# B. Tech. MECHANICAL ENGINEERING COURSE

# SYLLABUS( 3rd SEMESTER)

# DEPT OF MECHANICAL ENGINEERING

# BIT MESRA, RANCHI

# COURSE INFORMATION SHEET

**Course code: MA 203**
**Course title: Numerical Methods**
**Pre-requisite(s): NIL**
**Co- requisite(s): –-NIL**
**Credits:** L: 2 T: 0 P: 0 C: 2
**Class schedule per week: 2 Lectures**
**Class: B Tech**
**Semester / Level: 2**
**Branch: ALL**
**Name of Teacher:**
**Course Objectives:** This course enables the students to

| | |
|---|---|
| 1. | derive appropriate numerical methods to solve algebraic and transcendental equations |
| 2. | derive appropriate numerical methods to solve linear system of equations |
| 3. | approximate a function using various interpolation techniques |
| 4. | to find the numerical solution of initial value problems and boundary value problems |

**Course Outcomes:** After the completion of this course, students will be able to

| | |
|---|---|
| CO 1 | solve algebraic and transcendental equation using an appropriate numerical method arising in various engineering problems |
| CO 2 | solve linear system of equations using an appropriate numerical method arising in computer programming, chemical engineering problems etc. |
| CO 3. | Approximate a function using an appropriate numerical method in various research problems |
| CO 4 | evaluate derivative at a value using an appropriate numerical method in various research problems |
| CO 5 | solve differential equation numerically |

**Syllabus**

**MA 203** **Numerical Methods** **2-0-0-2**

**Module I: Errors and Nonlinear Equations**

**Error Analysis:** Definition and sources of errors, propagation of errors, floating-point arithmetic **Solution of Nonlinear equations:** Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method and its variants, General Iterative method. [05L]

**Module II: System of Linear Equations**

Gauss-Elimination, Gauss-Jordan, LU-Decomposition, Gauss-Jacobi and Gauss- Siedel methods to solve linear system of equations and Power method to find least and largest eigenvalues. [05L]

**Module III: Interpolation**

Lagrange's interpolation, Newton's divided differences interpolation formulas, inverse interpolation, interpolating polynomial using finite differences. [05L]

**Module IV: Differentiation and Integration**

Differentiation using interpolation formulas, Integration using Newton-Cotes formulas: Trapezoidal rule, Simpson's rule [05L]

**Module V: Solution of Ordinary Differential Equations**

Euler's method, modified Euler's method, Runge - Kutta Methods of second and fourth order to solve initial value problems. [05L]

**Text Books:**


1. Jain M.K, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, 2004.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI.
3. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.


**Reference Books:**


1. S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, 1985.
2. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, Seventh Edition, 2003.
3. R. W. Hamming: Numerical Methods for Scientists and Engineers, Second Edition, Dover

| Course delivery methods | |
|---|---|
| Lecture by use of boards/lcd projectors/ohp projectors | √ |
| Tutorials/assignments | √ |
| Seminars | |
| Mini projects/projects | √ |
| Laboratory experiments/teaching aids | |
| Industrial/guest lectures | |
| Industrial visits/in-plant training | |
| Self- learning such as use of nptel materials and internets | √ |
| Simulation | |

## Course outcome (co) attainment assessment tools & evaluation procedure

### Direct assessment

| Assessment tool | % contribution during co assessment |
|---|---|
| Mid semester examination | 25 |
| End semester examination | 50 |
| Quiz (s) | 10+10 |
| Assignment | 5 |

| Assessment components | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| Mid semester examination | √ | √ | √ | | |
| End semester examination | √ | √ | √ | √ | √ |
| Quiz (s) | √ | √ | √ | | |
| Assignment | √ | √ | √ | √ | |

**Indirect assessment –**

1. Student feedback on course outcome

### Mapping of course outcomes onto program outcomes

| Course outcome | Program outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 2 | 2 |

If satisfying< 34%=1, 34-66% =2, > 66% = 3.

# COURSE INFORMATION SHEET

Course code: CE101
Course title: **Environmental Science**
Pre-requisite(s):
Co- requisite(s):
Credits: L: 2 T: 0 P: 0
Class schedule per week: 2
Class: B. Tech
Semester / Level: I
Branch: All

**Course Objectives**
This course enables the students:

| | |
|---|---|
| 1 | To develop basic knowledge of ecological principles and their applications in environment. |
| 2 | To identify the structure and composition of the spheres of the earth, the only planet sustaining life. |
| 3 | To analyse, how the environment is getting contaminated and probable control mechanisms for them. |
| 4 | To generate awareness and become a sensitive citizen towards the changing environment. |

**Course Outcomes**
After the completion of this course, students will be:

| | |
|---|---|
| 1 | Able to explain the structure and function of ecosystems and their importance in the holistic environment. |
| 2 | Able to identify the sources, causes, impacts and control of air pollution. |
| 3 | Able to distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms. |
| 4 | Able to judge the importance of soil, causes of contamination and need of solid waste management. |
| 5 | Able to predict the sources of radiation hazards and pros and cons of noise pollution. |

## SYLLABUS

**Module 1. Ecosystem and Environment**

Concepts of Ecology and Environmental science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management, fate of environmental pollutants, environmental status and reports on climate change.

(8L)

**Module 2: Air Pollution**

Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, control methods and equipment for air pollution control, vehicular emissions and control, indoor air pollution, air pollution episodes and case studies.

(8L)

**Module 3: Water Pollution**

Water Resource; Water Pollution: types and Sources of Pollutants; effects of water pollution; Water quality monitoring, various water quality indices, water and waste water treatment: primary, secondary and tertiary treatment, advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal.

(8L)

**Module 4: Soil Pollution and Solid Waste Management**

Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis.

(8L)

**Module 5: Noise pollution & Radioactive pollution**

Noise pollution: introduction, sources: Point, line and area sources; outdoor and indoor noise propagation, Effects of noise on health, criteria noise standards and limit values, Noise measurement techniques and analysis, prevention of noise pollution; Radioactive pollution: introduction, sources, classification, health and safety aspects, Hazards associated with nuclear reactors and disposal of spent fuel rods-safe guards from exposure to radiations, international regulation, Management of radioactive wastes.

(8L)

**Text books:**


1. A, K. De. (3rd Ed). 2008. Environmental Chemistry. New Age Publications India Ltd.
2. R. Rajagopalan.2016.Environmental Studies: From Crisis to Future by, 3rd edition, Oxford University Press.
3. Eugene P. Odum. 1971. Fundamentals of Ecology (3rd ed.) -. WB Sunders Company, Philadelphia.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.

5. S.C. Santra. 2011. Environmental Science. New Central Book Agency.

**Reference books:**

1. D.W.Conell. Basic Concepts of Environmental Chemistry, CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International
3. G.M. Masters& Wendell Ela. 1991. Introduction to Environmental Engineering and Science, PHI Publishers.

**Gaps in the syllabus (to meet Industry/Profession requirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** |
|---|
| Lecture by use of boards/LCD projectors/OHP projectors √ |
| Tutorials/Assignments √ |
| Seminars √ |
| Mini projects/Projects |
| Laboratory experiments/teaching aids |
| Industrial/guest lectures |
| Industrial visits/in-plant training |
| Self- learning such as use of NPTEL materials and internets |
| Simulation |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Mid Sem Examination Marks | 25 |
| End Sem Examination Marks | 50 |
| Quiz (s) (1 & 2) | 10+10 |
| Teacher's assessment | 5 |

| Assessment Components | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| Mid sem exam | ✔ | ✔ | ✔ | | |
| End Sem Examination Marks | ✔ | ✔ | ✔ | ✔ | ✔ |
| Assignment | ✔ | ✔ | ✔ | ✔ | ✔ |

**Indirect Assessment –**

1.Student Feedback on Faculty

2. Student Feedback on Course Outcome

## Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Graduate Attributes**

| Course Outcome # | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k |
| 1 | 2 | 2 | 2 | 2 | L | 3 | 3 | 2 | 2 | 2 | 1 |
| 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |
| 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |
| 4 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |
| 5 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 |

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

| Mapping Between Cos and Course Delivery (CD) methods | | | | |
|---|---|---|---|---|
| | | | | |
| **CD** | **Course Delivery methods** | | **Course Outcome** | **Course Delivery Method** |
| CD 1 | Lecture by use of boards/LCD projectors/OHP projectors | | CO1 | CD1, CD2 |
| CD 2 | Tutorials/Assignments | | CO2 | CD1, CD2 |
| CD 3 | Seminars | | CO3 | CD1, CD2 |
| CD 4 | Mini projects/Projects | | CO4 | CD1, CD2 |

# COURSE INFORMATION SHEET

**Course code:** ME 201
**Course title:** Thermodynamics
**Pre-requisite(s):** Basic of Physics, Chemistry and Mathematics
**Co- requisite(s):**
**Credits: 3** L:3, T:0, P:0
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level: 03**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course enables the students:

| | |
|---|---|
| A. | To present a comprehensive and rigorous treatment of classical thermodynamics while retaining an engineering perspective. |
| B. | To lay the groundwork for subsequent studies in such fields as heat transfer and energy conversion systems and to prepare the students to effectively use thermodynamics in the practice of engineering. |
| C. | To develop an intuitive understanding of thermodynamics by emphasizing the engineering and engineering arguments. |
| D. | To present a wealth of real world engineering examples to give students a feel for how thermodynamics is applied in engineering practice. |

## Course Outcomes

After the completion of this course, students will be:

| | |
|---|---|
| 1. | Outline the basic concepts of thermodynamics. |
| 2. | Apply the first law of thermodynamics to analyze non-flow and steady flow systems. |
| 3. | Apply the second law of thermodynamics to evaluate the performance of cyclic devices. |
| 4. | Evaluate the entropy, availability, exergy and irreversibility in various thermodynamic processes. |
| 5. | Analyze air standard cycles |

## Syllabus

**Module: 1**

Introduction: Fundamental Concepts: Macroscopic versus microscopic point of view, definitions of system and surrounding, concept of control volume, thermodynamic state, processes and cycles, point function and path function, quasi-static process, concepts of simple compressible substances, dimensions and units, thermodynamic equilibrium; Temperature and Zeroth law; Concept of ideal gases and their equations of state; pure substance and phase, Thermodynamic properties and use of tables of thermodynamic properties; Thermodynamic definition of work, work done at the moving boundary of a system, other systems that involve work, Definition of heat, comparison of Heat and Work.

[10]

**Module: 2**

First Law of Thermodynamics: The first law referred to cyclic and non-cyclic processes, concept of internal energy of a system, conservation of energy for simple compressible closed systems; Definitions of enthalpy and specific heats; First law applied to a control volume, general energy equation; steady flow energy equation on unit mass and time basis, application of SFEE for devices such as boiler, turbine, heat exchangers, pumps, nozzles, etc.

[8]

**Module: 3**

Second Law of Thermodynamics: Limitations of the first law, concept of a heat engine, heat pump, refrigerator, statements of the second law, their equivalence, reversible heat engine, Carnot theorems and corollaries, Concept of reversibility; Internal and external irreversibility, Absolute thermodynamic temperature scale. [8]

**Module: 4**

Clausius Inequality, entropy, change in entropy in various thermodynamic processes, entropy balance for closed and open systems, Principle of increase-in-Entropy, entropy generation. Third law of thermodynamics, absolute entropy, available and unavailable energy, irreversibility. Exergy analysis of thermal power plant. [8]

**Module: 5**

Air Standard Cycles: Carnot, Stirling, Ericsson, Otto, Diesel, Dual cycles. [8]

**Text books:**


1. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
2. Yonus A Cengel and Michale A Boles, 2002, Thermodynamics: An Engineering Approach, McGraw Hill.

**Reference books:**


1. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India.
3. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.


## Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Program Outcomes**

| **Course Outcome #** | **Program Outcomes(PO)** | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | 1 | 2 |
| 1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | | | 1 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | | | 1 | 2 | 2 |
| 4 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| 5 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | | | 1 | 2 | 2 |

# COURSE INFORMATION SHEET

**Course code:** ME 203
**Course title:** Fluid Mechanics and Hydraulic Machines
**Pre-requisite(s):**Basic of Physics, Chemistry and Mathematics
**Co- requisite(s):NIL**
**Credits: 3** L:3, T:0, P:0
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level: 03**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course enables the students:

| | |
|---|---|
| A. | To present a comprehensive and rigorous treatment of classical fluid mechanics while retaining an engineering perspective. |
| B. | To lay the groundwork for subsequent studies in such fields as analysis of various fluid flow devicesand energy conversion systems and to prepare the students to effectively use Fluid mechanics theory in the practice of engineering. |
| C. | To develop an intuitive understanding of Fluid mechanics by emphasizing the engineering and engineeringarguments. |
| D. | To present a wealth of real world engineering examples to give students a feel for how Fluid mechanics is applied in engineering practice. |

## Course Outcomes

After the completion of this course, students will be:

| | |
|---|---|
| CO1. | Outline the concepts of continuum, system of control volume, fluid and flow properties. |
| CO2. | Apply the appropriate fundamental laws of fluid statics, dynamics to various fluid devices. |
| CO3. | Analyse various fluid static, dynamics problems. |
| CO4. | Evaluate the performanceof various fluid static, dynamic devices, hydraulic machines. |
| CO5. | Create optimum design of simple, complex fluid flow devices using conventional methods and modern tools. |

## ME 203 FLUID MECHANICS AND HYDRAULIC MACHINES

**Module: 1 Fluid statics:** Concept of continuum and physical properties of fluids, specific gravity, viscosity surface Tension, vapour pressure. Buoyancy force and Metacentric height. Measurement of pressure- Piezometer, U-tube and differential tube manometers, Bourdon pressure gauge, electronic pressure sensors and transducers.Numerical examples. (7 Lectures)

**Module: 2 Fluid kinematics :**Eulerian and Lagrangian description of fluid flow, stream function and velocity potential function. Stream line, path line and streak lines and stream tub. Classification of fluid flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows, Reynolds transport theorem, equation of continuity. **Fluid dynamics** : Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its.Buckingham's pi theorem and Rayleigh's method. Numerical examples. ( 9 Lectures)

**Module: 3 Closed conduit flow:**Reynold's experiment- Darcy Weisbach equation, Minor losses in pipes-pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow, pitot-static tube, venturimeter, orifice meter, Flow nozzle, Turbine flow meter. Concept of Boundary layer, separation of boundary layer and its control.Concept of fluid flow simulations.Numerical examples. (8 Lectures)

**Module: IV Hydraulic Turbines:** Hydrodynamic force of jets on stationary and moving vanes, velocity diagrams, work done and efficiency . Hydraulic Turbines : Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies , hydraulic design, draft tube theory and functions and efficiency. Performance of hydraulic turbines, geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic Turbine test standards.Numerical examples. (10 Lectures)

**Module: V Hydraulic pumps :** Classification, working, work done, manomertic head, losses and efficiencies, specific speed, pumps in series and parallel, performance characteristic curves, NPSH, Model studies, Reciprocating pumps, working, discharge, slip, indicator diagrams. Hydraulic Pump test standards.Numerical examples. (8 Lectures)

**TEXT BOOKS :**

T1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
T2. Hydraulic Machines by Jagdishlal
T3.Fluid Mechanics, Fundamentals and Applications (in SI Unit) by Yunus A. Cangel and John M. Cimbala, McGraw Hill.

**REFERENCE BOOKS :**

R1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
R2. Fluid Mechanics with Engineering Application by J.B. Franzini and Finnemore, McGraw Hill.
R3. Fluid Mechanics by V. L. Streeter.

**Online Resources**

https://www.youtube.com/watch?v=fa0zHI6nLUo
https://www.youtube.com/watch?v=XGnGBo-FrlA
http://engineeringvideolectures.com/video/15763

# Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Program Outcomes**

| **Course Outcome #** | **Program Outcomes(PO)** | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | 1 | 2 |
| 1 | 3 | 3 | 3 | 3 | 1 | | | | | | | 2 | 2 | 2 |
| 2 | 3 | 3 | 3 | 2 | 2 | | | | | | | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 2 | 2 | | | | | | | 2 | 2 | 2 |
| 4 | 3 | 3 | 3 | 2 | 2 | | | | 2 | 1 | 1 | 2 | 2 | 2 |
| 5 | 3 | 2 | 2 | 2 | 2 | | | | 2 | 1 | 1 | 2 | 2 | 2 |

# COURSE INFORMATION SHEET

**Course code: PE 213**
**Course title: MANUFACTURING PROCESSES**
**Pre-requisite(s): NIL**
**Co- requisite(s):**
**Credits: 03** L:3 T:0 P:0
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level:III/2**
**Branch: Mechanical Engineering**
**Name of Teacher:**

**Course Objectives:**
This course enables the students to:

| | |
|---|---|
| 1 | Examine the technical aspect related to basic manufacturing processes |
| 2 | Get acquainted with different methods of manufacturing used |
| 3 | Analyse different aspects of a manufacturing process along with their appropriate usage and scope |
| 4 | Derive relationship and use empirical relations to study the effects of manufacturing parameters on a process |
| 5 | Develop an understanding of existing and emerging manufacturing processes |

**Course Outcomes:**
After the completion of this course, students will able to:

| | |
|---|---|
| CO1 | Explain the basic principles behind different Casting, Welding, Forming and machining processes |
| CO2 | Select appropriate manufacturing process for a given component design |
| CO3 | Identify advantages and limitations of various casting, welding, machining and forming techniques |
| CO4 | Correctly explain and construct mathematical relationships existing amongst various parameters in different manufacturing processes |
| CO5 | Select appropriate welding process for a given joint |

## SYLLABUS

**Module 1: Casting** **[08]**

Introduction to foundry process and its importance; sand casting: patterns, pattern allowances, gating system components introduction and significance. Centrifugal casting , Hot chamber and cold chamber die casting; Investment casting,

**Module 2: Theory of Metal Cutting** **[08]**

Geometry of single point cutting tool, Introduction to orthogonal cutting; Tool forces in orthogonal cutting, types of chips, tool failure, tool life, cutting tool materials.

**Module 3: Machine Tools** **[08]**

Construction, operations and specifications of lathe and shaper. Construction, operations and specifications of milling & drilling machine. Introduction to grinding and types of grinding processes.

**Module 4: Metal Deformation Processes [08]**

Metal forming processes: Introduction to recovery, recrystallization and grain growth; Hot working and cold working

Rolling: Classification of rolling processes, rolling mills, products of rolling and main variables

Forging: Open and closed die forging, forging operations

Extrusion: Classification of extrusion processes, hot and cold extrusion processes

Sheet metal forming operations: Blanking and piercing, deep drawing, bending.

**Module 5: Welding [08]**

Principle, working and application of oxy- acetylene gas welding. Electric arc welding: MMAW/SMAW, SAW, GTAW and GMAW, Resistance welding. Soldering and Brazing

**Text books:**


1. SeropeKalpakjian and Steven Schmidt , Manufacturing Processes for Engineering Materials, Pearson Education, 6th Edition
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Material. Processes, and systems, 2nd Edition, Wiley India, 2007
3. P.N. Rao, Manufacturing Technology – Metal Cutting and Machine Tools, McGraw Hill.
4. P.N. Rao, Manufacturing Technology, Foundry, Forming and Welding, McGraw Hill
5. Hajra Choudhury, Elements of Workshop Technology–Vol.-II, Media Promoters and Publishers


**Reference books:**


1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, Materials and processes in Manufacturing, PHI.
2. P. F. Ostwald, and Jairo Munoz, Manufacturing Processes and Systems, 9th ed., Wiley, India, 2002
3. Principles of metal casting, Rosenthal. P. C, Tata Mc Graw Hill
4. M. C. Shaw, Metal Cutting Principles, Oxford University Press, Oxford, 1984


**Gaps in the syllabus (to meet Industry/Profession requirements):**

Non-Conventional Machining Processes, Analysis of Manufacturing Processes

**POs met through Gaps in the Syllabus:**

PO1-5, PO12

**Topics beyond syllabus/Advanced topics/Design:**

Advanced Manufacturing Processes

**POs met through Topics beyond syllabus/Advanced topics/Design:**

PO1-5, PO12

**Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

| COs | POs | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 2 | 2 | 3 | | 1 | | | 1 | | 1 | | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | | 1 | | | 1 | | 1 | | 3 |
| CO3 | 3 | 3 | 2 | 2 | 3 | | 1 | | | 1 | | 1 | | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | | 1 | | | 1 | | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | | 1 | | | 1 | | 1 | | 3 |

# COURSE INFORMATION SHEET

**Course code:** ME 205
**Course title:** Strength of Materials
**Pre-requisite(s):**Basics Mechanical Engineering, Mathematics course with ordinary deferential equations
**Co- requisite(s): NIL**
**Credits: 3** L: 3, T: 1, P:0
**Class schedule per week: 04**
**Class: B. Tech**
**Semester / Level:03**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course enables the students:

| | |
|---|---|
| A. | To understand the nature of stresses developed in structural members such as beams, shafts, curved bars, cylinders and spheres for various types of simple loads. |
| B. | To calculate the elastic deformation and deflection occurring in various simple geometries for different types of loading. |

## Course Outcomes

After the completion of this course, students will be:

| | |
|---|---|
| 1. | Understand the basic Strength of Materials theorems and to apply the concept in structural problems. |
| 2. | Analyze different structural bodiesviz.beam, column, circular ring, cylinder and rotating disc. |
| 3. | Evaluate the influence of various geometric and loading parameters of structural bodies. |
| 4. | Compare the results obtained from bending theory of beam and strain energy method of structural problems. |
| 5. | Create new ideas in the field of Solid Mechanics and Design. |

## Syllabus

### Module: 1

Stress at a point on a plane, Stress transformation equation, Principal stresses, Mohr's circle of stresses, Strain transformation equation, principal strain, strain rosette. (10 Lectures)

**Module: 2**

Types of Beam, Types of loading and support, Relationship between Shear force, Bending Moment and intensity of loading, SFD, BMD, Point of Contraflexure, second moment of area, parallel axes theorem, Bending stress and shear stress in beam. (10 Lectures)

**Module: 3**

Deflection of Beam, Double integration method, Macaulay's method, Moment area method, Buckling of column.Strain energy method, Castigliano's theorem, application of energy method on different types of beamand thin circular ring. (10 Lectures)

**Module: 4**

Shear Centre: Theory of shear flow, shear flow diagrams and shear center for thinwalledsymmetrical sections.
Bending of curved beams: Beams of small and large initial curvature, evaluation ofcircumferential stresses. (10 Lectures)

**Module: 5**

Thin and thick cylinders: Radial and circumferential stresses, stresses produced due to shrink fit.
Rotating Disc: Stresses in disc of uniform thickness and uniform strength. (10 Lectures)

**Text Books:**

1. Strength of Materials by E J Hearn.
2. Strength of Materials by S.S.Rattan.

**Reference Books:**

1. Mechanics of Materials by S. Timoshenko and James M. Gere.
2. Strength of Materials by Ryder.
3. Advanced Mechanics of Material by Seely& Smith

**Gaps in the syllabus (to meet Industry/Profession requirements)**
Analysis of torsion and combined stresses

**POs met through Gaps in the Syllabus**
PO1 TO PO5

**Topics beyond syllabus/Advanced topics/Design**
Stress-strain behaviour of materials using tensorial approach

**POs met through Topics beyond syllabus/Advanced topics/Design**
PO1 TO PO5

**Mapping of Course Outcomes onto Program Outcomes**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** | **PO1 1** | **PO1 2** | **PSO 1** | **PSO 2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | | 1 | 1 | | 1 | | | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | | 1 | 1 | | 2 | | | 2 | 2 | 2 |
| **CO 3** | 3 | 3 | 2 | 3 | | 1 | 1 | | 2 | | | 2 | 2 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | | 1 | 1 | | 2 | 1 | | 2 | 2 | 2 |
| **CO 5** | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | | 1 | 2 | 2 | 2 |

# COURSE INFORMATION SHEET

Course code: IT202
Course title: **Basic IT Workshop**
Pre-requisite(s):
Co- requisite(s):
Credits: L: 0 T: 0 P: 2
Class schedule per week: 2
Class: B. Tech
Semester / Level: IV/II
Branch: All

## Course Objectives

This course enables the students:

| | |
|---|---|
| 1. | Understand and use the basic Matlab functions and understand its environment and variables |
| 2. | Know about handling operations and advanced features like menus and toolbars |
| 3. | Implement programs with the use of arrays, strings and graphical data representations |
| 4. | Understand Python, Data Types, Operators, Arrays |
| 5. | Implement Functions and loops, object oriented programming using Python |

## Course Outcomes

After the completion of this course, students will be able:

| | |
|---|---|
| 1. | Apply features of Matlab and algorithms to solve problems |
| 2. | Develop application programs with the help of various tool boxes available in Matlab. |
| 3. | Apply data analysis through graphical data representations |
| 4. | Implement programs with the use of arrays, strings in Matlab |
| 5. | Implement Functions and loops, using Python |

# Syllabus

**Module I**

**Introduction to MATLAB and Basics Part I:**

Introduction, Advantage, Disadvantage of MATLAB, MATLAB Environment, Variables and Array, Built-in Functions of MATLAB, Subarrays, Multidimensional Arrays, Data Files.

**Module II**

**MATLAB Basic Part II:**

Scalar and Array Operations, Hierarchy of Operations, Introduction to Plotting, Polar Plots, Subplots, MATLAB profiler. String Functions, Complex Data, Three-Dimensional Plot

**Module III**

**MATLAB Advanced Features:**

Sparse Arrays, Cell Arrays,Structure Arrays, I/O Functions, Object Handles, Position and Units, Graphical User Interface: Dialog Boxes, Menus, Toolbars.

**Module IV**

**Introduction to Python Basics**

Basics, I Python, Data Types, Operators, Arrays, Plotting

**Module V**

**Python Programming Part 2:**

Functions and loops, object oriented programming, Numerical Formalism

Sample list of Assignments:

**Sample Assignments on Python**

**Data Types, Input- Outputs, Variables**

1. Write a program in Python to swap two variables.

2. Write a program in Python to check the input character is an alphabet or not.

**Loop**

3. Write a program in python to shuffle a deck of card using the module random and draw 5 cards.

4. Write a program in python to find the factors of a number.

**Array and Lists**

5. Write a program in python to transpose a given matrix M = [[1, 2], [4, 5], [3, 6]].

6. Write a program in python to print the median of a set of numbers in a file.

**Function**

6. Write a function in Python to find the resolution of a JPEG image.

7. Write a program in python and use in-built functions to convert a decimal number to binary, octal and hexadecimal number.

