Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Branch- Common to All Discipline

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

Course Objectives:

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; Biogeographical 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 assetsriver/forest/grassland/hill/mountain

• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural

• Study of common plants, insects, birds.

REFERENCE

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.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessmen

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Mechatronics Engineering, III-Semester (w. e .f. July-2025)

MT 302: Thermo-fluid Engineering

Course Objectives:

The objective of this course is to develop ability and gain insight into the process of problem-solving, with emphasis on thermodynamics and Fluid Mechanics .

Learning Outcomes

At the completion of this course, students should be able to

- Know about the basic concepts, statement and applications of Zeroth Law, First Law and Second Law of Thermodynamics
- To understand the concept of entropy, change in entropy, Available & Unavailable energy, concept of Availability
- Learn about pure substances, steam, properties of steam, determination of dryness fraction ,enthalpy, entropy and internal energy of different types of steam using steam table and Mollier diagram
- To have knowledge of basic properties of fluid, Hydrostatics, Buoyancy, Metacentre and stability conditions of floating bodies
- Derive and solve problems related to Euler's equation, Bernoulli's equation ,Application of Bernoulli's Equation in Venturi meter, Orifice meter, Pilot Tube (working principle), Momentum equation

Syllabus:

Unit 1: Basic Concepts & Laws of Thermodynamics : Basic concepts: Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Heat and work transfer. First law of thermodynamics, first law applied to various systems steady flow process, limitations of first law of thermodynamics.

Unit 2 Second law of Thermodynamics: Heat engine, heat reservoir, Refrigerator, heat pump, Carnot's cycle, statements of second law Reversible and irreversible processes, consequence of second law, Clausious Inequality , Entropy, T-S diagrams, Available & Unavailable energy Availability

Unit 3 : Properties of Steam : Pure Substance, Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, measurement of dryness fraction using calorimeter, Use of steam tables and Mollier chart to determine properties of steam.

Unit 4: Fluid Properties: Introduction, fluid and the continuum, fluid properties, surface tension, Newton's laws of viscosity and it's coefficients, Types of fluids, Pascal's Law, Hydrostatic Law, hydrostatics and buoyancy, meta centre and met centric height, stability of floating bodies and submerged bodies.

Unit 5 : Fluid Kinematics and Dynamics: Kinematics: Types of fluid flow, stream line, path line and streak line, types of flow and types of motion, local and connective acceleration, continuity equation of one, two and three dimensions, Velocity potential function, Stream Function, Laplace equation, circulation, flow nets.

Fluid Dynamics: Euler's equation, Bernoulli's equation ,Application of Bernouli's Equation: Venturimeter, Orifice meter, Pitot Tube, Momentum equation ,Impulse Momentum Equation and moment of momentum equation, their applications,

EVALUATION will be continuous an integral part of the class as well through external assessment.

References:

1. Nag P.K.; Engineering Thermodynamics; Mc Graw Hills Fifth Edition
2. Cengel Y; Thermodynamics; MC Graw Hills ,Eight Edition
3. Dwivedi K.K. , Pandey Mukesh. Engineering Thermodynamics, Dhanpat Rai & Co.
4. Chattopadhya P , Engineering Thermodynamics Second Edition,OXFORD University Press
5. Yadav R. Applied Thermodynamics , Central Publishing house Allahabad
6. Khurmi R.S. ,Thermal Engineering, S Chand
7. Rajput R.K. ,Thermal Engineering, Laxmi Publication
8. Domkundwar Thermal Engineering, Dhanpat Rai & Co.
9. Bansal R.K. Fluid Mechanics Laxmi Publication
10. ModI and Seth, Fluid Mechanics
11. Shames, Fluid Mechanics, Tata McGraw Hills

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Mechatronics Engineering, III-Semester (w. e .f. July-2025)

MT303 : Microcontroller Applications

Syllabus

UNIT-I 8051 Interfacing

Applications and serial communication 8051 interfacing to ADC and DAC, Stepper motor interfacing, Timer/ counter functions, 8051 based data acquisition system 8051 connections to RS-232, 8051 Serial communication , Serial communication modes, Serial communication programming, Serial port programming in C.

UNIT II: Microcontroller 8096

Introduction to 16-bit Microcontroller, functional block-diagram, memory status, complete 8096 instruction set, classification of instruction set, addressing modes, programming examples using 8096, hardware features of 8096,parallel ports, control &status Registers, Introduction to 16/32 bit PIC microcontrollers and DSPIC.

UNIT-III Introduction to Embedded Systems

: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.

UNIT-IV Embedded System Architecture:

Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.

