

**List of Experiments (Suggested)**

1**.** Study of an Automobile Chassis

2.Study of Differential Mechanism of an Automobile

3.Study of Multiple Clutch of an Automobile

4.Study of Braking System (Hydraulic / Air Brake)

5.Study and Demonstration of different circuit of carburetor

6. Checking the spark plug and setting the port and check the ignition in the spark plug

7.Calibration of Bourdon’s tube Pressure Gauge

8.Study the Electrical System of an Automobile

9.Study the assembly of Car Engine 10) Air Pollution testing of CO2,CO,HC,NOX

**References:**

1. Crouse , Automotive Mechanics TMH.

2. Srinivasan S; Automotive engines; TMH

3. Gupta HN; Internal Combustion Engines; PHI;

4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.

5. Kripal Singh, Automotive Engineering Khanna Pub.

6. Newton &Steeds , Automotive Engineering

7. Emission standards from BIS and Euro –I to Euro-VI

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**Electric Vehicles, IV Semester**

**EV404- Machine Drawing & Design**

**Course Objectives:**

To enable the students to prepare a detailed assembly drawing for machine components.

Course Outcomes : After studying this course,students will be able,

1. To understand Indian standards for machine drawing.

2. To understand Fits and Tolerances in technical drawing.

3. To prepare assembly drawing of joints, couplings and machine elements.

4. To know the basics of design of any components

5. To design and prepare knuckle joint, cotter joints and riveted joints.

**Module 1. Drawing conventions**: IS codes, sectional views and sectioning, surface finish and tolerances representation of machine parts such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears, Rivet heads and Riveted joints, Welded joints.

**Module 2. Assembly Machine Drawing** : Basic concept of assembly drawing ,bill of materials, Assembly drawing of Cotter and Knuckle joints, pedestal and footstep bearings.

**Module 3. Assembly Drawing of Engine parts:** crosshead and stuffing box, IC engines parts - piston and connecting rods; lathe machine parts; Tool post and Tail Stock.

**Module 4.Fundamentals of Machine Design:** Concept of Design, Product Life Cycle, basic design considerations and guidelines, Design essentials, Concept of Factor of safety, Safe or working stress, Flowchart representing the Design Process for Machine Design, Basic design equation for component subjected to static loads, variable loads, Design equations for combined static and dynamic Loading.

**Module 5 Design of Joints**: Knuckle joint, Cotter Joints (Socket and Spigot, Sleeve and Cotter, Gib and Cotter, ) Design of Riveted Joints, Circumferential and Longitudinal Joints, Design of Welded joint. **REFERENCES:**

1. Bhatt, ND; Machine Drawing; Charotar Publication

2. Dwivedi K.K. Pandey M ,Machine Drawing and Design, Dhanpat Rai & Co. Delhi

3. K C John ,Machine Drawing , PHI

4. Singh A; Machine Drawing; TMH publication

5. Narayana and Reddy; Machine Drawing; New age, Delhi.

6. Shigley JE et al; Mechanical Engineering Design, TMH

7. Khurmi R.S. Machine Design, S Chand

8. Sharma and Agrawal ,Machine Design

**Suggested List of Experiments**:

1. Draw assembly drawing of Knuckle joint.

2. Draw Assembly drawing of Cotter joint (Socket and Spigot, Sleeve and Cotter, Gib and Cotter).

3. Draw assembly drawing of Plummer block.

4. Draw assembly drawing of Foot step Bearing.

5. Draw assembly drawing of Cross head.

6. Draw assembly drawing of stuffing box.

7. Draw assembly drawing of piston.

8. Draw assembly drawing of connecting rod.

9. Draw assembly drawing of Tailstock.

10. Draw assembly drawing of Tool post.

11. Design a knuckle joint subjected to axial load.

12. Design a cotter joint (Socket and Spigot, Sleeve and Cotter, Gib and Cotter)

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**Electric Vehicles, IV Semester**

**EV405 - Materials Engineering and Solid Mechanics**

**Course Objectives:**

1. To understand the basics of solidification of metals, bonds in different metals and different mechanical properties of engineering materials

2. To learn about cooling curves ,phase diagrams and Iron carbon diagram

3. To compare the application of various heat treatment processes

4. Know the concepts of stress and strain.

5. Analyze the beam of different cross sections for shear force, bending moment, slope and deflection

**Syllabus:**

**Module 1 Solidification of metals** : Crystallisation, Crystal and amorphous , different types of bonds in different metals, Crystallography. Stability and metastability of metals. Different mechanical properties of metals and other engineering materials like strength, hardness, elasticity, plasticity, Malleability, Ductility, Creep, Fatigue etc. Introduction to industrial metals, steels and prevailing manufacturing methods by manufacturers.