8. Write a program in python to sort words in alphabetical order.

**Plot**

9. Use Matplotlib to draw histogram to represent average age of population given as Age [21, 54, 66, 44, 32,42, 54, 62, 93, 45, 32, 70]

10. Create a 3-D plot in Python for the function $\sqrt{y^2 - x^2}$ over the interval $-3 \leq x \leq 3$ and $-3 \leq x \leq 3$.

## Sample Assignments on MATLAB

**Assignment Statements:**

1. Given two sides a= 3.2 and b=4.6 of a triangle and angle theta= $60^0$ between these two sides. Find the length of the third side and the area of the triangle.

2. Write a MATLAB statement to calculate the sum of the series:

$$S= 1- x^2/2! + x^4/4! - x^6/6! + x^8/8! \quad \text{for } x= 1.5$$

**Arrays**

3. The array A is given below. Extend the 2-D array to 3-D array by including another 2-D array as second element in the third dimension.

$$A = 123; 543; 136;$$

4. Let a matrix A of size (3x4) is defined as, $= \ 12356791011 \quad 4812$ . Reshape the matrix A into matrix B of the size (6x2).

5. Let a column vector z be given as z = [2; 3; 4; 5].

(i) Form a diagonal matrix A, using the elements of z as he main diagonal elements of A.

(ii) Form the matrix B, using the elements of vector z as elements of upper diagonal of B.

(iii) Form the matrix C, using the elements of vector z as elements of first lower diagonal of C.

**Polynomials**

6. Integrate the polynomial $y = 4x^3 + 12x^2 + 16x + 1$. Take the constant of integration as 3.

7. Find the polynomial of degree 2 to fit the following data:

| x | 0 | 1 | 2 | 4 |
|---|---|---|---|---|
| y | 1 | 6 | 20 | 100 |

**Input-Output statement and files**

8. Write a program in MATLAB to illustrate the use of 'pause' command.

9. Write a program in MATLAB to illustrate the use of fwrite function for writing binary data of different formats to a file named 'check.txt'.

**Plots**

10. Plot the curve given by the equation y = sin(x) where x varies from 0 to 2π. Also label the x-axis and y-axis and provide a suitable title for the plot

11. Plot a bar graph for the data given as x = [1 2 3 4 5 6] and y = [10 15 25 30 27 19]

12. Given $x = t^2$ and $y = 4t$ for $-4 < t < 4$. Using MATLAB obtain a 3-D plot showing the matrix in (x, y) space as a factors of time.

**Control structures**

13. Write a program in MATLAB to find the count of even values in the given n numbers.

Functions

14. Write a function in MATLAB to calculate the roots of the quadratic equation $ax^2 + bx + c = 0$, where a, b, c are constants.

**Text Books:**

1. MATLAB® Programming for Engineers:Stephen J. Chapman, Thomson Corporation, 4th Edition

2. Introduction to Python for Engineers and Scientists, Sandeep Nagar, Apress, 2018

**Reference Books**

1. Learn Python The Hard Way, Zed A. Shaw, Addison-Wesley, Third Edition

Gaps in the syllabus (to meet Industry/Profession requirements): N/A

POs met through Gaps in the Syllabus: N/A

Topics beyond syllabus/Advanced topics/Design: through experiments involving design/modelling of device/circuits on advanced topics

POs met through Topics beyond syllabus/Advanced topics/Design: through experiments involving design/modelling of device/circuits on advanced topics

| CD # | Course Delivery methods |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Tutorials/Assignments |
| CD3 | Seminars/ Quiz (s) |
| CD4 | Mini projects/Projects |
| CD5 | Laboratory experiments/teaching aids |
| CD6 | Industrial/guest lectures |
| CD7 | Industrial visits/in-plant training |
| CD8 | Self- learning such as use of NPTEL materials and internets |
| CD9 | Simulation |

**Course Outcome (CO) Attainment Assessment tools & Evaluation procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Progressive Evaluation | (60) |
| Attendance Marks | 12 |
| Lab file Marks | 12 |
| Viva Marks | 24 |
| Day-to-day performance Marks | 12 |
| End SEM Evaluation | (40) |
| Lab quiz Marks | 20 |
| Lab performance Marks | 20 |

| Assessment Components | CO1 | CO2 | CO3 | CO4 |
|---|---|---|---|---|
| Progressive Evaluation | 3 | 3 | 3 | 3 |
| End SEM Evaluation | 3 | 3 | 3 | 3 |

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

**Indirect Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Objectives and Outcomes**

**Mapping of Course Outcomes onto Program Outcomes**

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD6 |
| CO2 | CD1, CD6,CD7 |
| CO3 | CD1, CD2, CD3, |
| CO4 | CD1, CD3,CD6,CD7 |
| CO5 | CD1,CD2,CD7 |

| | **Program Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcome #** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| CO1 | 3 | 3 | 3 | 1 | 3 | 2 | 1 | 3 | 1 | 2 | | |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 3 | | |
| CO3 | 1 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | |
| CO4 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | | |
| CO5 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 1 | |

# COURSE INFORMATION SHEET

**Course code: MA 204**
**Course title: Numerical Methods Lab**
**Pre-requisite(s): NIL**
**Co- requisite(s): –-NIL**
**Credits:** L: 0 T: 0 P: 2 C:1
**Class schedule per week: 2 Sessionals**
**Class: BE**
**Semester / Level: III / UG**
**Branch: ALL**
**Name of Teacher:**

## Course Objectives

This course enables the students to understand

| | |
|---|---|
| 1. | derive appropriate numerical methods to solve algebraic, transcendental equations and linear system of equations |
| 2. | approximate a function using various interpolation techniques, to find the numerical solution of initial value problems |
| 3. | ncepts in probability theory, the properties of probability distributions |
| 4. | estimation of mean, variance and proportion, the concepts of statistical hypothesis |

## Course Outcomes

After the completion of this course, students will be able to

| | |
|---|---|
| 1. | solve algebraic, transcendental equation and linear system of equations using an appropriate numerical method arising in various engineering problems |
| 2. | evaluate derivative at a value using an appropriate numerical method in various research problems, solve differential equation numerically |
| 3. | learn basic probability axioms, rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. |
| 4. | find the point and interval estimates, analyse data statistically and interpretation of the results |

# SYLLABUS

**List of Assignments**

1. Find a simple root of $f(x)=0$ using bisection method. Read the end points of the interval $(a,b)$ in which the root lies, maximum number of iterations $n$ and error tolerance eps.
2. Find a simple root of $f(x)=0$ using Regula-Falsi method. Read the end points of the interval $(a,b)$ in which the root lies, maximum number of iterations $n$ and error tolerance eps.
3. Find a simple root of $f(x)=0$ using Newton Raphson method. Read any initial approximation $x_0$, maximum number of iterations $n$ and error tolerance eps.
4. Solution of a system of $n\times n$ linear equations using Gauss elimination method with partial pivoting. The program is for $10\times 10$ system or higher order system.
5. Matrix inversion and solution of $n\times n$ system of equations using Gauss-Jordan method. If the system of equations is larger than $15\times 15$ change the dimensions of the float statement.
6. Program to solve a system of equation using Gauss-Seidel iteration method. Order of the matrix is $n$, maximum number of iterations $niter$, error tolerance is eps and the initial approximation to the solution vector is $x_0$. If the system of equations is larger than $10\times 10$ change the dimension in float.
7. Program to find the largest Eigen value in magnitude and the corresponding Eigen vector of a square matrix $A$ of order $n$ using power method.
8. Program for Lagrange interpolation.
9. Program for Newton divided difference interpolation.
10. Program for Newton's forward and backward interpolation.
11. Program for Gauss's central difference interpolation (both backward and forward).
12. Program to evaluate the integral of $f(x)$ between the limits $a$ to $b$ using Trapezoidal rule of integration based on $n$ subintervals or $n+1$ nodal points. The values of $a,b$ and $n$ are to be read. The program is tested for $f(x)=1/(1+x)$.
13. Program to evaluate the integral of $f(x)$ between the limits $a$ to $b$ using Simpson's rule of integration based on $2n$ subintervals or $2n+1$ nodal points. The values of $a,b$ and $n$ are to be read and the integrand is written as a function subprogram. The program is tested for $f(x)=1/(1+x)$.
14. Program to solve an IVP, $dy/dx=f(x),y(x_0)=y_0$ using Euler method. The initial value $x_0,y_0$ the final value $x_f$ and the step size $h$ are to be read. The program is tested for $f(x,y)=-2xy^2$.
15. Program to solve an IVP, $dy/dx=f(x),y(x_0)=y_0$ using the classical Runge-Kutta fourth order method with step size $h$, $h/2$ and also computes the estimate of the truncation error. Input parameters are: initial point, initial value, number of intervals and the step length h. Solutions with $h$, $h/2$ and the estimate of the truncation error are available as output. The right hand side The program is tested for $f(x,y)=-2xy^2$.

**Text Books:**

1. S.S.Sastry-Introductory Methods of Numerical Analysis-PHI, Private Ltd., New Delhi.
2. N.Pal& S. Sarkar- Statistics: Concepts and Applications, PHI, New Delhi-2005.

**Reference Books:**

1 R.V.Hogg et.al- Probability and Statistical Inpane, 7th Edn, Pearson Education, New Delhi-2006.

2. R.L.Burden&J.D.Faires- Numerical Analysis, Thomson Learning-Brooks/Cole, Indian Reprint, 2005.

Gaps in the syllabus (to meet Industry/Profession requirements): N/A

POs met through Gaps in the Syllabus: N/A

Topics beyond syllabus/Advanced topics/Design: through experiments involving design/modelling of device/circuits on advanced topics

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| CD5 | Laboratory experiments/teaching aids |
| CD6 | Industrial/guest lectures |
| CD7 | Industrial visits/in-plant training |
| CD8 | Self- learning such as use of NPTEL materials and internets |
| CD9 | Simulation |

**Course Outcome (CO) Attainment Assessment tools & Evaluation procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Progressive Evaluation | (60) |
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| Assessment Components | CO1 | CO2 | CO3 | CO4 |
|---|---|---|---|---|
| Progressive Evaluation | 3 | 3 | 3 | 3 |
| End SEM Evaluation | 3 | 3 | 3 | 3 |

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**Indirect Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Objectives and Outcomes**

**Mapping of Course Outcomes onto Program Outcomes**

| **Course Outcome** | | **Program Outcomes** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO 2 | PO3 | PO4 | PO 5 | PO6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 |
| **CO1** | 2 | 2 | 1 | 1 | 3 | | | | | | 1 | |
| **CO2** | 2 | 1 | 1 | 1 | 3 | | | 3 | | | 1 | |
| **CO3** | 1 | 2 | 3 | 3 | 3 | | | | | | 1 | 1 |
| **CO4** | | 1 | 1 | 3 | 2 | | | | | 1 | | |
| **CO5** | 1 | 1 | 2 | 2 | | | | 2 | | 3 | 1 | 1 |

If satisfying and < 34% = 1, 34-66% = 2, > 66% = 3

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD6 |
| CO2 | CD1, CD6,CD7 |
| CO3 | CD1, CD2, CD3, |
| CO4 | CD1, CD3,CD6,CD7 |
| CO5 | CD1,CD2,CD7 |

# COURSE INFORMATION SHEET

**Course code: ME 202**
**Course title:** Fluid Mechanics and Hydraulic Machines lab
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 1.5**L:0, T:0, P:3
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level: Third**
**Branch:**Mechanical Engineering
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To make student familiar with various fluid mechanics systems and machines |
| B | To make the student confident how to perform experiments related to fluid mechanics systems and machines |
| B. | To study performance of various fluid mechanics systems and machines |

**Course Outcomes**

After the completion of this course, students will be:

| | |
|---|---|
| 1. | Able to apply the knowledge to perform the experiments on free surface flow |
| 2. | Able to calibrate various flow measuring devices |
| 3. | Able to experimentally find out forces experienced by various vane shapes Due to liquid jet impact on them |
| 4. | Able to draw the characteristic curves of various hydro turbines |
| 5. | Able to draw the characteristic curves of various pumps |

## List of experiments:

1. To verify Bernoullis equation experimentally and to plot the total energy line vs distance.
2. To determine the centre of pressure of a plane surface under partial and submerged conditions.
3. To determine the surface profile of liquid under free and forced vortex conditions.
4. To determine the friction factor f for the turbulent flow through the commercial pipes of various sizes.
5. To determine the coefficient of discharge and velocity of flow through an orifice.
6. To calibrate a Triangular notch.
7. To determine the coefficient of discharge through mouth pieces (convergent and divergent).
8. To determine the coefficient of discharge through venturimeter and orifice meter, and to calibrate rota meter.
9. To visualize the phenomena of cavitation in the flow and to find out cavitation number and critical cavitation number of the pump.
10. To study the effectof liquid jet impact on hemispherical and flat plate vanes.
11. To draw the characteristic curves of a Francis turbine.