UNIT-V Input Output and Peripheral Devices

Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock.

Reference Books:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education, 2005.

2. Kenneth J. Ayala, The 8051 Microcontroller Architecture, III edition, CENGAGE Learning.

3. V. Udayashankara and M.S. Mallikarjunaswamy, 8051 Microcontroller: Hardware, Software & Applications, Tata McGraw - Hill, 2009.

4. McKinlay, The 8051 Microcontroller and Embedded Systems - using assembly and C, PHI, 2006 / Pearson, 2006.

5. Tim Wilmshurst, Designing embedded system with PIC microcontrollers Principles and applications. 2nd ed. 2011 Bsp books pvt lt

6. Shibu K V, “Introduction to Embedded System”, TMH.

7. David E Simon, “An Embedded Software Primer”, Pearson education Asia, 2001.

8. Steven F. Barett, Daniel J. Pack, “Embedded Systems” Pearson education, First Impression2008.

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Mechatronics Engineering, III-Semester (w. e .f. July-2025)

MT-304 : Strength of Materials

Objectives :

To familiarize the students with the fundamentals of deformation, stresses, strains in structural elements.

Learning Outcomes : At the completion of this course, students will be able to

1. Know the concepts of simple stress and strain, principle stress and strain ,Mohr circle.

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

3. Understand the concepts necessary to design the structural elemets.

4. analyze column and strut, thin shells.

5. understand the concept of different theories of failures.

UNIT-I Simple Stress and Strain

Concept of Elastic body, stress and Strain, stress strain diagram, Hooke's law, Various types of stress and strains, Elastic constants, Stresses in compound bars, composite and tapering bars, Temperature stresses. strain energy under axial loads and stresses due to impact of falling weights.

Complex Stress and Strains- Two dimensional and three dimensional stress system. Normal and tangential stresses, Principal Planes, Principal Stresses and Strains, Mohr's circle of stresses.

UNIT-II Bending and Shearing Stresses

Bending: Theory of simple bending, Concept of pure bending and bending stress, Equation of bending, Neutral axis, Section-Modulus, Determination of bending stresses in simply supported, Cantilever and Overhanging beams subjected to point load and uniformly distributed loading, Bending stress distribution across a section of beam, strain energy in bending.

Shearing Stress: Shearing Stress in a beam and shear stress distribution across a section in Beams.

UNIT III Slopes and Deflection

Differential equation of the elastic curve ,Determination of Slope and Deflection of beams by Double Integration Method, Macaulay's Method, Area Moment Method, and Strain Energy Method.

UNIT IV Torsion of Shafts and Theories of Failure

Concept of pure torsion, Torsion equation, Determination of shear stress and angle of twist of shafts of circular section, Torsion of solid and hollow circular shafts, comparison of hollow and solid shafts, Analyses of problems based on combined Bending and Torsion, Theories of Failure

UNIT V Columns & Struts, Thin Shells

Columns & struts : Theory of columns, Slenderness ratio, Direct and bending stresses in short columns, Stability of structures, Euler's formula for columns with different end conditions, Rankine's formula, Eccentric loads and the Secant formula ,Imperfections in columns

Thin Pressure Vessels: cylinders and spheres. Stress due to internal pressure, Change in diameter and volume.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

References:

1. Beer FP, Johnson Mechanics of Materials ,Sixth Edition ;Mc Graw Hills
2. Debabrata Nag & Abhijet Chanda :Strength of Materials : Wiley
3. Rajput R.K.; Strength of Materials, S.Chand Publications,New Delhi
4. Rattan; Strength of materials;Second Edition , Mc Graw Hills
5. Nash William; Schaum's Outline Series; forth Edition Strength of Materials;Mc Graw Hills
6. Singh Arbind K; Mechanics of Solids; PHI
7. Khurmi R.S.; Strength of Materials. S.Chand
8. Sadhu Singh; Strength of Materials; Khanna Pub.
9. R Subramannian , Strength of materials OXFORD University Press ,Third Edition .
10. S Ramamurthum , Strength of materials , Dhanpat Rai
11. S. H. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction to The Mechanics Of Solids, 2nd Ed., Tata McGraw Hill, 2008
12. Singer and Pytel ,Strength of Materials , TMH
13. Timoshenko and Gere, Strength of Materials, CBS Publishers & Distributors

Suggested List of Experiments:

1. To conduct a tensile test on a mild steel specimen and determine the following: (i) Limit of proportionality (ii) Elastic limit (iii) Yield strength (iv) Ultimate strength (v) Young's modulus of elasticity (vi) Percentage elongation (vii) Percentage reduction in area
2. To determine the deflection and bending stress of cantilever beam
3. To conduct torsion test on mild steel specimen to find modulus of rigidity or to find angle of twist of the materials.
4. To determine the Impact strength (Specific impact factor) through Izod test
5. To find out the Shear strength of a given specimen using UTM.
6. To perform the Charpy impact test on materials.
7. To determine the Flexural Strength of Concrete beam
8. To study the behavior of the given material under Compressive load and to find out following Modulus of elasticity
   - Maximum Compressive strength or ultimate stress
   - Percentage Decrease in length
   - Percentage Increase in area

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Mechatronics Engineering, III-Semester (w. e .f. July-2025)

MT 305: Electronic Measurement & Instrumentation

Syllabus:

Unit-1 Theory of Measurement

Introduction, Characteristics of Instruments and measurement systems (Static &Dynamic) Error analysis: Sources, types and statistical analysis. Instrument Calibration: Comparison Method. DC and AC Ammeter, DC Voltmeter- Chopper type and solidstate, AC voltmeter using Rectifier. Average, RMS, Peak responding voltmeters, Multi-meter, Power meter, Bolometer and Calorimeter.

Unit-2 CRO

Different parts of CRO, Block diagram, Electrostatic focusing, Electrostatic deflection, Post deflection acceleration. Screen for CRTs, Graticules, Vertical and Horizontal deflection system, Time base circuit, Oscilloscope Probes, Applications of CRO, Special purpose CROs- Multi input, Dual trace, Dual beam, Sampling, Storage (Analog and Digital) Oscilloscope Bridges :Maxwell's bridge (Inductance and Inductance-Capacitance), Hay's bridge, Schering bridge (High voltage and Relative permittivity), Wein bridge. Impedance measurement by Qmeter

Unit-3 Transducer

Classification of Transducers, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer- Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezo-electric transducer, Optical Transducer- Photo emissive, Photo conductive, Photo voltaic, Photo-diode, Photo Transistor

Unit-4 Signal and Function

Generators, Sweep Frequency Generator, Pulse and Square Wave Generator, Beat Frequency Oscillator, Digital display system and indicators, Classification of Displays, Display devices: Light Emitting diodes (LED) and Liquid Crystal Display(LCD).

Unit-5 Advantages of Digital Instrument over Analog Instrument

Digital-to-analog conversion (DAC) - Variable resistive type, R-2R ladder Type, Binary ladder, Weighted converter using Op-amp and transistor, Practical DAC. Analog-todigital Conversion (ADC) - Ramp Technique, Dual Slope Integrating Type, Integrating Type (voltage to frequency), Successive Approximations. Digital voltmeters and multi-meters, Resolution and sensitivity of digital multi-meter.

Text/Reference Books:

1. Albert D. Helfrick, William David Cooper, “Modern electronic instrumentation and measurement techniques”, TMH 2008.

2. Oliver Cage, “Electronic Measurements and Instrumentation”, TMH, 2009.

3. Alan S. Morris, “Measurement and Instrumentation Principles”, Elsevier (Buterworth Heinmann), 2008.

4. David A. Bell, “Electronic Instrumentation and Measurements”, 2nd Ed., PHI, New Delhi 2008.

5. H.S. Kalsi, “Electronics Instrumentation”, TMH Ed. 2004 6. A.K.Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai

7. MMS Anand, “Electronic Instruments & Instrumentation Technology”, PHI Pvt. Ltd., New Delhi Ed. 2005

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MT-306: Simulation and Modelling Lab

Modelling and Simulation lab should have advanced licensed softwares like Solid works, CATIA, PRO/E ,ANSYS, ,FLUENT, MSC / Nastran etc.

Course Outcome:

Students will get an insight into the use of different simulation and analysis software (viz. CATIA, PRO/E ,ANSYS, MSC / Nastran ***)*** to simulate flow behaviour and perform Structural analysis.

Suggested List of Experiments:

1) Design and drafting of riveted joints

2) Design and drafting of welded joints.

3) Layout of typical wing structure.

4) Stress analysis of a rectangular plate with a hole.

5) Static analysis on cantilever beam

6) Static analysis of forces in a simply supported beam

7) Static analysis- Plane truss

8) 2-D static stress analysis

9) 3-D static stress analysis

10) Three view diagram of a typical aircraft

11) Analysis of a model airplane wing

12) Simulation of flow through a Converging-diverging nozzle.

13) Structural analysis of a tapered wing

14) Stress and modal analysis of a cylinder under pressure

15) Stress distribution in indeterminate structure

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