**Module 2 Cooling curves**: Isomorphous, Utectic, Eutectoid , Eutectoid solid solution, Peritectic and other phase diagrams, Alloying , Characteristics of alloying elements, Iron – Carbon phase diagram, T-T-T diagrams, Types of Cast Iron. Types of Stainless Steels, Elastic, anelastic and Viscoelastic behavior.

**Module 3 Heat treatment of metals:** Based on phase diagram and T-T-T-Diagram the heat treatment of various metals, Bulk heat treatments, surface heat treatments, Case carburising, Types of Anealing, Normalizing, Spherodising, Phase Transformations like Parlite, Cementite, Austenite, Troostite, Bainite, Hard and soft Marten site etc. Laser hardening, Cyniding, Boriding, Nitriding, Flame hardening, Ion implantation, Etc. Heat treatment cycles. Metallographic studies, Optical Microscope, Electron Microscope.

**Module 4: Stress and strain:** stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke’s law, stress due to temperature, Poisson’s ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials,

strain energy under axial loads and stresses due to impact of falling weights. Transformation of stress and strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis.

**Module 5: Bending of Beams and Torsion of Shafts:**

**:** pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

Torsion in shafts: Tensional stresses in a shafts, deformation in circular shaft, angle of twist, stepped and hollow transmission shafts, Theories of Failures.

**REFERENCES:**

1. V. Raghwan, Material Science.

2. G.E.Dieter, Mechanical Metallurgy.

3. P Chalmers, Physical Metallurgy.

4. R. C.Rollason, Metallurgy for mechanical engineers.

5. Khanna O.P. Materials Science.

6. Sadhu Singh; Strength of Materials; Khanna Pub.

7 R Subramannian , Strength of materials OXFORD University Press ,Third Edition

. 8 S Ramamurthum , Strength of materials , Dhanpat Rai

**Suggested List of experiments**:

1. Metallographic studies – Study of Optical microscope, Optically flat surface preparation, etching reagents, Grain size- ASME no., micro structures, Image analysis, Standard specimen,

2. Carbon, sulphur, Phosphorus determination, Strauhlin's apparatus, Eggert's Method in different samples.

3. Hardness and Hardenability test, Jeremy Cony test. Soft and hard Martensite.

4. Different heat treatment cycles using electric furnace [ Programmable preferred ], Annealing, Case carburising, Normalising, etc

5. Standard tensile test on MS and CI test specimen with the help of UTM

6.. Direct/ cross Shear test on MS and CI specimen

7. Transverse bending test on wooden beams to obtain modulus of rupture

8. Fatigue test 5. Brinell Hardness tests 6. Vicker hardness test

9. Izod/Charpy test 8 Rockwell Hardness test

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**Electric Vehicles, IV Semester**

**EV406- Simulation and Modeling Lab**

**Course Contents**:

Introduction to Modeling Software Packages like Solid Works, CATIA, ANSYS, Assembly of Sleeve and Cotter joint, Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling, Assembly of Connecting Rod. Introduction to Simulation software Packages like ANSYS, Fluent, and etc. Various types of analysis. Structure analysis, Thermal analysis, Stress analysis, CFD analysis, FEM analysis, and their problem solving in actual situations.

**List of Experiments (Expandable)**

1. Introduction to CATIA software.

2. Introduction to ANSYS software.

3. Assembly of Sleeve and Cotter joint/ Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling using CATIA.

4. Assembly of Connecting Rod using CATIA.

5. Stress analysis using ANSYS (examples: plate with a circular hole, rectangular L bracket, Axis-symmetric components, various types of beams, etc.)

6. Thermal stress analysis of a 2D component.

7. Conductive and convective heat transfer analysis of a 2D component.

8. CFD Simulation of various situations (example: Laminar pipe flow, Flat plate boundary layer, steady flow past a cylinder, Compressible flow in a Nozzle, Flow over an airfoil.)

**Note:** Evaluation will be continuous an integral part of the laboratory class followed by the final external viva/voce examination

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