12. To draw the characteristic curves of a Pelton turbine.
13. To draw the characteristic curves of a Modern Francis turbine (Mixed flow type).
14. To draw the characteristic curves of a multistage centrifugal pump.
15. To draw the characteristic curves of a reciprocating pump.
16. To draw the characteristic curves of a jet pump.

## Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Program Outcomes**

| **Course Outcome #** | **Program Outcomes(PO)** | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | 1 | 2 |
| 1 | 1 | 2 | | 2 | 3 | | | | 3 | 2 | 1 | 2 | 1 | 2 |
| 2 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 2 | 1 | 2 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 2 | 1 | 2 | 3 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 2 | 1 | 2 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 2 | 1 | 2 | 3 | 3 |

# COURSE INFORMATION SHEET

**Course code: ME 204**
**Course title:** Mechanical Engineering Lab -I
**Pre-requisite(s): NIL**
**Co- requisite(s): NIL**
**Credits: 1.5** L: 0, T: 0, P: 3
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level: 03**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course enables the students:

| | |
|---|---|
| A. | To make student familiar with modern and conventional tools for material testing. |
| B. | To present real world engineering examples of solid mechanics. |

## Course Outcomes

After the completion of this course, students will be:

| | |
|---|---|
| 1. | Examine the hardness of materials (Hard steel and mild steel). |
| 2. | Evaluate the tensile and impact strength of materials. |
| 3. | Validate truss analysis for redundant truss and statically indeterminate trusses results experimentally. |
| 4. | Analysis of rods. |
| 5. | Compare the properties of two different lifting machines (Self-locking system) |

## List of experiments:

### Group 1

1. To determine Brinell hardness number of mild steel
2. To determine Rockwell hardness number (HRC Scale) of hard steel.

### Group 2

3. To determine the tensile strength of mild steel
4. To determine the impact strength of hard steel using conventional method.
5. To determine impact strength of mild steel using computer aided system.

### Group 3

6. To determine forces in members of statically determinant truss

7. To determine forces in members of statically indeterminant truss
8. To determine the property of proving ring

**Group 4**

9. To determine shear force in a simply supported beam
10. To determine bending moment in simply supported beam
11. To determine the modulus of rigidity of a shaft using Torsion test

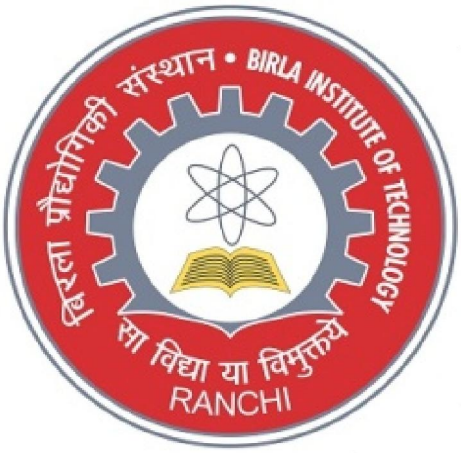
**Group 5**

12. To determine the properties of Screw Jack
13. To determine the properties of Worm and Worm Wheel

**Mapping of Course Outcomes onto Program Outcomes**

| **Course Outcome #** | **Program Outcomes(PO)** | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | 1 | 2 |
| 1 | 1 | 1 | 1 | 3 | 3 | | | 3 | 3 | 3 | | | 2 | 2 |
| 2 | 1 | 3 | 2 | 3 | 3 | | | 3 | 3 | 3 | | | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | | 2 | 2 |
| 4 | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | | 2 | 2 |
| 5 | 3 | 3 | 3 | 3 | 1 | | | 3 | 3 | 3 | | | 2 | 2 |

# BIRLA INSTITUTE OF TECHNOLOGY




## CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM

***(Effective from Academic Session: Monsoon 2018)***

**B. Tech.(4th Semester)**

## DEPARTMENT OF MECHANICAL ENGINEERING

## Institute Vision

To become a Globally Recognised Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

## Institute Mission

- To educate students at Under Graduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

**Department Vision:**

To become an internationally recognized Centre of excellence in academics, research and technological services in the area of Mechanical Engineering and related inter-disciplinary fields.

**Department Mission**

- Imparting strong fundamental concepts to students and motivate them to find innovative solutions to engineering problems independently
- Developing engineers with managerial attributes capable of applying latest technology with responsibility
- Creation of congenial atmosphere and excellent research facilities for undertaking quality research by faculty and students
- To strive for more internationally recognized publication of research papers, books and to obtain patent and copyrights
- To provide excellent technological services to industry

## Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems
reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

**Programme Educational Objectives (PEOs)**

1. To develop capability to understand the fundamentals of Science and Electrical & Electronics Engineering for analysing the engineering problems with futuristic approach.
2. To foster a confident and competent graduate capable to solve real life practical engineering problems
   fulfilling the obligation towards society.
3. To inculcate an attitude for identifying and undertaking developmental work both in industry as well as in academic environment with emphasis on continuous learning enabling to excel in competitive participations at global level.
4. To nurture and nourish effective communication and interpersonal skill to work in a team with a sense of ethics and moral responsibility for achieving goal.

**(A) Programme Outcomes (POs)**

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

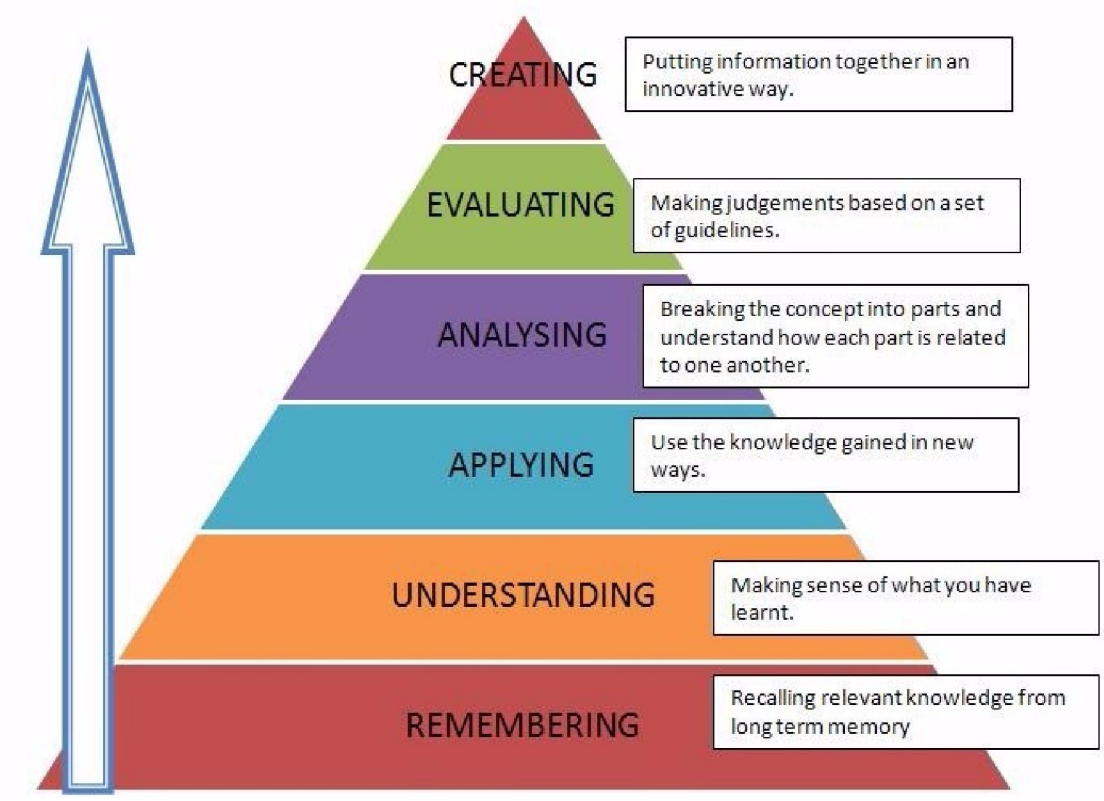
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

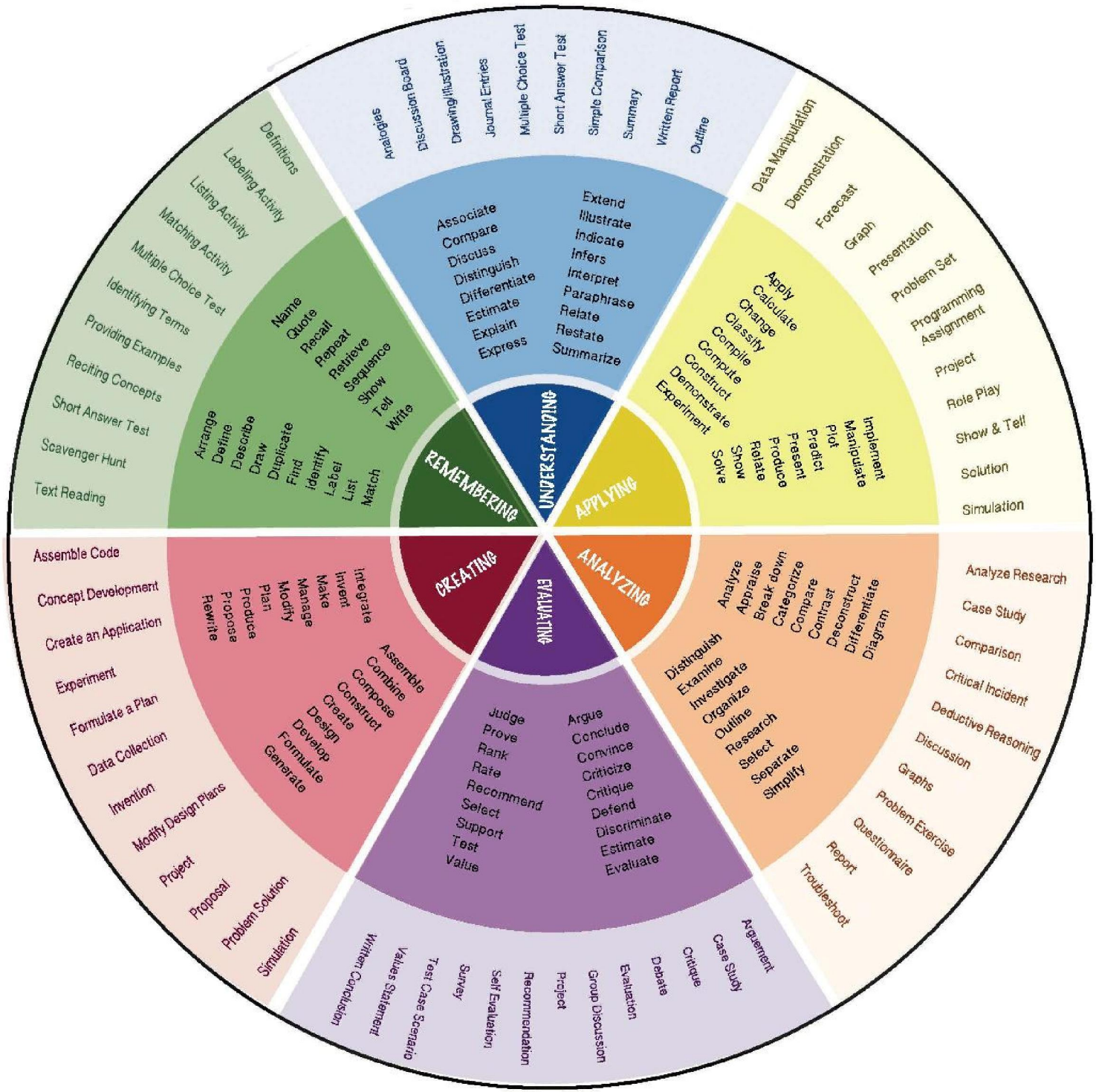
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:**

*Preamble*

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
Simulation
Apply
Calculate
Change
Classify
Compile
Compute
Construct
Demonstrate
Experiment
Implement
Manipulate
Plot
Predict
Present
Produce
Relate
Show
Solve
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate

# COURSE INFORMATION SHEET

Course code: IT201
Course title: **Basics of Intelligent Computing**
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: II/2
Branch: All

**Course Objectives**
This course enables the students:

| | |
|---|---|
| A. | To know the basic functions of different AI branches. |
| B. | To understand the functionalities of IoT . |
| C. | To know the application of fuzzy logic. |
| D. | To understand the basic functionalities of a cloud based system. |
| E. | To find the basic functions of soft computing. |

**Course Outcomes:**
After the completion of this course, students will be able to:

| | |
|---|---|
| 1. | Identify the difference between different branches of AI. |
| 2. | Analyze a fuzzy based system. |
| 3. | Design Neural Networks to solve problems. |
| 4. | Analyze a problem in terms of ANN point of view. |
| 5. | Identify the components of a cloud-based system. |

# SYLLABUS

**Module I**

**Introduction**

Definition of Computing, Conventional Computing vs. Intelligent Computing, Necessity of Intelligent Computing, Current trends in Intelligent Computing

**AI Concepts**

Introduction to AI, AI problems and Solution approaches, Fundamentals of problem solving using Search and Heuristics, Overview of Knowledge-base creation, and Intelligent Agents, Classification of AI.

(8 L)

**Module II**

**Introduction to Soft Computing**

Hard Computing vs. Soft Computing, Paradigms of Soft Computing, Real Life applications of Soft Computing

**Fuzzy Logic**

Classical Sets Vs Fuzzy Sets, Membership Functions, Fuzzy operations, Fuzzy Relations, Fuzzy Composition (Max-Min, Max-Product), Defuzzification, Fuzzy Inference System

**Genetic Algorithm**

Principle of Optimization, Traditional vs Evolutionary optimization, Genetic Algorithm: Working Cycle of GA, Encoding, Crossover, Mutation.(8 L)

**Module III**

**Introduction to Artificial Neural Networks:**

Biological Neuron to Artificial Neuron, Mc-Culloh Pitts Perceptron Model, Layer of Neurons, Activation Function, Artificial Learning, Types of Learning, Introduction to Back Propagation Networks, Applications of Neural Network. (8L)

**Module IV**

**Introduction to Cloud computing**

Conventional Computing, Historical developments, Defining a Cloud, Cloud Computing reference model, Overview of Virtualization: Introduction, Types of cloud, Cloud Platforms: Amazon Web Services, Microsoft Azure, Cloud Applications (8L)

**ModuleV**

**Introduction to IOT**

The IoT Paradigm, Concept of Things, IoT Hardware, IoT Protocols, IoT Architecture, enabling technologies of IoT, IoT Designing and its levels. (8L)

**Text books:**


1. Rich Elaine, Knight Kevin, Nair S. B. Artificial Intelligence, 3rd Edition, Tata Mc. Graw Hill.
2. Padhy N. P., Simon S. P. Soft Computing: With MATLAB Programming, Oxford University Press, 2015.
3. Buyya Raj Kumar, Vecchiola Christian &Selvi S.Thamarai , Mastering Cloud Computing, McGraw Hill Publication, New Delhi, 2013.
4. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.

**Reference Books:**

Raj Pethuru and Raman AnupamaC.,The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
Konar Amit, Computational Intelligence: Principles, Techniques and Applications, Springer.
Shivanandam and Deepa, Principles of Soft Computing, 2nd Edition, John Wiley and Sons, 2011.

Gaps in the syllabus (to meet Industry/Profession requirements): N/A

POs met through Gaps in the Syllabus: P10 will be met though report-writing/presentation-based assignment

Topics beyond syllabus/Advanced topics/Design: Teaching through paper

POs met through Topics beyond syllabus/Advanced topics/Design: Teaching through paper

| CD # | Course Delivery methods |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors |
| CD2 | Tutorials/Assignments |
| CD3 | Seminars/ Quiz (s) |
| CD4 | Mini projects/Projects |
| CD5 | Laboratory experiments/teaching aids |
| CD6 | Industrial/guest lectures |
| CD7 | Industrial visits/in-plant training |
| CD8 | Self- learning such as use of NPTEL materials and internets |
| CD9 | Simulation |

**Course Outcome (CO) Attainment Assessment tools & Evaluation procedure**

**Direct assessment**

| **Assessment tool** | **% contribution during co assessment** |
|---|---|
| Mid semester examination | 25 |
| End semester examination | 50 |
| Quiz (s) | 10+10 |
| Assignment | 5 |

| Assessment Components | CO1 | CO2 | CO3 | CO4 |
|---|---|---|---|---|
| Mid SEM Examination Marks | 3 | 3 | 2 | |
| End SEM Examination Marks | 3 | 3 | 3 | 3 |
| Assignment / Quiz (s) | 3 | 3 | 3 | 2 |

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

**Indirect Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **1** | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| **2** | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 1 |
| **3** | 3 | 1 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| **4** | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| **5** | 1 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD1,CD6 |
| CO2 | CD1, CD6,CD7 |
| CO3 | CD1, CD2, CD3,CD6,CD7 |
| CO4 | CD1, CD3,CD6,CD7 |
| CO5 | CD1,CD2,CD3,CD4,CD5,CD7 |

# COURSE INFORMATION SHEET

**Course code:** BE101
**Course title:** Biology for Engineers
**Pre-requisite(s):** NIL
**Co- requisite(s):** NIL
**Credits:**2 L:2 T:0 P:0
**Class schedule per week**: 02
**Class:** B. Tech
**Semester / Level:** III-IV /First
**Branch:** All
**Name of Teacher:**

**Course Objectives**

This course enables the students to:

| | |
|---|---|
| 1. | Recognize and understand the basic cell biology, biomolecules, related metabolic pathways and applicable bioenergetics. |
| 2. | Relate common biological phenomenon at molecular level. |
| 3. | Describe the chemical nature of enzymes and mechanism of action for their function in biochemical reactions. |
| 4. | Correlate the molecular methods of biological signal generation and propagation in living system. |
| 5. | Comprehend the steps involved in common application of biotechnology such as applicable for creation of transgenics, stem cells, plant metabolites production, PCR, ELISA. |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules involved in living system. |
| CO2 | Interpret the biomechanism involved in signal generation and transmission. |
| CO3 | Correlate the basic methods involved in common biotechnological application. |
| CO4 | Apply and effectively communicate scientific reasoning and data involved in common biotechnological applications. |

# BE101 Biological Science for Engineers

**Credit:2**

**Module-1:**
**Basic Cell Biology:** Origin of life, Cell theory, Cell Structure and function, Biomolecules, Cell cycle and cell division, Biological Organization. **[5L]**

**Module-2:**
**Bioenergetics and Metabolism**:Gibbs free energy and thermodynamics, aerobic and anaerobic respiration, Glycolysis, Krebs cycle and electron transport chain, Beta oxidation, Photosynthesis. **[6L]**

**Module-3:**
**Enzymes and its Application:** Classification of enzymes, Structure and mechanism of enzyme action and uses of enzymes, factors affecting enzyme activity, Immobilization of enzymes and their application.
**[5L]**

**Module-4:**
**Biological Signal Generation and Propagation:** Nerve cell structure and signal propagation.Mechanism of vision and hearing, cell signaling, Circadian rhythm.
**[6L]**

**Module-5:**
**Engineering Biological Systems and its Applications:**
Central dogma of molecular biology, Methods in genetic engineering and application, PCR, ELISA and its application, stem cell and tissue engineering.Artificial Intelligence in Biology, Plant factory. **[6L]**

**Books Recommended**
**Recommended Text Book**
1. Purves et al, (1998) Life: *The Science of Biology,* 4th Ed.
2. R. Dulbecco, The Design of Life.
3. Lehninger A, Principals of Biochemistry , 5th Ed

**Reference Book**

1. Stryer, L. (2002). *Biochemistry*. New York: W.H. Freeman.
2. K. Wilson & K.H. Goulding, (2006) *A biologist's guide to Principles and Techniques of Practical Biochemistry*.

**Gaps in the syllabus (to meet Industry/Profession requirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| Course Delivery methods |
|---|
| **Lecture by use of boards/LCD projectors/OHP projectors** |
| **Tutorials/Assignments** |
| **Seminars** |
| Mini projects/Projects |
| **Laboratory experiments/teaching aids** |
| Industrial/guest lectures |
| Industrial visits/in-plant training |
| **Self- learning such as use of NPTEL materials and internets** |
| Simulation |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

## Direct Assessment

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Mid Sem Examination Marks | 25 |
| End Sem Examination Marks | 50 |
| Assignment / Quiz (s) | 10+10 |
| Teacher's Assesment | 5 |

| Assessment Components | CO1 | CO2 | CO3 | CO4 |
|---|---|---|---|---|
| Mid Sem Examination Marks | √ | √ | √ | √ |
| End Sem Examination Marks | √ | √ | √ | √ |
| Quiz I | √ | √ | √ | |
| Quiz II | √ | √ | √ | |

**Indirect Assessment –**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

## Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome # | Program Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l |
| 1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 3 | 1 | 3 | 3 | 3 | | 1 | 1 | 1 | | 1 | 1 | 1 |
| 4 | 2 | 2 | 2 | 2 | | 2 | 2 | 2 | | 1 | 1 | 2 |

If satisfying< 34%=1, 34-66% =2, > 66% = 3

| Mapping Between COs and Course Delivery (CD) methods | | | |
|---|---|---|---|
| **CD** | **Course Delivery methods** | **Course Outcome** | **Course Delivery Method** |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | CO1, 2, 3, 4 | CD1, CD2, CD3, CD8 |
| CD2 | Tutorials/Assignments | CO1, 2, 3, 4 | CD1, CD2, CD3, CD8 |
| CD3 | Seminars | | |
| CD4 | Mini projects/Projects | | |
| CD5 | Laboratory experiments/teaching aids | | |
| CD6 | Industrial/guest lectures | | |
| CD7 | Industrial visits/in-plant training | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | |
| CD9 | Simulation | | |

# COURSE INFORMATION SHEET

**Course Code:** ME 207
**Course Title:** Kinematics and Dynamics of Machines
**Pre-requisite(s):** ME101 Basics of Mechanical Engineering
**Co- requisite(s):**
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | To understand basic principles of kinematic chains, Degree of freedom. |
| 2. | To analyse velocity and acceleration of planar mechanisms, balancing in rotary and reciprocating machinery, forces and moments acting in planar mechanism |
| 3. | To evaluate and design contact ratio, tooth profile and related parameters of gears. |
| 4. | To design cam profiles for specified motion of follower, Flywheel and governor. |
| 5. | To understand conservation of angular momentum and gyroscopic couple. |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate various principles related to kinematics of planar mechanisms |
| CO2 | Design planar mechanisms for relevant applications |
| CO3 | Evaluate dimensions and kinematic parameters related to gear systems |
| CO4 | Design cam profiles |
| CO5 | Evaluate gyroscopic couple and precessional velocity of a gyroscopic system. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>Planar mechanisms and kinematic analysis: Mechanisms and machines, Kinematic pairs, Kinematic chains, Kinematic inversions, Mobility and range of movement, Velocity and acceleration analysis (graphical and analytical), Coriolis' component of acceleration, Instantaneous centre of zero velocity, Aronhold-Kennedy theorem of three centres. | **08** |
| **Module – II**<br>Force analysis of planar mechanism and principles of flywheel and Governor: D'Alembert's principle and dynamic equilibrium, Dynamic force analysis (analytical method), Dynamically equivalent link, Turning moment on crank shaft, Turning moment diagram, fluctuation of energy and speed, flywheel, Principles of centrifugal governors: Porter, Proell and Hartnell governor. | **10** |
| **Module – III**<br>Balancing: Balancing of rotating masses, Two plane balancing, Balancing of inline, V, twin, and radial engines, principles of balancing machines. | **8** |
| **Module – IV**<br>Gear and Cam: Basic terminology of a spur gear, Types of gears, Fundamental law of gearing, contact ratio, Interference and undercutting, Gear trains, Basic terminology cam, Displacement diagram, Velocity and acceleration of follower, Graphical determination of cam profiles. | **8** |
| **Module – V**<br>Gyroscope and Vibrations: Euler's equation of motion, Euler's modified equation of motion, Steady state, Stability of spinning top, ship, two wheeled and four wheeled vehicle. | **8** |

**Text Books:**

1. A. Ghosh and A. K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Press Privet Limited, Third edition.
2. Thomas Bevan, The theory of Machines, CBS Publishers and Distributers Privet Limited, Third edition.
3. R. L. Norton, Kinematics and Dynamics of Machinery, McGraw Hill Education.

**Reference Books:**

1. John J. Uicker, Gordon R. Pennockand Joseph E. ShigleyTheory Of Machine And Mechanisms, Oxford University Press; 4th edition.
2. J. L. Meriam and L. G. Kraige, Engineering Mechanics: Dynamics, John Wiley and Sons Inc. Seventh edition.
3. S. S. Rattan, Theory of Machines, Tata McGraw Hill education, Third Edition.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**
Detailed force analysis of gear and cam.

**POs met through Gaps in the Syllabus**
PO1 TO PO5

**Topics beyond syllabus/Advanced topics/Design**
Balancing of locomotives

**POs met through Topics beyond syllabus/Advanced topics/Design**
PO1 TO PO5

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | | 1 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | - | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 209
**Course Title:** Energy Conversion Systems
**Pre-requisite(s):** ME 201 Thermodynamics
**Co- requisite(s):**
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | To provide basic knowledge of steam power cycle and different methods to improve the efficiency of the plant. |
| 2. | To develop comprehensive knowledge on boiler heat balance, steam turbine and condenser operation principles and to prepare the students to effectively use energy conversion theory in the practice of engineering. |
| 3. | To develop an intuitive understanding of energy conversion devices by emphasizing the scientific and engineering arguments. |
| 4. | To present a wealth of real world engineering examples to give students a feel for how energy conversion principle is applied in engineering practice. |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand the basic working principle of vapour power system |
| CO2 | Understand the combustion and energy equations to study the performance of boiler |
| CO3 | Apply the energy equation to evaluate the performance of nozzle |
| CO4 | Analyze impulse and reaction turbo machines for energy transfer |
| CO5 | Evaluate the performance of condenser |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>*Vapour Power Cycle:* Components of steam power system; Carnot vapour cycle and Rankine cycle; their comparison; p-v, T-s & h-s diagrams; Deviation of actual vapour power cycle from ideal cycle; mean temperature of heat addition; Reheat cycle; Ideal regenerative cycle; feed water heaters. | **10** |
| **Module – II**<br>*Fuels and Combustions:* Classification of fuels; basic chemistry and combustion equations; conversion of volumetric to weight analysis and vise-versa; theoretical and excess air; *Boiler performance:* Equivalent evaporation; Boiler efficiency; Heat balance; Boiler Draught; its classification; Chimney height, maximum discharge and efficiency. | **10** |
| **Module – III**<br>*Steam Nozzles:* Introduction; types of steam nozzles; nozzle efficiency; velocity of steam flow through the nozzle; discharge and condition of maximum discharge through a nozzle; physical significance of critical pressure ratio and choked flow; Supersaturated flow through nozzle; General relationship between area, velocity and pressure in nozzle flow. | **7** |
| **Module – IV**<br>*Steam Turbines:* Classifications; compounding of turbines; working principle, velocity diagrams, diagram work and efficiency of impulse and reaction turbine; degree of reaction, Parsons turbine, condition for maximum efficiency impulse and reaction turbine; Losses in steam turbines, reheat factor and condition line; governing of steam turbine; Back-pressure and pass-out Turbine. | **10** |
| **Module – V**<br>*Steam condensers:* Classification of condensers; sources of air leakage into the condenser; effects of air leakage in condenser; vacuum efficiency; condenser efficiency; cooling water calculations; Air ejector. | **5** |

**Text Books:**

1. Power Plant Engineering – P.K. Nag; Tata McGraw-Hill publication.
2. Elements of Heat Engine – Pandey&Saha
3. Steam and Gas Turbine and Power Plant Engineering – R. Yadav, Central Publishing House
4. Thermal Engineering – R. K. Rajput

**Reference Books:**

5. Power Plant Technology- M.M.Ei.-Wakil. McGraw Hill
6. Theory and Practice of Heat Engine – D. A. Rangham; Camb. Univ. Press.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

Detailed analysis of combined power cycle, renewable energy conversion principles, major emissions and control, economics of energy conversion system.

**POs met through Gaps in the Syllabus**

PO1 TO PO5

**Topics beyond syllabus/Advanced topics/Design**

Design of different energy conversion systems like nuclear reactors, turbines and renewable energy devices

**POs met through Topics beyond syllabus/Advanced topics/Design**

PO1 TO PO5

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | | 1 | | | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | | | 3 |
| CO3 | 2 | 2 | 3 | 2 | 2 | | | | 2 | | | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | | | | 1 | | | 2 |
| CO5 | 3 | 2 | 3 | 3 | 1 | | 2 | | 1 | | | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | - | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 211
**Course Title:** Machine Design
**Pre-requisite(s):** ME 201 Thermodynamics, ME 205 Strength of materials
**Co- requisite(s):**
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | To apply the concepts of stress analysis, theories of failure to select appropriate material and design machine components. |
| 2. | To design the variety of mechanical components. |
| 3. | To apply mechanical engineering theories for static and dynamic loading in design of mechanical components. |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate strong understanding on theories of failure materials due to static and dynamic loads. |
| CO2 | Design various types of mechanical joints, power drives, bearings, and springs. |
| CO3 | Evaluate stresses acting in various mechanical components. |
| CO4 | Select appropriate types of power drives for designing mechanical systems. |
| CO5 | Analyse the Design various types of mechanical systems. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br><br>**Failure of materials:** Principles of Machine Design, standardization,Preferred numbers, Tolerances, Design against static and fluctuating loads, Theories of failures,Design of cotter joint and knuckle joint, Fatigue failure, Endurance limit, Notch Sensitivity, Gerber, Soderberg, Goodman, and Modified Goodman criteria, Design against combined loads. | **10** |
| **Module – II**<br><br>**Design of threaded, welded, and riveted joints:** Threaded joints: Basic types of screw fastening, Bolt of uniform strength, Terminology of screw threads, Bolt under tension, Bolts for cylinder cover, Eccentrically loaded bolted joints in shear. Welded joints: Butt joints, Fillet joints, Strength of butt and fillet welds, Welded joints subjected to bending and torsion. Riveted joints: Types of rivet heads, types of rivet joints, rivet materials, Strength equations, Efficiency of joint, Caulking and fullering. | **9** |
| **Module – III**<br><br>**Design of friction drives:**Design of belt, rope, and chain drives: Types of belts, Flat- and Round-Belt Drives, V-belts, Wire Rope, Chains, Brakes and clutches: Types of Brakes and Clutches, Clutch/Brake selection and specification, Clutch and Brake materials, Disc Clutches, Disk Brakes, Drum Brakes. | **9** |
| **Module – IV**<br><br>**Design of bearing and springs:** Bearings, Comparison of Sliding and Rolling contact bearings, Types of sliding contact bearings, Bearing materials, Lubricating oils, Types of rolling contact bearings, Load carrying capacity, Equivalent bearing load, Load-life relationship, Selection of bearing life, Design of helical and leaf springs: Spring rate, Spring configuration, Spring materials, Design of helical compression springs, helical extension springs, helical torsion springs, and Belleville springs, Stresses in leaf springs, Nipping, Equalized stresses. | **9** |
| **Module – V**<br><br>**Design of Gears:** Gear drives, Types of gear, Terminology of gear, standard systems of gear tooth, Force analysis of spur, helical, bevel, and worm gears, Beam and wear strength of spur, helical, bevel, and worm gears, Lewis and Buckingham's equation, Effective load on spur gear tooth, Virtual number of teeth of helical and bevel gears, Effective load on gear teeth, Selection of materials. | **9** |

**Text Books:**

1. Machine Design, An Integrated Approach,by, Robert L. Norton, Second Edition
2. Shigley's Mechanical Engineering Design, by Richard Budynas (Author), Keith Nisbett (Author)
3. Introduction to Machine Design by V. B. Bhandari

**Gaps in the Syllabus (to meet Industry/Profession requirements)**
Design of pressure vessels

**POs met through Gaps in the Syllabus**
PO1 TO PO5

**Topics beyond syllabus/Advanced topics/Design**
Optimization techniques and statistical approach in machine design

**POs met through Topics beyond syllabus/Advanced topics/Design**
PO1 TO PO5

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | - | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 251(**PROG ELECTIVE-1)**
**Course Title:** Thermo-Fluid Engineering
**Pre-requisite(s):** Engineering Mathematics, Fluid Mechanics, Engineering Thermodynamics
**Co- requisite(s):**
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | Derive the governing equations of the fluid flow from both Lagrangian as well as Eulerian viewpoint |
| 2. | Analyse the thermo-fluid aspects including the exergy of a system |
| 3. | Evaluate and understand the rotational and irrotational flows |
| 4. | Interpret the derived Navier-Stokes and energy equations and understand its physical significance |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Outline the applicability of the underlying principles of both the fluid flow and thermodynamics |
| CO2 | Apply the knowledge of the governing equations related to the fluid flows and thermal systems |
| CO3 | Analyse both closed and open systems and be able to independently use the Reynolds transport theorem. |
| CO4 | Analyse the exergy of both the open and closed systems |
| CO5 | Applythe underlying concepts on various thermo-fluid systems |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>Introduction, Lagrangian and Eulerian descriptions; velocity and acceleration field; convective effects; streamline coordinates; the Reynolds transport theorem – its physical interpretation, relationship to material derivative, and applications to the fixed and nondeforming control volumes. | **9** |
| **Module – II**<br>Fluid element kinematics; linear motion and deformation; relationship between stress and rate of strain; Euler's equation of motion; stress components; relationship between irrotational flow and viscosity. | **9** |
| **Module – III**<br>Navier-Stokes equation and its applications; energy equation and its applications to various problems. | **9** |
| **Module – IV**<br>Exergy: reversible work and irreversibility; exergy of a closed mass system; exergy of a flow stream; exergy transfer by heat, work and mass; exergy destruction; exergy balance for steady-flow systems. | **9** |
| **Module – V**<br>Compressible flow: stagnation properties; speed of sound and Mach number; one-dimensional isentropic flow; variation of fluid velocity with flow area; property relations for isentropic flow of ideal gases; converging–diverging nozzles. | **9** |

## Text Books:

**1**. D.F. Young, B.R. Munsonand T.H. Okiishi, *A Brief Introduction to Fluid Mechanics*, 3rdEd., John Wiley and Sons Inc., 2003.
**2**. V.L. Streeter, E.B. Wylie and K.W. Bedford, *Fluid Mechanics*, 9th Ed., McGraw Hill, 2010.
**3**. Y.A. Cengel and M.A. Boles, *Thermodynamics: An Engineering Approach*, 4thEd., McGraw Hill, 2001.

Reference Books:
**1**. M.C. Potter and D.C. Wiggert, *Mechanics ofFluids*, 2ndEd., Pearson Education, 1997.
**2**. D.A. Kaminski and M.K. Jensen, *Introduction to Thermal and Fluid Engineering*, John Wiley & Sons, Inc., 2017.

**ONLINE RESOURCES**
**1.**https://nptel.ac.in/courses/112105183/
**2.**https://nptel.ac.in/courses/101103004/

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

### Direct Assessment

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

### Indirect Assessment

1. Students' Feedback on Course Outcome.

### Mapping of Course Outcomes onto Program Outcomes

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | 3 | 2 | 1 | 2 | 1 | 1 | | | | | | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 1 | | | | | | 1 |
| **CO3** | 2 | 3 | 2 | 2 | 1 | 1 | | | | | | 2 |
| **CO4** | 2 | 2 | 3 | 2 | 1 | 1 | | | | | | 1 |
| **CO5** | 2 | 1 | 3 | 2 | 1 | 2 | | | | | | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | CO1-5 | CD8 |
| CD9 | Simulation | | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 253(**PROG ELECTIVE-1)**
**Course Title:** Composite Materials
**Pre-requisite(s):** Engineering Mathematics, Fluid Mechanics, Engineering Thermodynamics
**Co- requisite(s):** None
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | To present a comprehensive exposure to different composite materials |
| 2. | To lay the groundwork for various types and kinds of composite materials |
| 3. | To develop an intuitive understanding of Polymer, ceramic, metal based Composite materials. |
| 4. | To present a wealth of real world engineering examples to give students a feel for how composite materials are replacing the materials in all types of engineering products. |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Correlate requirement of composite materials. |
| CO2 | Understand applicability of composite materials under various conditions. |
| CO3 | Characterize necessity of choice of various components of composite materials and their forms like filler, fibre, nano etc. with relative properties. |
| CO4 | Apply various techniques for suitable composite material with required enhanced properties. |
| CO5 | Evaluate the performance composite materials for engineering applications. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>**Introduction to Composite Materials:** Definition of composites, Classification of composites; General characteristics of reinforcement- classification, terminology used in fiber science, CMC, MMC and PMC. | **5** |
| **Module – II**<br>**Polymer Matrix Composites:** Thermoplastic and thermosetting resins; Commonly used matrix reinforcement system;Fibre, Flake and particulate reinforced composites, Reinforcements used in PMC's- glass, carbon, aramids, boron, Roving's, yarns, fabrics, etc.; Thermoset matrices for aerospace components- polyesters, epoxies, phenolics, vinyl esters, cyanate esters, etc.; Thermoplastic matrices for advanced composites- PEEK, polysulfones, polyimides, etc. concept of A stage, B stage and C stage resins;**Particulate and Fiber Filled Polymeric Composites**: Applications, Function of matrix, Function of fibres, Polymer-fibre interface, Factors influencing the performance of composite, Coupling agents, Bonding agents, Short fibre composites, Theories of stress transfer, Analysis of short fibre composites, Critical fibre length, Rule of mixtures;**Continuous FiberPolymeric Composites:** Analysis of long fiber composites, Longitudinal behavior of unidirectional composites; Failure mechanism and strength, Factors influencing longitudinal and transverse strength and stiffness, Halpin-Tsai equations for transverse modulus, Prediction of Poisson's ratio, Various failure modes | **10** |
| **Module – III**<br>**Specialty Composites:** Composites for satellites and advanced launch vehicles, Design considerations PMC- for structural composites, Theory and application of ablatives, MMC- design, applications; Silicon carbide composites, design, processing and properties; **Carbon-Carbon Composites:** Matrix precursors, Manufacturing considerations, Multi directional reinforced carbon-carbon composites | **8** |
| **Module – IV**<br>**Nanocomposites:** Nano particle dispersion in polymer matrix, Polymer- nanoclay composites and polymer-carbon nanotubes composites; **Functionally graded and Hierarchical Composites**; Classification i.e. Natural and Man-made, Uniaxial and bi-axial property gradient, Application in various industrial sectors. | **7** |
| **Module – V**<br>**Manufacturing Techniques:** Hand lay-up, Filament winding, Pultrusion, Resin transfer moulding, Processing science of reactive polymer composites, Process steps for production, Selection of processing conditions toolings, Equipments, Carbon-carbon composites, Processing, Thermal and mechanical properties, Quality control; **Testing of composites**: Raw material testing, Property evaluation at laminate level, NDT techniques; **Design and analysis of composite structures**: Macro mechanics of a lamina, Micro mechanics, Laminate analysis, FE model and analysis | **10** |

**Text Books:**

1. R.M. Jones, Mechanics of Composites, 2nd ed., Taylor & Francis, 1999.
2. T. G. Gutowski, (Ed.) Advanced Composites Manufacturing, John Wiley & Sons, New York 1997.
3. K.K. Chawla, Ceramic Matrix Composites, Kluwer Academic Publishers, 2003.
4. N. Chawla, K.K. Chawla, Metal Matrix Composites, Springer-Verlag, 2006.
5. J.C. Seferis, L. Nicolais, (Eds.) The Role of the Polymeric Matrix in the Processing and Structural Properties of Composite Materials, Plenum Press, New York 1983

Reference Books:

1. P.M. Ajayan, L. Schadler, P.V. Braun Nano Composite Science and Technology, Wiley VCH, 2003.
2. E. Fitzer, L.M. Manocha, Carbon Reinforcement and Carbon/Carbon Composites, SpringerVerlag, Heidelberg, New York, 1998.

**Gaps in the syllabus (to meet Industry/Profession requirements)**

Various composite materials, their properties and applications.

**POs met through Gaps in the Syllabus**

PO1-5

**Topics beyond syllabus/Advanced topics/Design**

Characterisation of the composite materials.

**POs met through Topics beyond syllabus/Advanced topics/Design**

PO1-5

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | 3 | 2 | 1 | | | | | | | | | 1 |
| **CO2** | 3 | 2 | 1 | | | 1 | 2 | | | | | 1 |
| **CO3** | 3 | 2 | 2 | | | 1 | | 2 | 1 | 1 | | 1 |
| **CO4** | 3 | 2 | 2 | | | 1 | | 2 | 1 | 1 | | 1 |
| **CO5** | 3 | 3 | 2 | | | | | | | | | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 255(**PROG ELECTIVE-1)**
**Course Title:** Renewable energy sources
**Pre-requisite(s):** Basic of Physics, Chemistry and Mathematics
**Co- requisite(s):**
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | To understand the difference between the non-renewable energy system and the renewable energy systems |
| 2. | To lay the groundwork for subsequent studies in the fields of renewable energy sources |
| 3. | To develop an intuitive understanding of the applications of different renewable energy sources like solar, wind, biomass, ocean thermal, geothermal etc. |
| 4. | To understand the working principles related to different renewable energy systems |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Outline the various sources of energy |
| CO2 | Understand the working principle of different solar thermal energy systems and Photo-voltaic system |
| CO3 | Understand the working principle of wind energy conversion system |
| CO4 | Demonstrate the working principles of different biomass system |
| CO5 | Understand the working principles and applications of different renewable energy sources like solar, wind, biomass, ocean thermal, geothermal etc. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>ENERGY SOURCES: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations,Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario. | **8** |
| **Module – II**<br>SOLAR ENERGY : Introduction, Solar Radiation, Solar Constant, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation,Principle of Conversion of Solar Radiation into Heat, Collectors,( Flat Plate and Concentrating Collectors) ,Solar Water Heaters , Solar Cookers , Solar driers, Solar Still, Solar Furnaces, Solar Green Houses. Solar Photovoltaic, Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications. | **9** |
| **Module – III**<br>WIND ENERGY: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basics of lift and drag, Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, wind farm, Advantages and Disadvantages of WECS | **9** |
| **Module – IV**<br>BIOMASS ENERGY: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants , energy plantation, Biomass program in India. | **9** |
| **Module – V**<br>**OTHER RENEWABLE ENERGY SOURCES**<br>Tidal Energy, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle). Geothermal Energy, Resources of geothermal energy, Hydrogen and Storage, Fuel Cell Systems, Hybrid Systems. | **10** |

**Text Books:**


1. Rai. G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.


Reference Books:


1. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
3. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
4. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
5. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.


**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | | | 1 |
| **CO2** | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | | 1 |
| **CO3** | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | | 1 |
| **CO4** | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | | 1 |
| **CO5** | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | | - |

# COURSE INFORMATION SHEET

**Course Code:** ME 257(**PROG ELECTIVE-1)**
**Course Title:** Non-Destructive Testing
**Pre-requisite(s):** NIL
**Co- requisite(s):** None
**Credits:** L: 3 T: 0 P: 0
**Class schedule per week: 03**
**Class: B. Tech.**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

## Course Objectives

This course envisions to impart to students to:

| | |
|---|---|
| 1. | Understand various Non Destructive Evaluation and Testing methods, theory and their industrial applications. |
| 2. | To develop comprehensive knowledge on various NDT techniques |
| 3. | Analyse various NDT techniques and their employability for different materials |
| 4. | Apply new inspection techniques for new materials |

## Course Outcomes

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Comprehension:-Able to list & classify major Non-Destructive Testing methods available. |
| CO2 | Analysis:-Able to find the defects in a given component/material without damaging it. |
| CO3 | Analysis:-In a position to distinguish among various NDT techniques and their employability for different specimen under testing. |
| CO4 | Analysis:-Having the knowledge and essential skills to specify strengths and weaknesses of materials used in fabrication. |
| CO5 | Application:-To discover new inspection techniques for new materials. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module – I**<br>Introduction and Classification of NDT, Visual Inspection Methods, Dye Penetrant Testing(DPT)- Basic Principle, Types of dye and method of application, DPT-Developer application and Inspection. | **9** |
| **Module – II**<br>Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Principle & Instrumentation for ECT, Techniques used in ECT, Advanced ECT methods, Applications & limitations of ECT. | **9** |
| **Module – III**<br>Magnetic Particle Testing :Basic definition of Magnetism & Principle of MPT, Magnetizing Techniques, Procedure & Equipment used for MPT, Applications & limitations of MPT. | **9** |
| **Module – IV**<br>Radiographic Testing:Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films–graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography. | **9** |
| **Module – V**<br>Ultrasonic Testing:Basic Properties of Sound Beam, Ultrasonic Transducers, Inspection techniques, Flaw Characterisation Techniques and Detection Equipment, Applications, Advantages & Limitations of Ultrasonic Testing. | **9** |

**Text Books:**

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, NewAge International Publishers, 2010.

Reference Books:

1. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control",American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 4, Radiographic Testing.

**Topics beyond syllabus/Advanced topics/Design**

Acoustic emission testing & advanced Ultrasonic testing

**POs met through Topics beyond syllabus/Advanced topics/Design**

PO1-5

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | | | | |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | | | | | 1 | 1 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 1 | | 1 | 1 | - |
| **CO4** | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | | 1 | - | - |
| **CO5** | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 1 | | - | 1 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | CO1-5 | CD2 |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | - | - |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | | - |

# Department of Electrical and Electronics Engineering
## Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

## Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

## Institute Mission

- To educate students at Undergraduate, Post Graduate, Doctoral and Post Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

## Department Vision

To become an internationally recognized centre of excellence in academics, research and technological services in the area of Electrical and Electronics Engineering and related inter-disciplinary fields.

## Department Mission

- Imparting strong fundamental concepts to students and motivate them to find innovative solutions to engineering problems independently
- Developing engineers with managerial attributes capable of applying latest technology with responsibility
- Creation of congenial atmosphere and excellent research facilities for undertaking quality research by faculty and students
- To strive for more internationally recognized publication of research papers, books and to obtain patent and copyrights
- To provide excellent technological services to industry

## Program Educational Objectives (PEO)

1. To develop capability to understand the fundamentals of Science and Electrical & Electronics Engineering for analyzing the engineering problems with futuristic approach.
2. To foster a confident and competent graduate capable to solve real life practical engineering problems fulfilling the obligation towards society.
3. To inculcate an attitude for identifying and undertaking developmental work both in industry as well as in academic environment with emphasis on continuous learning enabling to excel in competitive participations at global level.
4. To nurture and nourish effective communication and interpersonal skill to work in a team with a sense of ethics and moral responsibility for achieving goal.

## Program Outcomes (PO)

A graduate shall

a) Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem
b) Gain skillful knowledge of complex engineering problem analysis
c) Be able to design system components and processes meeting all applicable rules and regulations
d) Be proficient in arriving at innovative solution to a problem with due considerations to society and environment
e) Be capable of undertaking suitable experiments/research methods while solving an engineering problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results
f) Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources
g) Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional engineering practice and demonstrate through actions, the need for sustainable development
h) Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
i) Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting
j) Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large.
k) Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time.
l) Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

## Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

# COURSE INFORMATION SHEET

**Course code: EE102**
**Course title: EE102 ELECTRICAL ENGINEERING LABORATORY**
**Pre-requisite(s):** Physics, Fundamentals of Mathematics and Electrical Engineering.

| **Credits:** | L | T | P |
|---|---|---|---|
| | 0 | 0 | 3 |

**Class schedule per week: 3**

**Course Overview:** Concepts of measuring instruments, AC RLC series parallel circuit operation, resonance, KVL and KCL, circuit theorems, 3-phase star and delta connections, measurement of low and high resistance of D.C. machine, measurement of power by three voltmeter, three-ammeter methods, measurement of power of 3-phase induction motor by two-wattmeter method.

**Course Objectives**

This course enables the students :

| | |
|---|---|
| A. | To describe students practical knowledge of active and passive elements and operation of measuring instruments |
| B. | To demonstrate electrical circuit fundamentals and their equivalent circuit models for both 1-φ and 3- φ circuits and use circuit theorems |
| C. | To establish voltage & current relationships with the help of phasors and correlate them to experimental results |
| D. | 1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena<br>2. To evaluate different power measurement for both 1-φ and 3- φ circuits |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| 1. | classify active and passive elements, explain working and use of electrical components, different types of measuring instruments; |
| 2. | illustrate fundamentals of operation of DC circuits, 1-φ and 3- φ circuits and also correlate the principles of DC, AC 1-φ and 3- φ circuits to rotating machines like Induction motor and D.C machine.; |
| 3. | measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations; |
| 4. | analyse response of a circuit and calculate unknown circuit parameters; |
| 5. | recommend and justify power factor improvement method in order to save electrical energy. |

**LIST OF EXPERIMENTS :**

1. **Name: Measurement of low & high resistance of DC shunt motor**
   Aim: (i) To measure low resistance of armature winding of DC shunt motor
   (ii) To measure high resistance of shunt field winding of DC shunt motor

2. **Name: AC series circuit**
   Aim: (i) To obtain current & voltage distribution in AC RLC series circuit and to draw phasor diagram
   (ii) To obtain power & power factor of single phase load using 3- Voltmeter method and to draw phasor diagram

3. **Name: AC parallel circuit**
   Aim: (i) To obtain current & voltage distribution in AC RLC parallel circuit and to draw phasor diagram
   (ii) To obtain power & power factor of single phase load using 3- Ammeter method and to draw phasor diagram

4. **Name: Resonance in AC RLC series circuit**
   Aim : (i) To obtain the condition of resonance in AC RLC series circuit
   (ii) To draw phasor diagram

5. **Name: 3 phase Star connection**
   Aim : (i) To establish the relation between line & phase quantity in 3 phase star connection
   (ii) To draw the phasor diagram

6. **Name: 3 phase Delta connection**
   Aim : (i) To establish the relation between line & phase quantity in 3 phase delta connection
   (ii) To draw phasor diagram

7. **Name: 3 phase power measurement**
   Aim : (i) To measure the power input to a 3 phase induction motor using 2 wattmeter method
   (ii) To draw phasor diagram

8. **Name: Self & mutual inductance**
   Aim : To determine self & mutual inductance of coils

9. **Name: Verification of Superposition, Thevenin's and Reciprocity theorem**
   Aim : (i) To verify Superposition theorem for a given circuit
   (ii) To verify Thevenin's theorem for a given circuit

10. **Name: Verification of Norton's, Tellegen's and Maximum Power transfer theorem**
    Aim : (i) To verify Norton's theorem for a given circuit
    (ii) To verify Maximum Power transfer theorem for a given circuit

**Gaps in the syllabus (to meet Industry/Profession requirements)**

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors
2. Visualize Phase sequence

**POs met through Gaps in the Syllabus :** a, b, c, g

**Topics beyond syllabus/Advanced topics/Design**

1. Assignment : Simulation of electrical circuits with dependent/independent sources by various techniques (Mesh current/Node Voltage/Thevenin's theorem/Norton's theorem/Maximum power transfer theorem etc.) using MATLAB/PSIM/C++ softwares
2. Active/reactive power calculation for 3 – Φ circuits

**POs met through Topics beyond syllabus/Advanced topics/Design:** e, f, i, j, k

**Mapping of lab experiment with Course Outcomes**

| Experiment | Course Outcomes | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| **1** | 3 | 3 | 3 | 2 | |
| **2** | 3 | 3 | 3 | 3 | 2 |
| **3** | 3 | 3 | 3 | 3 | 2 |
| **4** | 3 | 3 | 3 | 3 | 2 |
| **5** | 3 | 3 | 3 | 1 | |
| **6** | 3 | 3 | 3 | 1 | |
| **7** | 3 | 3 | 3 | 2 | 2 |
| **8** | 3 | 3 | 3 | 3 | |
| **9** | 3 | 3 | 3 | 2 | |
| **10** | 3 | 3 | 3 | 2 | |

**3=High, 2=Medium, 1=Low**

| **Course Delivery methods** | |
|---|---|
| CD1 | Lecture by use of boards/LCD projectors |
| CD2 | Tutorials/Assignments |
| CD3 | Mini projects/Projects |
| CD4 | Laboratory experiments/teaching aids |
| CD5 | Self- learning such as use of NPTEL materials and internets |

| | |
|---|---|
| CD6 | Simulation |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

## Direct Assessment

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| **(1) Progressive Evaluation (60)** | |
| Day to Day performance & Lab files | 30 |
| Quiz (s) | 10 |
| Viva | 20 |
| **(2) End Semester (40)** | |
| Examination Experiment performance | 30 |
| Quiz | 10 |
| Grand Total | 100 |

| Assessment Compoents | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | | | | | |
| End Semester Marks | | | | | |

**Indirect Assessment –**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping of Course Outcomes onto Course Objectives**

| Course Outcome # | Course Objectives | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **1** | 3 | 3 | 3 | 3 |
| **2** | 3 | 3 | 3 | 3 |
| **3** | 3 | 3 | 3 | 3 |
| **4** | 3 | 3 | 3 | 3 |
| **5** | 2 | 3 | 3 | 3 |

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome # | Program Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l |
| 1 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 2 | 2 |
| 5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

**Mapping of Course Outcomes onto Program Educational Objectives**

| Course Outcome # | Program Educational Objectives | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 3 | 3 | 2 | 2 |
| 2 | 3 | 3 | 3 | |
| 3 | 3 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | |
| 5 | 3 | 3 | 2 | 2 |

**Mapping Between COs and Course Delivery (CD) methods**

| Course Outcome | Course Delivery Method |
|---|---|
| CO1 | CD1,CD2,CD4, CD5 |
| CO2 | CD1,CD4,CD5 |
| CO3 | CD1,CD3,CD4,CD5,CD6 |
| CO4 | CD1,CD2,CD4, CD5 |
| CO5 | CD4, CD5 |

| Course Delivery (CD) methods | | Program Outcomes (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO a | PO b | PO c | PO d | PO e | PO f | PO g | PO h | PO i | PO j | PO k | PO l |
| CD1 | Lecture by use of boards/LCD projectors | 2 | 1 | 1 | 2 | 3 | 1 | | | | | | |
| CD2 | Tutorials/ Assignments | 2 | 2 | 2 | 2 | 3 | 3 | | | 3 | 3 | 1 | 2 |
| CD3 | Seminars | | | | | | | | | | | | |
| CD4 | Mini projects/Projects | | | | | | | | | | | | |
| CD5 | Laboratory experiments/teaching aids | 3 | 3 | 3 | 3 | 3 | 1 | | 2 | 3 | 2 | 2 | 3 |
| CD6 | Industrial/guest lectures | | | | | | | | | | | | |
| CD7 | Industrial visits/in-plant training | | | | | | | | | | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| CD9 | Simulation | 3 | 3 | 3 | | 3 | 3 | | | 2 | 2 | | |

# COURSE INFORMATION SHEET

**Course code:** ME 208
**Course title:** Dynamics of Machine Lab
**Pre-requisite(s):** ME207 Kinematics & Dynamics of Machines
**Co- requisite(s):**
**Credits: 1.5** L: 0, T: 0, P: 3
**Class schedule per week: 03**
**Class: B. Tech**
**Semester / Level: 04/02**
**Branch:** Mechanical Engineering
**Name of Teacher:**

**Course Objectives**

This course enables the students to:

| | |
|---|---|
| 1 | Verify basic principles of vibration, its source and effect in different mechanical systems. |
| 2 | Verify the effect of critical speed in simple rotating systems |
| 3 | Verify and determine gyroscopic couple |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Measure vibration parameters in single degree freedom systems |
| CO2 | Understand the concept of whirling of shaft experimentally |
| CO3 | Perform experiments on balancing of reciprocating masses |
| CO4 | Apply the knowledge of dynamics in balancing of wheels. |
| CO5 | Demonstrate the working principles of gyroscope, cam and governor |

**List of Experiments:**

**Experiment no. 1: Simple pendulum**

Objective: To study the motion of simple pendulum.

**Experiment no. 2: Compound pendulum**

Objective: To verify the relation of a compound pendulum and determination of radius of gyration.

**Experiment no. 3: Bifilar suspension**

Objective:To determine the radius of gyration of a given bar using bifilar suspension.

**Experiment no. 4: Torsional vibration I**

Objective:To study the torsional vibration of a single rotor system.

**Experiment no. 5: Torsional vibration II**

Objective: To study the torsional vibration of two rotor system.

**Experiment no. 6: Effect of damping**

Objective:To find the frequency of beam at different damping

**Experiment no. 7: Balancing**

Objective:Balancing of reciprocating masses.

**Experiment no. 8: Wheel balancer**

Objective:To balance an unbalanced wheel on the Wheel balancer.

**Experiment no. 9: Gyroscope**

Objective: To study the gyroscopic couple due to simultaneous spin and precession of a disc.

**Experiment no. 10: Whirling of a shaft**

Objective: To study the effect of whirling of shaft for different boundary conditions.

**Experiment no. 11: Hartnell Governer**

Objective: To determine the position of sleeve against controlling force and speed of a Hartnell governer and to plot characteristic curve for radius of rotation.

**Experiment no. 12: Cam follower mechanism**

Objective: To construct displacement diagram for cam follower mechanism and to determine jump speed against different inertia of the follower.

**Reference Books**


1. Theory of mechanisms and machines by A. Ghosh and A.K. Mallik, East West Press.
2. Theory of Machines by S.S.Rattan, TMH Pvt. Ltd.


**Gaps in the syllabus (to meet Industry/Profession requirements)**
No experiment to verify coriolis acceleration

**POs met through Gaps in the Syllabus**
PO1 TO PO5

**Topics beyond syllabus/Advanced topics/Design**
Second and third critical speed of a whirling shaft

**POs met through Topics beyond syllabus/Advanced topics/Design**
PO1 TO PO5
**Mapping Between COs and Course Delivery (CD) methods**

| CDCode | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1-5 | CD1 |
| CD2 | Tutorials/Assignments | | |
| CD3 | Seminars | - | - |
| CD4 | Mini Projects/Projects | - | - |
| CD5 | Laboratory Experiments/Teaching Aids | CO1-5 | CD2 |
| CD6 | Industrial/Guest Lectures | - | - |
| CD7 | Industrial Visits/In-plant Training | - | - |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | - | - |
| CD9 | Simulation | - | - |

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**
**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| **(1) Progressive Evaluation (60)** | |
| Day to Day performance & Lab files | 30 |
| Quiz (s) | 10 |
| Viva | 20 |
| **(2) End Semester (40)** | |
| Examination Experiment performance | 30 |
| Quiz | 10 |
| Grand Total | 100 |

**Indirect Assessment**

1. Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l |
| **CO1** | 3 | 2 | 1 | 1 | | 1 | | | 1 | | | 1 |
| **CO2** | 3 | 2 | 2 | 2 | | 1 | | | 2 | | | 2 |
| **CO3** | 3 | 3 | 2 | 2 | | 1 | | | 2 | | | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 |

# COURSE INFORMATION SHEET

**Course code: PE 205**
**Course title: MANUFACTURING PROCESSES -I LAB**
**Pre-requisite(s):** Nil
**Co- requisite(s):** PE204MANUFACTURING PROCESSES - I
**Credits: 1.5** L:0 T:0 P: 3
**Class schedule per week:** 3
**Class: B.Tech.**
**Semester / Level: IV/Second**
**Branch: Production Engineering**
**Name of Teacher:**

**Course Objectives:**
This course enables the students to:

| | |
|---|---|
| 1 | Examine different patterns used in sand casting. |
| 2 | Get familiar with sand testing and drawing inference from it. |
| 3 | Get hands on experience of arc welding and selecting best technique in engineering practices. |
| 4 | Develop skills on ultrasonic welding and spot welding. |
| 5 | Know different techniques used in polymer processing. |

**Course Outcomes:**
At the end of the course, a student should be able to:

| | |
|---|---|
| CO1 | Distinguish and develop the patterns used in sand casting. |
| CO2 | Judge the composition of molding sand for sand casting. |
| CO3 | Compare arc welding processes and identify their respective applications. |
| CO4 | Classify welding process and identify their respective applications. |
| CO5 | Discriminate between the processes used in polymer processing. |

## SYLLABUS

**LIST OF EXPERIMENT:**

1. **FOUNDRY SHOP**
   **EXPERIMENT – I:Pattern Study**
   **Objective**: To study different types of pattern used in sand casting.

2. **CARPENTARY SHOP**
   **EXPERIMENT-I:Pattern Making**
   **Objective:**To prepare a single piece wooden pattern according to given dimension for Al casting.

3. **FOUNDRY SHOP**
   **EXPERIMENT-II:Permeability Test**
   **Objective**: To determine the permeability number for given molding sand sample.

4. **FOUNDRY SHOP**
   **EXPERIMENT-III: Moisture Test**
   **Objective:** To determine the amount of moisture for given molding sand sample.

5. **FOUNDRY SHOP**
   **EXPERIMENT-IV:Clay Content Test**
   **Objective**: To determine the amount of clay for given molding sand sample.

6. **FOUNDRY SHOP**
   **EXPERIMENT-V:Grain Fineness Number**
   **Objective:**To determine the Grain fineness number for given molding sand sample.

7. **WELDING SHOP**
   **EXPERIMENT-I:Shielded Metal Arc Welding**
   **Objective**: To study the effect of AC and DC arc in manual/shielded metal arc welding.

8. **WELDING SHOP**
   **EXPERIMENT-II: Gas Metal Arc Welding**
   **Objective:**To determine metal deposition rate in GMAW.

9. **WELDING SHOP**
   **EXPERIMENT-III:Submerged Arc Welding**
   **Objective:**To study Submerged arc welding equipment and perform SAW welding.

10. **WELDING SHOP**
    **EXPERIMENT-IV:Spot Welding**
    **Objective:**To study resistance welding equipment and perform spot welding on thin sheet.

11. **POLYMER**
    **EXPERIMENT-I:Ultrasonic Welding**
    **Objective**: To study ultrasonic welding setup and perform plastic welding using the same.

12. **POLYMER**
    **EXPERIMENT-II:Blow Molding**
    **Objective:**To study blow molding equipment and perform molding operation.

13. **POLYMER**
    **EXPERIMENT-III: Injection Molding**
    **Objective:**To study injection molding machine and perform molding operation.

**Books recommended:**

**TEXT BOOK**

1. S K Hajra Choudhury, A K. Hajra, "Elements of Workshop Technology:Vol- I and Vol - II", Media Promotors Pvt Ltd. **(T1)**
2. B S Raghuwanshi, "A course in Workshop Technology", Dhanpat Rai Publications. **(T2)**

**EFERENCE BOOK**

1. P.N. Rao, "Manufacturing Technology Vol-1and Vol-II", Tata McGraw Hill.**(R1)**
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson. **(R2)**

**Gaps in the syllabus (to meet Industry/Profession requirements):**
Nil

**POs met through Gaps in the Syllabus:**
Nil

**Topics beyond syllabus/Advanced topics/Design:**

**POs met through Topics beyond syllabus/Advanced topics/Design:**

**Course Delivery Methods:**

| | | |
|---|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | |
| CD2 | Assignments/Seminars | |
| CD3 | Laboratory experiments/teaching aids | √ |
| CD4 | Industrial/guest lectures | |
| CD5 | Industrial visits/in-plant training | |
| CD6 | Self- learning such as use of NPTEL materials and internets | |
| CD7 | Simulation | |

**Course Evaluation:**

**Direct Assessment-**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Continuous Internal Assessment | 60 |
| Semester End Examination | 40 |

| Continuous Internal Assessment | % Distribution |
|---|---|
| Day to day performance & Lab files | 30 |
| Quiz1 | 10 |
| Viva-voce | 20 |
| **End Semester Examination** | **% Distribution** |
| Examination: Experiment Performance | 30 |

| Quiz 2 | 10 | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Assessment Components** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| Day to day performance & Lab files | √ | √ | √ | √ | √ |
| Quiz1 | √ | √ | √ | √ | √ |
| Quiz 2 | √ | √ | √ | √ | √ |
| Viva-voce | √ | √ | √ | √ | √ |
| Examination: Experiment Performance | √ | √ | √ | √ | √ |

**Indirect Assessment –**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping of Course Outcomes (Cos) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

| **COs** | **POs** | | | | | | | | | | | | **PSOs** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 1 | 3 | | | | | | 3 | 2 | 1 | 1 | 3 | 1 |
| CO2 | 3 | 1 | 1 | 3 | | | | | 3 | 2 | 1 | 1 | 3 | 1 |
| CO3 | 3 | 1 | 1 | 1 | | | | | 3 | 2 | 1 | 1 | 3 | 1 |
| CO4 | 3 | 2 | 1 | 1 | | | | | 3 | 2 | 1 | 1 | 3 | 1 |
| CO5 | 3 | 1 | 1 | | | | | | 3 | 2 | 1 | 1 | 3 | 1 |

**< 34% = 1, 34-66% = 2, > 66% = 3**

**Mapping Between Course Outcomes (Cos) and Course Delivery Method**

| Course Outcomes | Course Delivery Method |
|---|---|
| CO1 | CD3 |
| CO2 | CD3 |
| CO3 | CD3 |
| CO4 | CD3 |
| CO5 | CD3 |